GEOLOGY AND ORE DEPOSITS OF THE STANLEY AREA

by

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IDAHO BUREAU OF MINES AND GEOLOGY

MOSCOW, IDAHO
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ABSTRACT

The Stanley area is on the eastern border of the Idaho batholith in central Idaho. The main rock units are the Pennsylvanian Wood River Formation, the Cretaceous Idaho batholith, and the Oligocene Challis Volcanics.

Uranium is being mined from: (1) pitchblende-bearing veins in the batholith and (2) younger, bedded deposits in carbon-rich, arkosic sandstone and conglomerate.

In the bedded deposits, uraninite and coffinite are accompanied by pyrite and marcasite. Uranium is approximately proportional to carbon. Pyrite, mostly in vitrain seams containing up to 15.0 percent $U_3O_8$, occurs mainly as microfossil spheres. Most of the microfossils are probably Pyritosphaera barbaria Love; diameters of measured pyritized spheres range from 4 to 18 microns. Field relations and laboratory evidence indicate that the uranium in the bedded deposits was derived from the pitchblende veins and then syngenetically precipitated in carbonaceous "filter traps" located along fracture-controlled streams which flowed in pre-Challis times over the batholith.

Prior to World War II, over $13,000,000 in silver and gold was mined from post-Challis veins. Most production came from bonanza deposits in the Yankee Fork district. Outside of this district, gold-silver accompanies pyrite mostly in narrow veins; late-stage fluorite in some of these veins has some economic potential. Other potentially economic veins in the Stanley area contain scheelite, molybdenite, and stibnite.

Placer gold has been mined by hand, dragline, and dredge from many of the streams. The placers also contain magnetite, ilmenite, monazite, garnet, zircon, cinnabar, brannerite, and euxenite.
INTRODUCTION

PURPOSE

In 1955 uranium was discovered in the mountainous country northeast of Stanley, an area previously known mainly for its gold-silver mineralization. Because of the uranium mining and exploration, a study of the ore deposits and geology of the Stanley area was conducted by the Idaho Bureau of Mines and Geology in 1959 and 1960. The present study extends the earlier geologic work conducted by the Bureau and by the U. S. Geological Survey.

PHYSICAL GEOGRAPHY

Location

The Stanley area is in the drainage of the Main Fork of the Salmon River in west-central Custer County, Idaho (Fig. 2). The area, in the Salmon River Mountains, is within the Challis National Forest.

In this report the 355-square-mile region shown on the map in Figure 1 is referred to as the Stanley area. This area includes most of the Stanley, Yankee Fork, and Robinson Bar mining districts.

Roads and human facilities

Paved U. S. Highway 93 follows the Salmon River through the area; from Stanley, the distance is 61 miles to Ketchum and 57 miles to Challis. During the summer and fall, Stanley can be reached from the west by a good Forest Service road that starts at Cascade.

Mining roads to most claims require high-clearance vehicles, preferably vehicles with four-wheel drive. More remote portions of the area can be reached by trails.

A good, but unimproved, air strip is on the terrace just south of Upper Stanley. Mail and stage service leaves Stanley for Ketchum or Challis on alternate days, Monday through Saturday.

Stanley, population 33, is a summer tourist town; supplies, meals and lodging are usually available. Sunbeam, located at the mouth of Yankee Fork, contains a few cabins. Bonanza and Custer are ghost towns that once held over 5,000 people.
Climate and flora

The Stanley area has marked climatic variations from summer to winter and from valley floors to mountain ridges. During summer months, between the middle of June and the middle of September, the climate may be classed as semi-arid; the little rain that falls is usually derived from sudden thunder showers. Day temperatures are usually in the 70's or 80's; night temperatures in the valleys are usually in the 40's or 50's. Freezing temperatures are uncommon in July or August; in the higher mountain country, where night-time temperatures are lower, freezing temperatures may occur during any summer night.

Winter comes early in the high mountains with snow flurries starting in mid-September. In the valleys, first snow usually falls in early to mid-October. In mid-winter, valley floors are usually covered with several feet of snow. Mid-winter temperatures in the valleys have reached 60° below zero; temperatures continuously colder than 50° below zero for periods up to two weeks have occurred.

Sagebrush and grass grow on well-drained, older gravel terraces and, at lower elevations, on open south- and west-facing slopes. North- and east-facing slopes and crests of ridges at lower elevations are commonly covered with evergreen trees, especially pine and fir. In many places in the high country, evergreen trees cover all of the terrain except the highest peaks and the steepest rock slopes. Aspens surround most springs and grow along most perennial streams and creeks. Forests of lodgepole pine thickly cover the young moraines in Stanley Basin.

Very little of the Stanley area has been logged although much of the area contains Douglas fir of timber quality.

Geomorphology

Drainage

The Salmon River, the main drainage artery, flows through the area. Average gradient is 27 feet per mile. The main tributaries of the Salmon are Yankee Fork, Warm Springs Creek, Basin Creek, and Valley Creek.

The Salmon, its main tributaries, and most perennial and intermittent streams are controlled by several complex fracture sets.

East of Stanley the Salmon is entrenched and forms a deep V-shaped canyon; downcutting along most of the small tributaries is intense. Lower Hardin Creek, with an average gradient of 650 feet per mile for its 3.8-mile length, is representative of tributaries east of Basin Creek. Gradients along the lower portions of tributaries such as American and Rough creeks are steeper than gradients along the central portions, indicating that these youthful streams have been recently rejuvenated.
Figure 2  Index map showing location of the Stanley area, Custer County, Idaho
The Salmon south of Stanley occupies a valley approximately 26 miles long and 6 miles wide that trends N20W. This valley joins an equally broad valley, occupied by Valley Creek and the upper drainage of the Middle Fork of the Salmon, that trends N40W. This valley complex, approximately parallel to the major northwest-trending valleys east of the Stanley area, seems to be structurally controlled.

Stanley Basin, part of this valley complex, comprises the lower valley of Valley Creek and Salmon River Valley between Red Fish Lake moraine and Stanley.

**Topography**

Total relief in the Stanley area is 4,240 feet. The highest point, Tongo Peak at 10,000 feet, is in the northwest part of the area; the lowest point is in the southeast where the Salmon leaves the area at 5,760 feet.

Except for a few relatively flat valley floors, the area is highly dissected. The greatest local relief occurs in the vicinity of Tongo Peak where granitic rock of the Idaho batholith has been eroded by valley glaciers; from Tongo Peak to Loon Creek, a distance of 0.8 mile, the difference in elevation is 2,400 feet. South of the glaciated northern half of the area, though the topography is still rugged, local relief is not as great. West of Basin Creek, the granitic rocks have not been glaciated and are deeply weathered; ridges have rounded tops, and slopes are between 20° and 25°. Between Basin Creek and Yankee Fork, ridge crests are higher than ridge crests west of Basin Creek; where the ridges are capped by resistant volcanic flows, ridge slopes commonly exceed 30°.

**Glacial geology**

In most of the high country, valley floors above 7,000 feet contained glaciers during much of the Wisconsin. The most intensely glaciated area is in the northwest, at the headwaters of Valley, Knapp, Loon, Basin, and Cabin creeks. Valleys are U-shaped with amphitheater-like heads. Imperfectly to perfectly developed Alpine features include aretes, cols, matterhorns, and hanging side valleys. Some valley heads contain two or more cirques hanging above the main, glacially eroded valleys. Some cirques are rock-floored and most contain tarns (cirque lakes). Some of the tarns are connected by water-falls and, from above, look like beads strung on a string (for example, the Knapp Lakes).

Some spectacular terminal moraines dam valleys on the eastern side of the Sawtooth Mountains (see Pleistocene morainal deposits). Upstream from these moraines are some of the finest examples of U-shaped valleys in the United States.
HISTORY OF MINING ACTIVITY

The following information on early mining in the Stanley area was acquired mainly during discussions with long-time area-residents Otto and Bill Centaurs, sons of Herman Centaurs who accompanied the first placer-mining party to work Robinson Bar and with Mr. and Mrs. Arthur McGowan who have collected early-day records of the Yankee Fork and Stanley mining districts.

The first known discovery of an economic metallic mineral in the Stanley area was by a prospecting party led by Capt. John Stanley in July, 1863. The party discovered placer gold in the drainage basin that they named "Stanley Basin"; however the party did not remain to work their discoveries.

Placer gold was discovered on Robinson Bar in late fall, probably in the late 1860's, by a prospector named Robinson. Being low in supplies and afraid of the coming winter and Indians, Robinson left for Boise Basin after making his discovery. At Garden Valley he described his discovery and how to reach it to a group of placer miners with the admonition, "If you get there before me next spring, save me a claim." Ebenezer Cunningham staked the first claim on the bar—the Great Centennial; Robinson, though was never heard of again. During the first year or two, supplies were obtained from northern Utah and later from a one-man trading post at Salmon.

Discovery of placer gold in the Yankee Fork district at the conflux of Jordan Creek and Yankee Fork was made in February, 1873. The first quartz claim in the district was staked in 1874.

The first placer claims in the Stanley mining district were located in Spring Gulch and on Buckley Bar. The dates of these discoveries are not known; however, they probably occurred in the late 60's or early 70's.

Most placer mining activity occurred in the 70's and 80's and in the depression years of the 1930's; however, placer gold recovered by dredge and drag-line operations on Yankee Fork and Jordan Creek between 1940 and 1952 probably exceeded the production from the numerous early-day hand operations. Silver-gold vein mining in the Yankee Fork district was most active between 1875 and 1900.

Pitchblende was discovered on Basin Creek in 1955. Uranium mining, commenced in 1958, has continued through the summer of 1961.

FIELD WORK

Field work was performed during three weeks in the fall of 1959 and 11 weeks in the summer and fall of 1960.

The base map used was a manuscript copy of the new U. S. Forest Service series of planimetric maps (2 inches equal 1 mile). Air photos of the U. S. Geological
Survey project GS-VQL (1957) were used for locating mining prospects and other features.

Radioactivity measurements were made with a Precision Radiation Instruments Company scintillometer model No. 111-B.

PREVIOUS GEOLOGIC WORK

Previous geologic work includes studies by P. L. Williams on glacial geology of Stanley Basin (1961), B. F. Kern on the uranium deposits of the Stanley district (1959) and A. L. Anderson on silver-gold deposits of the Yankee Fork district (1949). Older work of a reconnaissance nature was performed by Ross (1937), Umpleby and Livingston (1920), and Umpleby (1913).

ACKNOWLEDGMENTS

Marvel Stalcup, graduate student at the University of Idaho, gave valuable field assistance during the first six weeks of the 1960 field season. Stalcup collected much of the geologic data on the Red Mountain area (Fig. 1) during an independent study.

Some of the data shown on the geologic map in Figure 1 is taken from geologic maps included in the reports by Ross (1937), Anderson (1949), and Kern (1959).

Geologists and officials of uranium mining companies who contributed valuable data are Don Laub of Phillips Petroleum Company; Herb Lewis of Rare Metals Corporation of America; Cecil Smith, Galen Quigley, and Jeff Jeffries of Vitro-Idaho Minerals Corporation; Malcolm Brown and Ben Dickerson of Sidney Mining Company; and Hank Childs of Western Fluorite Mining Company.

Phil Dodd, Jim Scott, Ed Anderson, Ben Bower, and Bob Cohenour of the AEC, contributed their time and advice.

Residents of the Stanley area that contributed information on many of the old mining properties include O. Centaurus, A. McGowan, F. Preston, J. Benzer, J. Lynch, J. Wiedman, J. Seagraves, J. Vaught, M. Patterson, J. Brewer, J. Keller, and others.
ROCKS AND ROCK UNITS

PALEOZOIC SEDIMENTARY ROCKS

Rocks of the Wood River Formation

Rocks of the Pennsylvania Wood River Formation crop out in most of the area east of Warm Springs Creek and in a belt that extends from the mouth of the West Fork of Yankee Fork southeastward across Ramey and Peach creeks. Small isolated patches of Wood River rocks also crop out at the mouth and in the headwaters of Rankin Creek, near the mouth of Sawmill Creek, and along Jordan Creek at the foot of Estes Mountain (Fig. 1).

The formation as first described by Lindgren (1900, p. 89-90; 193-195) included rocks of the Devonian(?) and Mississippian Milligan Formation as well as rocks restricted to the Wood River Formation as defined by Umpleby and others (1930, p. 24-34). Umpleby and co-workers differentiated the two formations on the basis of stratigraphic relations, fossils, lithologic differences, and the existence of a thick persistent conglomerate at the base of the restricted Wood River Formation.

The Wood River Formation east of Yankee Fork is mainly composed of thin-to medium-bedded, blue-gray quartzite. In places thin-bedded quartzite grades into massive, blue-black quartzite; in other places it grades into graphitic argillite. Many weathered surfaces are deeply stained with limonite. Miniature folds are common in the argillaceous beds.

The formation, east of Warm Spring Creek, is composed mostly of a hard, fine-grained white quartzite. The grayish-white color of weathered surfaces is caused by a coating of impure secondary calcite.

Metamorphosed sedimentary rocks

Highly metamorphosed sedimentary rocks of unknown age were found in two isolated blocks within the batholith.

One block, just southwest of the junction of Valley Creek and Stanley Creek roads, is about one square mile in area. This block, composed mostly of bedded quartzite and some calcareous argillite, metamorphosed almost to a gneiss, may be a roof pendant in the batholith.

The second block, atop the ridge at the head of Copper Creek, is about 200 feet wide. Composed of pyrometasomatically replaced and altered limestone and quartzite, this block was probably engulfed during injection of the granitic magma. Limestone beds in the center of the block have been marbleized; limestone at the margins has been selectively replaced by magnetite, ilmenite, massive garnet,
hornblende, actinolite, epidote, and spinel.

CRETAEOUS INTRUSIVE ROCKS

Rocks of the Idaho batholith

More than half the area is underlain by granitic rocks of the Idaho batholith. Batholithic rocks crop out in the west and in the south and extend up the west side of Yankee Fork to almost encircle Challis rocks (Fig. 1).

Except along the belt of uranium mineralization east of Basin Creek, most contacts between the batholith and the Challis and Wood River formations are faults. Through-out the area, granitic rocks are cut by a multitude of fractures. Where granitic rocks have been deeply incised by stream erosion, fracture-controlled weathering has given the rocks a blocky appearance. In places, fractures are so closely spaced that the granitic rocks appear sheeted. In non-glaciated areas, ridges underlain by granitic rocks are rounded and covered with thick soil; scattered outcrops appear as low, rounded knobs. Weathered surfaces of granitic rocks are usually grayish white; fresh surfaces range from light gray to greenish gray.

Composition and texture of the granitic rocks are not uniform throughout the area. However, changes in composition and texture are gradational; sharp contacts between plutonic rock types are not present.

Regional and local textural variations occur mainly from east to west, more or less perpendicular to the margin of the batholith. Regionally, texture grades from coarse-grained porphyritic in batholithic rocks near the contact, to fine- to medium-grained granitic in rocks near the western boundary of the area. The strikingly porphyritic texture is caused by the presence of very large inset crystals (phenocrysts) of microcline.

Local textural variations are common in the western part of the area. Along Stanley and Kelley creeks the texture changes in short distances from a fine-grained aplite to a medium-grained granitic rock containing scattered microcline phenocrysts.

Composition generally ranges from sodic quartz monzonite to calcic granodiorite. The average composition, a calcic quartz monzonite with a plagioclase-potassium feldspar ratio of 63/27 (Table 1), is close to the boundary between quartz monzonite and granodiorite. The average plagioclase is sodic andesine. Composition of granitic rock specimens collected from the Stanley area are summarized in Table 1.
Table 1. Mineral composition of granitic rock specimens collected
from the Stanley area.*

<table>
<thead>
<tr>
<th></th>
<th>% Quartz</th>
<th>% Plagioclase</th>
<th>% An Plagioclase</th>
<th>% Potassium feldspar</th>
<th>Plagioclase feldspar</th>
<th>Biotite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>52</td>
<td>50</td>
<td>38</td>
<td>40</td>
<td>78/22</td>
<td>11</td>
</tr>
<tr>
<td>Min.</td>
<td>17</td>
<td>25</td>
<td>28</td>
<td>12</td>
<td>40/60</td>
<td>&lt;1/2</td>
</tr>
<tr>
<td>Average</td>
<td>29</td>
<td>39</td>
<td>32</td>
<td>26</td>
<td>63/37</td>
<td>4</td>
</tr>
</tbody>
</table>

*From grain counts on thin sections and on rock slices stained by cobaltinitrate and potassium rhodizone; plagioclase An percentages determined by Michel-Levy method.

Plagioclase forms subhedral crystals in which combined polysynthetic, carlsbad, and spear-type twinning is common. Granophyre intergrowths rim some plagioclase crystals. Some plagioclase is zoned; where zoned, calcic cores are more highly altered than the sodic rims. Plagioclase is generally altered to sericite and kaolinite. In the coarser-grained rocks, plagioclase grains average 1 to 2 mm long; in aplitic rocks the grains are about 1/2 mm long.

Quartz is present mainly as unaltered anhedral grains and grain clusters interstitial between feldspar crystals. Much of the quartz has pronounced undulatory extinction. Quartz grains in coarse-grained rocks are an average 1 to 2 mm in diameter; in aplitic rocks, grain diameters average only 0.2 to 0.3 mm.

Orthoclase occurs as small, anhedral to subhedral crystals up to 3 mm wide and as subhedral to euhedral phenocrysts, rarely up to 1/2 inch long. Some phenocrysts are zoned; many of the zoned phenocrysts contain inclusions aligned along zone boundaries. Orthoclase is generally more abundant than microcline; however, in places orthoclase is an accessory mineral and microcline is by far the most important potassium feldspar. The orthoclase alters mainly to kaolinite.

Microcline occurs as small anhedral grains less than 1/2 mm wide, as subhedral crystals with an average width between 1 and 2 mm, and as phenocrysts some of which are as much as 4 inches long and a few of which reach 6 inches in length. These large phenocrysts have inclusions of all the other minerals: quartz, plagioclase, orthoclase, and biotite occur within the large phenocrysts as deeply embayed relics. The large phenocrysts probably formed during a deuteritic potassium metasomatism.
Intergrowths, though not quantitatively important, commonly occur as small patches of granophyre, myrmekite, perthite, and antiperthite surrounding larger feldspar crystals. These intergrowths probably formed during the last stages of magmatic cooling.

Accessory minerals identified in thin sections are, in order of their relative abundance: biotite, magnetite, ilmenite, sphene, muscovite, apatite, zircon, hornblende, garnet, and rutile. Monazite, epidote, and xenotime, panned from short streams that drain only granitic rocks, also probably originated as minor accessories.

Most of the accessories are late; they occur mainly in interstitial clumps between larger groups of quartz and feldspar crystals (Fig. 3). Biotite, the major mineral in these clumps, forms ragged, anhedral to subhedral, randomly oriented flakes having an average length of 1 mm. Most other accessories are euhedral. Biotite is more abundant in coarser-grained rocks than in aplitic rocks. Most of the biotite is iron rich; much is titaniferous. Most of the other accessories are aligned between biotite flakes; some, such as apatite, magnetite, and zircon, occur as inclusions in unaltered biotite. In places, especially south of Salmon River, sphene is the most important accessory present. Much of the sphene is crowded with included magnetite-ilmenite granules. Hornblende is an uncommon to rare accessory. Biotite alters to muscovite, magnetite, and chlorite; sphene alters to leucoxene and ilmenite; ilmenite alters to leucoxene; and hornblende alters to biotite. Biotite and hornblende are the only ferromagnesian minerals present.

Much work must still be done to determine the method of intrusion and age of the Idaho batholith. Anderson (1952) has suggested that the batholith was formed by multiple emplacement. Larsen and co-workers (1958, p. 51), after a reconnaissance study of the batholith during which rock specimens were collected for age dating, concluded that

...the batholith is early Late Cretaceous in age and...it was intruded in a short time, not over a few million years...the mean age of 16 samples of granitic rocks of the Idaho batholith is $108 \pm 12$ million years.

The 16 age determinations (1958, p. 54) listed by Larsen and co-workers are valuable contributions to Idaho geology. However, the above quoted conclusions do not seem to be justified by the ages determined from the 16 samples. The age of the youngest rock sampled was 94 million years; the oldest was 135 million years—a range of 41 million years. This 41 million-year range equals 38 percent of the total average age of the batholith and equals 44 percent of the age of the youngest rock sampled. A time lapse of 41 million years seems much too large to be termed "...a short time, not over a few million years."

Of the samples dated by Larsen and co-workers, only one is known to come from the Stanley area (1958, no. L113, p. 15 and 19). This sample, collected from
Figure 3  Clump of late(?) accessory minerals in quartz monzonite; s, sphene; b, biotite; h, hornblende; m, magnetite (replacing biotite); qf, quartz and feldspar; Salmon River near mouth of American Creek (thin section, plane light x 100).

Figure 4  Thick, quartz-latte porphyry dike, P & B claim; resistant outcrop typical of many intermediate and acidic dikes.
along the Salmon River one mile downstream from Elkhorn Creek, has an average age of 96 million years (zircon, 90 million years; thorite, 102 million years).

**Pegmatite and aplite**

Many small pegmatite and aplite dikes cut the Idaho batholith. All are older than Challis rocks.

In places, such as along Elkhorn Creek, batholithic rock is cut by a complex of cross-cutting, closely spaced, pegmatite and aplite dikesets. Many of these dikesets have highly irregular shapes and may have been somewhat plastically deformed; they were probably injected after emplacement of the batholith but prior to any substantial cooling.

Simple pegmatite dikes up to 3 feet thick cut granitic rocks in many places throughout the area. Individually, these dikes have relatively uniform thickness and attitude; most have occupied fractures. These dikes were probably emplaced somewhat later than the pegmatite and aplite dikesets.

The simple pegmatite dikes contain quartz and feldspars with minor muscovite or biotite. The feldspars are orthoclase, microcline, and sodic plagioclase. Most of the dikes are unzoned; however, a few are composed of quartz cores bounded by feldspar walls.

Branerite and euxenite in placers on Kelley and Stanley creeks are probably of pegmatitic origin. These minerals, however, were not found in place. Near the Bear Valley euxenite placers, 27 miles to the west, euxenite has been found in pegmatite clots and lenses within batholithic rocks (J. H. Mackin, oral communication).

**TERTIARY VOLCANIC AND SEDIMENTARY ROCKS OF THE CHALLIS VOLCANICS**

Challis rocks, underlying more than a third of the Stanley area, crop out in the central, north central, and northeastern portions of the area.

Rocks of this group were first described by Ross as the Challis Volcanics from outcrops in the Seafoam mining district (1930, p. 2). From exposures in the Casto quadrangle and in the Bayhorse region, Ross (1934, p. 46-53; 1937, p. 49-68) later subdivided the Challis Volcanics into three main members, from top to bottom:
1. The Yankee Fork rhyolite member, from 0 to over 1,600 feet thick, consists mainly of brownish, violet, or nearly black rhyolite flows containing small phenocrysts of quartz. Minor amounts of light-colored tuff are interbedded with the rhyolite.

2. The Germer tuffaceous member, from 0 to over 2,000 feet thick, composed mostly of medium- to fine-grained, cream-buff and light-brown, rocks of explosive origin. Bedding is common. Basalt and calcic andesite flows are commonly interbedded with the tuffs, especially in the upper part of the member.

3. A latite-andesite member, from 0 to over 3,000 feet thick, composed mainly of flows, flow breccias, and some tuff.

Anderson (1961, p. 43-53) has shown that Challis rocks in the Lemhi quadrangle were deposited during three separate periods of extrusion; rocks of each period are separated by pronounced angular and erosional unconformities. Anderson proposes that Challis rocks be given group status and that rocks of the three volcanic sequences be given the formational names Kadlets Volcanics (upper sequence), Yearian Volcanics (middle sequence), and Cheney Volcanics (lower sequence). The Cheney and the Yearian volcanics of the Lemhi quadrangle are similar to the latite-andesite and the Germer tuffaceous members, respectively, in the Custo-Bayhorse-Stanley areas. The Kadlets Volcanics, however, are composed mainly of basalt flows, whereas the Yankee Fork member is composed mainly of rhyolite flows.

In general, Challis rocks within the Stanley area comprise the middle Germer tuffaceous member (Yearian Volcanics) and the lower latite-andesite member (Cheney Volcanics). Germer rocks, composing about three-quarters of the Challis group in the area, were the most receptive hosts for late-Tertiary, epithermal, gold-silver mineralization. Many of the brighter colors exhibited by Germer rocks were produced by hydrothermal alteration (Anderson, 1949, p. 16).

Underlying the Germer rocks is a sequence of massive, blackish to greenish-gray andesite, latite, and dacite flows with interbedded greenish-gray to reddish tuffs. Much of the flow rock is a dense, blackish, calcic andesite in which amphibole and pyroxene phenocrysts have been, in part, deuterically altered to calcite. The flow rocks commonly have a highly altered groundmass consisting mostly of plagioclase microlites; they have trachytic texture. Most of the flows contain quartz in at least accessory amounts.

Along the upper reaches of Coal and East Basin creeks, thick sequences of massive, greenish-gray, porphyritic tuff are exposed. In much of the area, this tuff is the main rock overlying the uranium deposits. The tuff is unstratified, non-vesicular, and does not contain cooling joints. In thin section, this rock is seen to be mostly andesitic, crystal-vitrific tuff with a seriate porphyritic texture.
Where Challis rocks overlie granitic rocks of the Idaho batholith, the basal portion of the Challis is a thin irregular sequence of sedimentary rocks derived mainly by erosion from the batholith. The lower portion of this sequence, which formed prior to any volcanic activity, is arkosic sandstone, arkose, and conglomerate; all are high in carbonaceous matter. These rocks grade upwards to tuffaceous sandstone, which gives way to lithic tuff. At no place within the sequence can a contact be found that would separate rocks mainly of sedimentary origin from rocks mainly of volcanic origin. The thickness of the sequence is highly irregular. In places it is probably only a few feet thick; in other places it is probably more than 100 feet thick. The carbon-rich sedimentary rocks at the base of this sequence are the main hosts for uranium mineralization in the Stanley area. A measured section of part of this sequence, exposed at the East Basin No. 1 pit, is given below.

Partial section, basal sedimentary and tuffaceous rocks of the latite-andesite member (Cheney Volcanics), Challis group, East Basin No. 1 pit, SW1/4 and NW1/4 sec. 8, T11N, R14E.

Feet

Covered, soil .......................................................... 2.0
Siltstone and coal, interbedded; maximum thickness of siltstone beds is 4 inches and of coal beds is 3 inches; coal is mostly dull, contains some very thin lenses of vitrain .................. 4.5
Tuff, massive, arkosic(?), soft, highly iron stained; contains minor carbonaceous material; contains thin small lenses and pods of gray vitreous pyroclastic material that alters to clay ...... 13.5
Covered, soil rich in carbonaceous shaly debris .................. 8.0
Coal and vitrain, interbedded; contains thin beds of fine-grained, tuffaceous, arenaceous siltstone; tuffaceous siltstone is very light gray (N8) to pinkish gray (5YR8/1); thickness of coal and vitrain beds ranges from 1/4 inch to 1 foot; iron-stained; grades from carbon-rich rock at the bottom to tuffaceous rock at the top... 9.5
Shale, carbonaceous; iron-stained ................................. 1.5
Arkose, massive; iron-stained ...................................... 4.5
Shale, carbonaceous; contains thin layers of volcanic ash; iron-stained ......................................................... 2.0
Arkose, coarse grained; iron-stained .............................. 10.0
Arkose and coal, interbedded; arkose is commonly light gray (N7); size of arkose grains ranges from 1/4 to 1 mm; arkose beds contain numerous detrital fragments of coal; coal lenses and beds have a maximum thickness of 6 inches; most individual coal beds, seams, or lenses can be traced only a few feet but some are traceable for a few scores of feet; many of the coal beds consist of vitrain seams, from 1/32 to 1/4 inch thick, intercalated with "dull" coal layers, from 1/16 to 1/2 inch thick .................. 13.5

*Rock color chart, distributed by Geological Society of America
Covered, weathered carbonaceous shale, non-radioactive.............. 6.0
Sandstone, arkosic; "cap rock" covering uranium ore bed; hard and
massive with relatively few fractures; bottom 3 1/2 feet is very
light gray (N8) and is coarser-grained than the top 3 1/2 feet which
is medium light gray (N6); top 3 1/2 feet contains thin horizontal
stringers and lenses of coal having an average thickness of 1/32
inch; top few inches are an arenaceous, carbonaceous shale—a
fossil soil; numerous carbonized plant roots extend from fossil soil
to base of sandstone (Fig. 32). ............................................. 7.0
Arkose and arkosic sandstone, medium- to coarse-grained; moderately
to well cemented; detrital quartz and feldspar grains mainly angular
to subangular; cement is mostly clay minerals, calcite present in
places; vitrainized wood fragments and branches common; ore-grade
mineralization—uraninite, coffinite, pyrite, and marcasite........... 3.5
Conglomerate, basalt; absent in places; contains cobbles up to 3 1/2
inches in diameter; aggregate consists mainly of well-rounded to
subrounded pebbles and cobbles of blue-gray quartzite (Wood River
Fm.), vein quartz, and granitic rock; mineralized .................. 0.5
Total 86.0

Quartz monzonite, weathered at surface; biotite alters to chlorite and
feldspars to clay minerals; limonite stained in places, especially
along fractures.

In 1937, Ross (p. 67-68) stated that, because of plant fossil and stratigraphic
evidence, "...the Challis Volcanics are possibly, if not probably, of Oligocene age
and that they can hardly be younger than early Miocene." Anderson (1961, p. 47, 52)
suggests that the latite-andesite member (Cheney Volcanics) was deposited in medial
Oligocene time and that the upper flows (Kadletz Volcanics) are in the early Miocene.

Radioactive dating of the black uranium minerals, uraninite and coffinite, which
formed at the same time as their enclosing sediments, would give a fairly exact age for
the base of the Challis. Six specimens containing these minerals were submitted to the
U. S. Geological Survey for dating in October, 1959; unfortunately ages of these speci-
mens are not yet available.

Many thin carbonaceous beds occur in tuff, near the base of the Challis, below
the flows of the latite-andesite member. Upstream from the Coal Creek and East Basin
Creek workings, fossil plant leaves, twigs, spores, and pollens occur in these beds.
Plant fossils from about 400 feet upstream from the Coal Creek No. 1 pit (center of the
E1/2, NW1/4, sec. 16, T11N, R14E) collected by Choate and Stalcup in July, 1960, and
identified by J. A. Wolfe included Metasequoia glyptostrooides Hu and Cheng,
Sequoia affinis Lesquereux, Alnus corallina Lesq. of Brown, and Hydrangea (?)
(Ross, 1962, p. 97). These fossils came from beds that are from 25 to 150 feet above
the batholith contact. One mile to the northwest and from the same stratigraphic horizon, Ross collected spores and pollens from the East Basin No. 1 pit (USGS Paleobotanical Loc. D1802) that were regarded by E. B. Leopold and H. F. Ranson as of Eocene age (1962, p. 98).

In 1962 Ross, (p. 102) in reviewing the evidence on the age of the Challis Volcanics, states

In summary, the most convincing paleontologic evidence indicates that the parts of the formation that contain it are of Oligocene age. Some beds now correlated with the Challis Volcanics may be of early Miocene age and some beds contain plants that indicate an Eocene age.

TERTIARY DIKE ROCKS

General statement

Numerous Tertiary dikes and dike swarms of various compositions and textures crop out in the Stanley area. Dike rocks observed include quartz latite-dacite porphyries, lamprophyres, granophyre porphyries, rhyolites, porphyritic rhyolites, and rhyolite porphyries. Most of the observed dikes cut batholithic rock in the western part of the area; dike frequency in batholithic rock seems to increase from the southeast to the northwest. Some dikes cut Challis rocks. Acidic dikes outnumber basic dikes. Most of the acidic dikes are less than 50 feet thick; most of the quartz latite-dacite dikes are more than 50 feet thick.

Emplacement of the dikes was controlled mostly by fractures that strike north to east. Dike sets strike, in probable order of their importance, N65-70E, N40-45E, N15-20E, and N65-70W. Most of the dikes dip 60-70N; however, many dip 70-80S and some dip 30-40N.

In the Stanley mining district, many of the highly fractured, more acidic dikes are hosts for gold-silver mineralization.

The dikes are compositionally, texturally, structurally, and stratigraphically similar to the dikes that form the "porphy belt" of Boise Basin (Anderson, 1947, p. 139-150; Ross, 1934, p. 246-249) and to dikes that crop out along the Middle Fork of the Salmon River in the Casto quadrangle (Ross, 1934, p. 248, 250). Dikes similar, in part at least, also occur in the Lava Creek district, the Seafoam mining district, and in the Sawtooth Mountains.

Ross (1934b, p. 65-67) stated that the dikes and associated pink granite in the Casto quadrangle may be related to late Challis rhyolitic flows.
Quartz latite-dacite porphyries

A number of prominent porphyry dikes that range in composition from quartz latite to dacite crop out along Basin and Stanley creeks. One resistant, 50-foot quartz latite dike crosses Basin Creek near its mouth (Fig. 4). This dike has columnar joints spaced 2 to 4 feet apart and has chilled border zones 1 to 3 feet thick. The chilled border zones, having formed simultaneously with the columnar joints, have an unusual scalloped shape. Several quartz-latite dikes, cropping out north of Hay Creek on the Lightning No. 2 claim, intersect the lower flows of the Challis. These dikes may have been the feeders for the flows.

Phenocrysts, composing more than 50 percent of these dike rocks, are set in a matrix that is mostly greenish gray. The phenocrysts are mostly subhedral orthoclase, subhedral to anhedral quartz, and euhedral oligoclase (An20). Orthoclase forms the largest phenocrysts; some of these phenocrysts are up to 10 mm long. Some orthoclase phenocrysts are rimmed with plagioclase overgrowths. The quartz phenocrysts have weak undulatory extinction. Orthoclase and plagioclase phenocrysts are partly altered to kaolinite and calcite. The even, fine-grained matrix is composed mostly of feldspars highly altered to sericite and kaolinite; anhedral quartz is present in amounts ranging from 10 to 15 percent. Matrix minerals have an average diameter of 0.02 to 0.05 mm. Mafic minerals are biotite, partly altered to chlorite and magnetite, and minor magnetite.

Lamprophyres

Lamprophyre dikes cut granitic rocks in much of the area. Some of the observed dikes are up to 10 feet thick; however, most are 1 to 4 feet thick. Most of the dikes are seriate porphyritic; where fresh, dike rocks are generally bluish gray to bluish black in color. Some of the dikes are resistant to weathering; rock exposed in natural outcrops is relatively fresh. Others, especially basaltic varieties exposed either in natural outcrops or open pits, are highly altered and have undergone orbicular weathering. Weathered basaltic dikes occur on the Little Joe claims on Coal Creek, on the Giant Spar claims between Big and Little Casino creeks, on the Salmon River near American Creek, and on Warm Spring Creek. The basaltic dikes exposed in one of the uranium pits on the Little Joe claims cut basal sandstone and tuffaceous beds of the Challis group. Many of the lamprophyre dikes along Big Casino, Little Casino, Copper, Nip and Tuck, Joes Gulch, and Kelley creeks are in close association with the acidic dikes of rhyolitic composition. Though lamprophyric and rhyolitic dikes seem to have been equally fractured during post-dike faulting, the lamprophyre dikes are probably the younger. The rhyolitic dikes are hosts for much of the gold-silver-fluorite mineralization along these creeks; whereas, the only mineralization observed in the lamprophyre dikes consists of chalcedony, opal, and calcite stringers. Similar dike-mineralization relations were observed by Ross in the Boise Basin "porphyry belt" (1934a, p. 250-251). Rolland Reid, during a geologic study of the Sawtooth Mountains, saw basaltic dikes cutting acidic porphyry dikes (oral communication).
Thin sections were cut from unaltered cores of nodules weathered from the porphyritic basalt dikes on the Little Joe claims. The basalt comprises 47 percent plagioclase, 25 percent pyroxene, 17 percent palagonite, and 11 percent magnetite. Plagioclase, as fresh labradorite (An58), forms a seriate texture composed of subhedral, randomly oriented laths. Albite twinning predominates over minor pericline twinning; zoning is minor. Subhedral, titaniferous augite phenocrysts are highly altered to chlorite and calcite. Anhedral augite masses molding the smaller plagioclase laths, contain slender magnetite rods in closely spaced gridworks. Minute, anhedral granules of pigeonite form much of the groundmass in conjunction with abundant magnetite as irregular blebs and unoriented rods. The irregularly rounded patches of palagonite commonly have centers of calcite and rims of chlorite and zeolites.

Granophyres

Granophyre dikes crop out along Stanley, Kelley, and Nip and Tuck creeks. Most of the dikes are only a few feet thick; however, north of Stanley Creek, one mile east of Anderson Creek, a northerly trending porphyry dike or closely spaced dike swarm is at least 1,200 feet thick. Where it is fresh, dike rock consists of a pinkish matrix containing pale pink feldspar and clear quartz phenocrysts.

Quartz, orthoclase, and plagioclase phenocrysts compose more than 50 percent of the rock. The size of the average phenocryst is 2 mm. Composed of euhedral to subhedral bypyramids and anhedral masses, quartz phenocrysts are commonly rimmed by granophyric overgrowths. Orthoclase and plagioclase (oligoclase) phenocrysts are highly altered to kaolinite and sericite. Minor biotite crystals are mostly altered to chlorite and muscovite. The matrix consists mainly of granophyric intergrowths of quartz in orthoclase. Most of these intergrowths have regular patterns--examples developed include screen-like, sheaf-like, herringbone, and radial patterns. Magnetite and zircon are minor accessories.

Rhyolites, porphyritic rhyolites, and rhyolite porphyries

Rhyolitic dikes, non-porphyritic to porphyritic, occur in a northerly trending belt that extends from Big Casino Creek to Potato Mountain. The rhyolitic dike rock, though highly fractured, is generally dense, hard, and unaltered by weathering. Color ranges from a grayish white in the non-porphyritic varieties to pinkish gray in the porphyries. Most have vitreous, chilled border zones from an inch to a foot in thickness. The thickest dike observed was a 75 foot non-porphyritic dike at the Giant Spar claim on Little Casino Creek. Rhyolitic dikes are hosts, in part at least, for gold-silver mineralization at the Homestake, Bright Star, Iron Crown, and Golden Day mines.

The non-porphyritic dikes are composed of equal amounts of quartz and orthoclase as anhedral grains in a fine-grained saccharoidal texture. Orthoclase is
highly altered to sericite and kaolinite. Grain size generally ranges from 0.05 to 0.10 mm. Occasional small phenocrysts are sparsely distributed through the rhyolite. Mafics are absent.

In the porphyritic dikes, feldspars are more abundant; in some dikes they compose about 85 percent of the rock. Orthoclase, in the matrix and as phenocrysts, predominates over plagioclase. In some dikes sanidine is the major phenocryst feldspar. Quartz, as euhedral bipyramids and doubly terminated prisms and as anhedral masses, is the other major phenocryst mineral. In most dikes mafics are absent; however, some dikes contain up to 10 percent biotite as fresh subhedral flakes. The texture and grain size of the matrix minerals are about the same as in the non-porphyr- itic dikes.

QUATERNARY DEPOSITS

Pleistocene morainal deposits

A series of terminal moraines up to 1,000 feet high line the western side of the Stanley basin southwest of Stanley. The moraines were deposited by glaciers that flowed down the eastern valleys of the Sawtooths and out onto the piedmont plain.

The moraines were deposited during several stages of glacial advance. Williams (1961) has mapped moraines of the Stanley Basin as having been deposited during three glacial advances in the Wisconsin--Bull Lake I, Bull Lake II, and Pinedale.

The moraines are composed of unsorted and unstratified clay, sand, gravel, and boulders. The boulders are subangular to subrounded; the exposed portion of one boulder, in the Forest Service campground at Redfish Lake just south of the Stanley area, is approximately 90 feet long, 40 feet wide, and 35 feet high.

The morainal material is composed mostly of quartz monzonite and granodiorite. Some morainal material was contributed by dikes and batholithic roof pendants of meta-sedimentary rock occurring along the crest of the northern Sawtooths.

The younger moraines have been little altered by erosion. Some of the triangular valleys back of the moraines contain lakes; the noses of other moraines have been cut by streams and former lakes have been drained.

The older moraines have been modified by deep weathering and stream erosion. The Salmon River is eroding morainal debris deposited by a glacier that once extended to the site of Lower Stanley. Glacial erratics lie scattered about the plain, now being cut by the Salmon; other erratics up to 19 feet long armor the air-stripe terrace south of Upper Stanley. Material within the terrace, as exposed by road cuts along the terrace
base, is unsorted; fewer large erratics are present than are in the younger moraines to the southwest. Probably this material was deposited by a glacier that filled most of the lower valley.

**Pleistocene terrace gravels**

Pleistocene gravel terraces occur along the Salmon River and many of its tributaries. Below Sunbeam, such terraces are 100 to 400 feet above the Salmon River. At Robinson Bar, relict terraces occur at four levels, high above the Salmon; the Salmon is now deeply entrenched in bedrock. Most terraces along the smaller tributaries are less than 100 feet above present stream levels.

The terraces are underlain by gravels consisting mostly of subrounded to subangular sand, pebbles, cobbles, and small boulders. Large boulders are common in terraces along streams with steep gradients such as the Salmon at Robinson Bar, whereas cobbles are the coarsest material in terraces along streams with shallower gradients such as lower Stanley Creek. In general, the terrace deposits are not cemented; some, however, are weakly cemented, especially at their base. Most of the terraces are well drained and support no vegetation larger than sage brush. Some shallow terrace deposits, such as Buckley Bar and the bar on the east side of American Creek, are partly covered by pines.

Much of the rich placer gold recovered in the late 1800's and early 1930's came from the base of gravel terraces.

**Recent alluvium**

Recent alluvium in the Stanley area comprises reworked terrace gravels, slope wash, some outwash, and minor flood-plain sands and gravels. Much of the recent alluvium is in stream channels incised in terrace gravels along many of the larger and medium-sized valleys. Some Pleistocene gravel terraces, modified by recent erosion are veneered by alluvium. Fill in most of the smaller valleys consists almost entirely of recent slope wash slightly reworked by stream action. Flood-plain sands and gravels have formed beside narrow meander belts along lower Valley Creek and along local base-level flats along Basin Creek.
STRUCTURAL GEOLOGY

INTRODUCTION

The contact zone between the Idaho batholith and Paleozoic sedimentary rocks forms a major discontinuity in crustal rock of east-central Idaho. Stanley area rocks, which occupy part of this zone, have been complexly deformed. Because of the deformational complexity, the general lack of marker beds, and the covering of many critical fault zones by alluvium, the structural history of the area is difficult to decipher. In the following discussion of folds and fractures, post-batholith faults are emphasized because of their relatively good exposures in the gold-silver and uranium workings in batholith and Challis rocks.

FOLDS

In Paleozoic sedimentary rocks

Folding in the Wood River Formation has been intense. Beds have steep dips and in some places are overturned. Folds range from microscopic ones to folds several miles wide. Two or more stages of folding probably took place—axial planes are not concordant. Rocks of the Wood River Formation close to the contact with the Idaho batholith are more intensely deformed than are sedimentary rocks east of the area. Ross (1937, p. 75-82) describes a large, strangely shaped "pinched" anticline near Clayton that trends northerly, subparallel to the batholith contact; he suggests that much of the folding in Paleozoic rocks, including formation of the anticline near Clayton, was caused by forceful intrusion of the batholith.

In granitic rocks

The amount of folding which granitic rocks of the Idaho batholith have undergone is unknown. The granitic rocks have been folded at least as much as the overlying Challis rocks, probably more. In some places in the granitic rocks, folded fractures and dikes were observed. Where observed, folds were of the same general order of magnitude as folds in Challis rocks.

In Challis rocks

In the vicinity of Red Mountain, six folds occur within a distance of four miles along the ridge southeast of Hindman Lake (Fig. 1); those near the batholith-Challis contact are narrow and closely spaced, whereas those farther southeast measure up to 1 1/2 miles wide. The fold axes strike from N20E to N35E.

Attitude of Challis rock units is difficult to measure in much of the area, as, for example, between Basin Creek and Yankee Fork. Here units are massive and outcrops exposing contacts within the Challis are rare.

FRACTURES

General statement

Fracturing in rocks of the Stanley area is complex. Types of fractures conspicuously developed are faults, joints, and cleavage fractures.

Some pre-mineralization faults controlled most vein deposition in the area. Post-mineralization faults offset two of the major types of deposits—the high-angle veins and the flat-lying, sedimentary, uranium deposits. In many of the placers, closely spaced joints in bedrock have aided in the erosional formation of natural riffles. At the Iron Crown Mine, thin quartz stringers containing free gold fill many of the cooling fractures in a thick, porphyritic, rhyolite dike. Cleavage fractures in many places contain small stringers of gold-bearing quartz, chalcedony, and opal.

Faults

Classification and origin

Faulting in rocks older than the batholith was not studied. In the batholith and younger rocks the more important faults can be generally classified into seven groups. Faults in each group have subparallel strikes. The average strike and the general range of strikes for each group is shown below; the groups which are probably most dominant are starred.

<table>
<thead>
<tr>
<th>Strike</th>
<th>Strike</th>
</tr>
</thead>
<tbody>
<tr>
<td>N10W(N 0-20W)</td>
<td>N10E(N 5-15E)</td>
</tr>
<tr>
<td>*N45W(N35-50W)</td>
<td>*N30E(N20-35E)</td>
</tr>
<tr>
<td>*N70W(N60-90W)</td>
<td>N45E(N40-50E)</td>
</tr>
<tr>
<td></td>
<td>*N65E(N60-80E)</td>
</tr>
</tbody>
</table>

These seven groups contain at least 15 and possibly more than 20 sets of faults. Most of the groups contain a high-angle fault set and at least one (commonly two) intermediate-angle fault sets; intermediate-angle fault sets dip SE and NW for NE-trending groups and NE and SW for NW-trending groups. In most of the groups, the high-angle faults are the primary faults; they were caused by the main deformational stresses. The intermediate-angle faults were probably caused by secondary stresses.

Almost all of the faults have dips greater than 45 degrees. Where observed, low-angle faults cut all other faults.
The poles of 116 of the most conspicuous faults or fault zones measured in the granitic and Challis rocks were plotted on a Schmidt equal-area stereonet. These poles represent fault-set measurements taken at over 60 properties or localities; measurements from any one property used for plotting were limited to a maximum of three. Most of the measurements were made in a 7-mile wide, east-west belt from Anderson Creek to Peach Creek. Figure 5 is a contour diagram of the 116 poles plotted. Seventeen fault sets represented by the maxima shown on the contour diagram are listed in Table 2 along with the maxima values (in percent of faults occurring in one percent of the total area). The sets that are probably dominant, as determined from field relations, are starred.

### TABLE 2

Fault-set attitudes and relative ranks as determined from the contour diagram of 116 fault poles

<table>
<thead>
<tr>
<th>NW Faults</th>
<th>NE Faults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault-set attitude</td>
<td>Rank</td>
</tr>
<tr>
<td>(generalized) (from stereonet)</td>
<td>Max. %</td>
</tr>
<tr>
<td>N10W 85E (N 8W 86E)</td>
<td>6-7</td>
</tr>
<tr>
<td>N10W 60E (N 8W 58E)</td>
<td>2-3</td>
</tr>
<tr>
<td>N45W 85NE (N45W 85NE)</td>
<td>4-5</td>
</tr>
<tr>
<td>*N45W 55NE (N45W 54NE)</td>
<td>4-5</td>
</tr>
<tr>
<td>N50W 75SW (N49W 77SE)</td>
<td>2-3</td>
</tr>
<tr>
<td>N65W 50SE (N63W 50SE)</td>
<td>2-3</td>
</tr>
<tr>
<td>*N75W 50NE (N74W 49NE)</td>
<td>5-6</td>
</tr>
<tr>
<td>*N85W 85SE (N85W 85SW)</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The fault-set attitudes and relative ranks shown in the table must be considered as tentative; the 116 measurements used are insufficient for a good statistical analysis. In addition, weak fault sets in many places are masked by strong sets and therefore are probably not properly represented. In some places, the rocks are so badly brecciated that individual faults could not be measured. In other places, the strikes of conspicuous faults could be measured but the dips could not.

Of the 116 faults or fault zones, 34 contain well-developed slickensides. Rakes of these slickensides range from 1 to 79 degrees; the average rake is 31 degrees. These data indicate that at least on these 34 faults or fault zones, the average strike-slip component of the net slip is approximately 2/3 and the average dip-slip component is approximately 1/3. The average of the rakes measured on any one set ranges from as low as 5 degrees (N10W 85E set) to as high as 75 degrees (N75W 50NE set). Probably, movement on the high-angle (primary) faults was mostly strike-slip and on the intermediate-angle (secondary) faults was mostly dip-slip.

Most of the faults studied in the Stanley area are normal.

Because of recurrent movement along most of the faults, age relations are difficult to decipher. Although all seven of the fault groups cut Challis rocks, the batholith rocks are more broken by faults than the Challis rocks; consequently, at least some of the fault groups originated prior to Challis deposition. At some of the uranium properties, post-Challis faulting has displaced buried stream-channel fill along the same fault zones that controlled the original formation of the stream channels on the pre-Challis erosion surface. In other places, faults of several sets contain both pre-Challis pitchblende veins and post-Challis gold-silver veins.

Most of the post-batholith folds and faults can best be explained as resulting from a state of stress in which the largest principal stress was oriented NW-SE and approximately horizontal. Within the Stanley area, the direction of this largest principal stress probably ranged from N40W to N60W; the average direction was probably N45W. In Figure 6, the fault sets determined from the contoured fault poles are graphically related to the proposed compressive stress. The relations summarized in this figure can be explained by diagrams and text in De Sitter's *Structural Geology* (p. 122-142).

A possible interpretation of Stanley area faults are presented in the following description of fault groups.

**Description of fault groups**

**N70W group** Most faults of this group are strike-slip faults. Faults of this group formed early in the deformation process, probably earlier even than the N65E shear faults. At both the Little Joe and Lightning properties N70W faults are cut by N65E faults.

Shear faults of the N70W and N65E groups contain many of the silver-gold bonanza veins in the Yankee Fork district. Most of the movement along these faults was
Figure 5

Contour diagram of the poles of 116 conspicuous faults in granitic and Challis rocks. Contours at 1 percent intervals per 1 percent of area.
Figure 6  Diagram relating fault sets and fold axes to a probable northwest-directed, compressive stress
pre-mineralization; however, the faults were probably reopened during subsequent cycles of compressional stress and elastic rebound.

**N65E group** Of the seven fault groups, the N65E group is probably best developed. Most of the faults in this group are probably strike-slip faults. Faults of this group control portions of Kelley Creek, Salmon River, Rough Creek, Blind Creek, and Warm Springs Creek. Typical of these faults is the fault or fault zone that parallels the Salmon River from Lower Stanley to Basin Creek. That zone of faulting is at least several hundreds of yards wide. Rock along the river is highly fractured; in places it has been mylonitized. A line of hot springs along the fault zone suggests its relatively deep-seated extent. Hot springs occur at no place in the Stanley area except along the Salmon.

The average rake of slickensides measured on the N60E 85NW set of this group is 33NE. Drag-folded fractures and dike along the Salmon River fault as well as the major offset of the Wood River Formation along the Rough Creek fault indicates that movements were dextral; relative movement of the northwest walls was to the northeast and down.

**N45W group** Most faults of the N45W group are probably tension faults that formed parallel to the main compressive stress during the early stages of deformation. It is in these tension faults that most of the pre-Challis pitchblende veins occur, such as those at the Lightning No. 2 and Baker properties. The N60-65W pitchblende-bearing faults may also belong in this group—these faults are tension faults formed where the compressive stress had a N60W direction.

Some N45W faults of this group are probably frictional shear faults. Substantial displacements have occurred on a few faults of this type, for example, on the fault along lower Basin Creek.

**N30E group** The N30E group, one of the most dominant fault groups, contains both tensional and shear faults. The best examples of the tensional faults are the faults that follow upper Stanley Creek, Short Creek, East Basin Creek, Coal Creek, and lower Yankee Fork. These faults are high-angle normal faults separated by tilted fault blocks. These faults, parallel to the folds in the southern part of the Red Mountain area, probably formed during the release of the northwest compressive stress. On Coal Creek fault, the northwest block has been down-faulted probably more than 1,700 feet (shown on cross-section, Fig. 1); the dip of the fault plane ranges from 80SE to 70NW.

It is along the relatively open, northeast-trending tension faults that most of the dike swarms and many of the quartz-gold-silver-fluorite veins were emplaced.

Evidence of strike-slip movement along some N30E faults indicates that some faults of this group are shear faults, probably formed complementary to the N60E group (Fig. 6).
**N45E group** The N45E faults are probably high-angle tension faults closely related to the N30E tensional block faults described above. In the Red Mountain area, Challis rocks have been down-faulted to the southeast against batholith rocks along such high-angle N45E faults.

**N10W and N10E groups** The N10W and N10E groups may be one genetic class of faults; both groups comprise mostly shear faults that probably formed complementary to the N70W group (Fig. 6). Many of the longer linear features shown on Figure 7, such as along portions of Jordan Creek, Yankee Fork, Upper Harden Creek, and Basin Creek, are probably shear faults of the N10W group. Good examples of the N10E group are the shear faults at the Bright Star, Hide Out, and Giant Spar properties.

**Joints**

Joints are found in all rocks of the Stanley area, but are best developed in the granitic rocks. Joints in granitic rocks probably developed in part from cooling stresses and in part from deformational (both shearing and tensional) stresses. At any one locality in granitic rocks at least two systems of joints are present; however, one system is generally dominant. Most joint systems are composed of three subperpendicular joint sets; in many cases two sets of a system dominate over the third set. Distances between fractures in any set range from 1 to 4 feet. Attitudes of joint systems are not constant throughout the area.

Most of the thicker dikes contain a dominant joint system consisting of three sets of cooling fractures. One set is parallel to dike walls; the other two sets are generally perpendicular to dike walls and to each other. In some cases, cooling fractures aid in determining dike attitudes.

**Cleavage fractures**

Cleavage fractures are locally well developed along major fault zones where granitic and Challis rocks have been subjected to high shearing stresses. Dikes within these zones contain very closely spaced cleavage fractures. At the intersection of two or more fault zones, as at the Giant Spar and Homestake claims on Little Casino Creek, several cleavage systems may be present.

**Linear features**

Figure 7 is a map of the more conspicuous, fracture-controlled, linear features determined by stereoscopic study of airphotos. Most of the linear features shown are unusually straight erosional depressions; included are portions of most of the main stream valleys. Field study indicated that most of these linear features follow faults; some, though, follow well-developed joints. Bearings of almost all of the linear features shown agree with the strikes of the seven groups of faults described previously.
Because many of the faults in the area contain metalliferous veins, the linear features, especially at their intersections, should be good targets for exploration. For example, a shaft is now being sunk in a mineralized breccia zone that occurs in the middle of Jordan Creek at the mouth of Red Rock Creek. Both creeks are linear features shown on Figure 7 (the map was drawn prior to the sinking of the shaft).
ECONOMIC GEOLOGY

URANIUM DEPOSITS

General statement

Uranium mined in the Stanley area has come from two types of deposits: one type consists of pitchblende-bearing veins that fill fractures in quartz monzonite-granodiorite of the Idaho batholith; the second type consists of uraninite and coffinite in close association with carbonaceous material in bedded sedimentary rocks that overlie the batholith. alteration uranium minerals accompany both types of deposits.

A third type of uranium deposit consists of the brannerite- and euxenite-bearing placers on Kelley and Stanley Creeks (see placer deposits). These placers have been worked for gold-silver, but radioactive blacks have not been successfully recovered.

Most of the uranium claims are shown in Figure 8. All of the uranium workings shown in Figure 9 were visited during the investigation; however, some of the anomalies shown could not be found during the field investigation because I was not accompanied by the original prospector(s). Five known anomalies occur outside of the map area of Figure 9 but are shown in Figure 1.

Vein deposits

Description

Numerous veins, stringers, and mineralized fractures containing uranium occur in batholithic rock that underlies and flanks bedded uranium deposits. The area of known mineralization in granitic rock--roughly circular--has a diameter of approximately 11 miles.

The uranium-bearing veins are of two general types--veins with substantial amounts of quartz, and veins with little or no quartz. Veins that contain quartz, as at the Alta property, have resisted erosion and are exposed at the surface. Veins that contain little or no quartz are deeply weathered; pitchblende above the water table has been altered to sooty pitchblende and yellow secondary minerals. In general, fractures that contain deeply weathered veins are only moderately radioactive at the surface.

Moderate to intense vein-type mineralization occurs on the Baker, Lightning, Hardee, Alta, Side Hill, Bell Cross, Enterprise, and P and B claims. The first five of these properties lie along a relatively straight line that trends N60W. Possibly, this line of deposits is above the main channel that fed uranium-bearing solutions into the highly fractured granitic rocks; however, only at the Lightning upper pit do uranium
mineralized fractures with a N60W strike predominate. Not only do mineralized fractures and radioactivity anomalies occur at the above properties, but at many other localities in the granitic rocks. Many such occurrences are located within a belt that stretches along Basin Creek from its mouth to the Aspen claims north of Hay Creek (Figs. 8 and 9).

Throughout the granitic rocks, most fractures that contain uranium strike N35-45W, N55-65W, or N30-55E.

**Mineralogy and paragenesis**

Primary minerals that have been identified in the uranium-bearing vein structures, include pitchblende (uraninite), quartz, chalcedony, and minor amounts of pyrite, stibnite, molybdenite, gold, and silver.

Pitchblende occurs as monomineralic stringers and in veinlets with quartz and chalcedony. The monomineralic stringers range in thickness from a fraction of a millimeter to one inch. At Lightning No. 2, the closely spaced stringers form a minable stockwork. In a pitchblende-quartz stringer at Hardee No. 3, pitchblende (Table No. 3) occurs only along the stringer wall whereas pyritiferous quartz fills the stringer center. In this stringer, pyrite-bearing quartz is probably younger than pitchblende. At the Alta property, some chalcedony stringers are highly radioactive; uraninite is probably finely disseminated through the chalcedony.

Stibnite has been observed at the Alta, Hardee, and Lightning properties. Sb-bitite occurs as small blades and miniature rosettes dispersed through grayish-black chalcedony. Much of the stibnite has been replaced by second-generation chalcedony.

Molybdenite has been exposed at the water table in the Lightning No. 2 adits. Tiny blades of molybdenite are disseminated in quartz; and larger blades, grouped in "bundles" up to 1 inch long, are somewhat bent and distorted. Quartz that surrounds molybdenite has inclusions of corroded pyrite and gold. Age relations between molybdenite and gold-pyrite could not be determined.

Pyrite and gold were observed in polished sections of specimens from the Lightning, Hardee, and P and B workings. Pyrite occurs in quartz as brecciated stringers, as partially replaced cubes, and as irregularly shaped blebs. As anhedral grains up to 0.3 mm across, gold generally is in contact with pyrite; some gold is disseminated in quartz. Gold rims pyrite grains and is included in unfractured pyrite.

Silver has not been observed in polished sections; however, an assay of a sample from Hardee No. 3 contained 0.5 oz. of Ag and 0.18 oz. of Au per ton. The silver is intermixed, in part at least, with gold.
Figure 8
Map of some of the Uranium Claims
(Claim locations acquired from best available source; accuracy ranges from excellent to poor)
Mr. Edwin E. Anderson of the AEC has done preliminary work on the identification of secondary uranium minerals in vein deposits from the Stanley area and has compiled the following information (Petrologist: Grand Junction, Colorado; written communication):

1. kasolite has been positively identified on material from the Bell Cross, and a member of the phosphuranylite-renardite series has been tentatively identified;

2. the yellow-orange "gummite" at the Alta probably consists mostly of beta-uranophane, clarkeite, schaepite, and vandendrieschite;

3. one of the yellow secondary minerals at the Hardee No. 3 has been tentatively identified as uranophane;

4. in addition to the above minerals, several others are probably present in the area, including at least one new mineral (as yet undescribed).

Complete paragenesis of the minerals could not be determined from the specimens available. Pitchblende probably was deposited prior to the invasion of sulfide-bearing quartz: pitchblende stringers do not contain relics of sulfides or gold whereas quartz does. Pyrite and gold-silver were deposited essentially simultaneously. Stibnite and molybdenite probably followed pyrite and gold-silver.

**Bedded deposits**

**Description**

Bedded sedimentary rocks that contain uranium deposits occur only at the base of the Challis Volcanics. In the area of uranium mineralization, Challis rock units generally strike northwest and dip northeast. The line of outcrop of mineralized basal beds forms a northwest-trending belt, 6.1 miles long, that extends from Lightning No. 3 to the Mandate claims (Figs. 8 and 9). Along the outcrop line, the poorly cemented, easily eroded, sedimentary rocks are mostly covered by talus derived from overlying Challis tuffs and flows; natural outcrops of mineralized beds are rare.

The belt of mineralized sedimentary rocks is within the area in which quartz monzonite-granodiorite is cut by numerous pitchblende-bearing veins and stringers. However, uranium veins have not been found cutting mineralized bedded deposits.

Study of bedded deposits exposed by mining or penetrated by drilling, indicates that uranium is restricted to carbonaceous beds that were deposited in streams, flood plains, ponds, small lakes, or swamps. Some of the deposits, like Lightning
No. 3 and Coal Creek No. 1, occupy buried stream channels that trend northwest. The streams that carved these channels followed pre-existing faults or fault zones in the quartz monzonite country rock. Recurring movement along these fault zones has faulted the "shoe string" channel-fill deposits parallel to their longitudinal axes. The buried stream channels generally parallel the present course of Basin Creek.

Sedimentary rocks that contain uranium deposits are generally interbedded claystones, siltstones, and arkosic sandstones. The basal few inches of several deposits are composed of a pebble conglomerate; at Coal Creek No. 1 the entire channel fill is a conglomerate. Carbonaceous material in the sedimentary rocks consists of fine-grained "trash" that fills voids and pores; scattered, vitrified, wood fragments; thin, concordant, vitrain seams in mudstone beds; and intercalated beds and lenses of lignite, subbituminous coal, and vitrain.

Uranium is intimately associated with carbon. Most ores are dark gray mudstones or arkosic sandstones in which uranium is disseminated in the carbon-rich matrix. The richest ore consists of vitrified, fossilized wood fragments and branches. Hand specimens of mineralized vitrain contain up to 15.0 percent U₃O₈.

At most properties, mineralization occurs in carbonaceous beds at several horizons. Although the thickest and highest grade ore bed is generally the bed just above the quartz monzonite-granodiorite contact, mineralized horizons occur up to 40 feet above the contact. Uranium in most beds is erratically distributed horizontally and vertically.

Mineralogy and paragenesis

X-ray and mineralogical studies were performed on polished sections or polished thin sections of ore specimens from each of the bedded deposits.

The specimens contain uraninite, coffinite, pyrite, and marcassite. All four minerals are closely associated with carbonaceous matter. From X-ray powder-diffraction photographs, uraninite and coffinite were identified in vitrain containing over 2 percent U₃O₈. The limited X-ray work indicated that uraninite is more abundant in vitrain than is coffinite. The black uranium mineral(s) associated with the carbonaceous "trash" do not occur in sufficient concentrations to allow X-ray identification; however, the uranium mineral(s) is probably either uraninite or coffinite or both. Pyrite, mostly framboidal, was observed only in vitrains; marcassite was observed only with carbonaceous "trash" between detrital sand grains.

Uraninite was positively identified by X-ray in several specimens of vitrain from the Shorty and East Basin pits (Table 3). The specimens contain from 2 to 13 percent U₃O₈. In these specimens most uraninite is submicroscopic. Several polished sections of vitrain contain fine web-like networks of a mineral that was tentatively identified as uraninite. In most of the specimens uraninite is accompanied by framboidal pyrite.
Table 3. X-ray powder-spacing data for Stanley uraninite (vein and bedded) and coffinite

<table>
<thead>
<tr>
<th>Uraninite&lt;sup&gt;1&lt;/sup&gt; AEC</th>
<th>Uraninite&lt;sup&gt;2&lt;/sup&gt; Hardee #3</th>
<th>Uraninite&lt;sup&gt;3&lt;/sup&gt; East Basin #1</th>
<th>Coffinite&lt;sup&gt;4&lt;/sup&gt; Mesa Co Colo</th>
<th>Coffinite&lt;sup&gt;5&lt;/sup&gt; Shorty #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>d A</td>
<td>L/I&lt;sub&gt;0&lt;/sub&gt;</td>
<td>d A</td>
<td>L/I&lt;sub&gt;0&lt;/sub&gt;</td>
<td>d A</td>
</tr>
<tr>
<td>3.157</td>
<td>100</td>
<td>3.206</td>
<td>100</td>
<td>3.133</td>
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<tr>
<td>2.735</td>
<td>48</td>
<td>2.735</td>
<td>50</td>
<td>2.735</td>
</tr>
<tr>
<td>1.934</td>
<td>49</td>
<td>1.928</td>
<td>50</td>
<td>1.919</td>
</tr>
<tr>
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<td>50</td>
<td>1.639</td>
</tr>
<tr>
<td>1.579</td>
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<tr>
<td>1.368</td>
<td>9</td>
<td></td>
<td>1.344</td>
<td>50</td>
</tr>
<tr>
<td>1.355</td>
<td>18</td>
<td>1.245</td>
<td>20</td>
<td>1.245</td>
</tr>
<tr>
<td>1.223</td>
<td>15</td>
<td></td>
<td>1.206</td>
<td>20</td>
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<td>1.163</td>
<td>13</td>
<td>1.112</td>
<td>10</td>
<td>1.106</td>
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<tr>
<td>1.0523</td>
<td>15</td>
<td>1.052</td>
<td>10</td>
<td>1.037</td>
</tr>
<tr>
<td>0.9666</td>
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<td></td>
<td></td>
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<tr>
<td>0.9243</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9114</td>
<td>8</td>
<td>0.911</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>0.8646</td>
<td></td>
<td>0.858</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Standard, ASTM card No. S-0550, Cu radiation, Ni filter
2 Vein deposit (pitchblende), Mo radiation, Zr filter
3 Bedded deposit (in vitrain), Mo radiation, Zr filter
4 Standard (Froendel, 1958, p. 288) Cu radiation, Ni filter
5 Bedded deposit (in vitrain), Cu radiation, Ni filter
6 Symbols: s, strong; m, medium; w, weak; f, faint
Coffinite was identified in a small, vitrainized, fossil branch from the Shorty pit (Table 3). The fossil branch contains over 10 percent U₃O₈. In polished section, the coffinite is submicroscopic even under magnifications up to 2,000 x. X-ray analyses of different portions of the branch indicate that coffinite may be concentrated at "hot spots" throughout the branch. Uraninite, pyrite, or marcasite do not occur in the specimen, and vein structures are not present.

Pyrite occurs in vitrain seams mainly as pyritized microfossils similar to those described by Love from the Pumphisteron Oil Shale of Scotland (1957, p. 429-440). Most of the pyritized microfossils are spherical and are probably *Pyritiosphaera barbaria* Love (Love, 1957, p. 433). Measured diameters of spheres ranged from 4 to 18 microns. Each sphere is composed of an aggregate of euhedral crystals that average 0.7 microns across (Fig. 10). The pyrite spheres are concentrated in thin lenses concordant with bedding (Fig. 11). Where closely packed, the spheres are partially coalesced.

A few pyrite masses are polygonal and may represent a different microfossil. In section these masses are roughly pentagonal and composed of euhedral crystals approximately 4 microns across (Fig. 10).

Love (1957, p. 429-440) shows that pyrite which coats such micro-organisms is genetically related to the micro-organisms.

Pyrite not in direct association with micro-organisms, occurs as minute crystals scattered throughout vitrain seams. Pyrite also replaces cells and fills fine fractures in vitrainized wood (Fig. 12).

Marcasite occurs in rocks that range from carbon-poor, coarse-grained arkosic sandstone to carbon-rich, fine-grained mudstone. Marcasite fills voids and replaces, in order of succession:

1. interstitial carbonaceous trash (Fig. 13);
2. matrix minerals including chlorite, sericite, muscovite, biotite, and clay minerals (Fig. 14);
3. detrital feldspar grains;
4. the margins of detrital quartz grains.

Marcasite occurs as subhedral crystals up to 0.01 mm wide and as irregular massive replacements in which anhedral grains average 0.2 mm wide.
Figure 14  Subhedral marcasite (black) replacing clay minerals and fibrous tuffaceous material (gray) which cement quartz and feldspar grains (white); arkosic sandstone, East Basin No. 1 pit (thin section, plane light, x 100).

Figure 15  Jack-leg drilling of uranium ore in highly fractured sedimentary rocks, Shorty pit.

Figure 18  Contact of weathered quartz-monzonite and overlying cobble-conglomerate channel fill, Coal Creek No. 1 pit (cobbles are about 6 inches in diameter).
Figure 12  Pyrite (white) filling pores and fractures in vitrainized wood, East Basin No. 2 (polished section, green filter, x 60).

Figure 13  Marcasite (white) replacing carbonaceous matter (black) which fills voids between quartz grains (gray), arkosic sandstone, East Basin No. 1 (polished thin section, reflected light, x 55).
Figure 10 Pyritized microfossils in vitrinite. Each sphere is an individual microfossil. East Basin No. 1 (polished thin section, reflected light, oil immersion, green filter, x 1400).

Figure 11 Pyrite(p) "lenses" along bedding (inclined in photograph) in vitrinite (polished thin section, reflected light, green filter, x 60). Figure 10 is a 23.4x blow-up of a portion of the massive-appearing pyrite in the lower-left corner of Figure 11 (at x).
Vitrain is jet black and has a conchoidal fracture. Both eu-vitrain and pro-
vitrain can be found in most of the bedded deposits. The two subvarieties of eu-
vitrain—collain and ulmain—and the three subvarieties of pro-vitrain—periblain,
suberain, and xylain—were observed in polished sections. Most of the vitrain is
the subvariety, collain, which is formed by precipitation of ulmins from solution.
In polished section, collain is seen as lenses and irregular masses. Collain re-
places carbonaceous trash and matrix minerals, and engulfs detrital quartz grains.
In collain are found most, if not all, of the pyritized micro-fossils. Collain was
almost certainly formed during or shortly after deposition of the sediments. Black
uranium minerals occur in all varieties of vitrain.

Calcite is not abundant in the deposits but does occur in places. Where
present, calcite replaces detrital grains of plagioclase and potassium feldspars.

Most of the secondary uranium minerals found in the bedded deposits are
yellow-green in color and have been collectively called "autinite" by geologists
and miners working in the area. "Autinite" from East Basin No. 1 has been positively
identified as meta-autinite by X-ray (Edwin E. Anderson, AEC, written communica-
tion). Probably all of the "autinite" exposed in the pits has dehydrated to meta-
autinite (Frondel, 1958, p. 206).

Results of semiquantitative spectrographic analyses

Copies of semiquantitative spectrographic analyses of 34 samples of Stanley
uranium ores contracted for by the AEC were kindly sent me by Edwin E. Anderson
(Grand Junction, Colorado). Twenty of the samples were from bedded deposits and four-
teen were from veins in granitic rocks.

In the analyses, those elements whose amounts were significantly different
in the two types of deposits are As, Ba, Ce, Fe, Hg, Mn, Mo, P, Pb, Sb, Ti, Zn,
and Zr. The highest percentages obtained for each element in the two types of de-
posits are shown in Table 4.
Table 4
Differences in element content between bedded and vein uranium deposits, semiquantitative spectrographic analyses

<table>
<thead>
<tr>
<th>Element</th>
<th>Bedded deposits</th>
<th>Vein deposits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest % (20 samples)</td>
<td>Highest % (14 samples)</td>
</tr>
<tr>
<td>As</td>
<td>7.2</td>
<td>0.152</td>
</tr>
<tr>
<td>Ba</td>
<td>0.53</td>
<td>1.52</td>
</tr>
<tr>
<td>Ge</td>
<td>0.032</td>
<td>0.141</td>
</tr>
<tr>
<td>Fe</td>
<td>25.1</td>
<td>5.81</td>
</tr>
<tr>
<td>Hg</td>
<td>0</td>
<td>0.191</td>
</tr>
<tr>
<td>Mn</td>
<td>0.053</td>
<td>1.41</td>
</tr>
<tr>
<td>Mo</td>
<td>0.021</td>
<td>0.131</td>
</tr>
<tr>
<td>P</td>
<td>3.31</td>
<td>0</td>
</tr>
<tr>
<td>Pb</td>
<td>0.053</td>
<td>0.231</td>
</tr>
<tr>
<td>Sb</td>
<td>0</td>
<td>0.571</td>
</tr>
<tr>
<td>Ti</td>
<td>5.03</td>
<td>0.643</td>
</tr>
<tr>
<td>Zn</td>
<td>0.053</td>
<td>2.81</td>
</tr>
<tr>
<td>Zr</td>
<td>0.211</td>
<td>0.041</td>
</tr>
</tbody>
</table>

1. reported value
2. nearest figure: range-percentage series: 7, 3, 1.5, 0.7, 0.3, etc.
3. median figure: range-percentage series: 10-1, 1-0.1, 0.1-0.01, etc.

Sixteen of the 20 samples from bedded deposits contain arsenic. Four samples containing high to very high amounts of arsenic—from the East Basin and Shorty pits—also contain very high amounts of uranium. As-U values for these four samples are: % As = 1.5, 7.0, 3.0, and 1.0; %U_{3O_8} = 1.46, 5.60, 2.60 and 12.57 respectively. All four samples are rich in vitrain or other carbonaceous matter. In only one of the 14 vein samples is As present (0.15 percent).
Samples from vein deposits are high in elements commonly found in veins—Zn, Ba, Mn, Sb, Pb, Mo, and Hg. These elements are low or absent in samples from bedded deposits. Fe, though relatively high in vein-deposit samples, is even higher in bedded-deposit samples. Mineralogic studies indicate that Fe in bedded deposits occurs almost entirely as pyrite and marcasite and is almost certainly diagenetic.

One sample from the sedimentary deposits contains 3.3 percent P; P in such concentration generally occurs under subaqueous, anoxic conditions—generally marine—where P is closely associated with organic matter and high Fe. High Ti and Zr, in samples from bedded deposits, are probably in detrital ilmenite and zircon in the arkosic sandstone. Rare-earth Ce in the vein deposits may be in isomorphic series with U in an unidentified vein mineral.

Semiquantitative spectrographic as well as chemical analyses indicate that Cu and V are present only in trace to minor amounts in both types of deposits.

Origin

Kern (1959, p. 15-19) suggested that vein and bedded uranium deposits are of the same age and origin. Kern postulated that uranium-bearing solutions rose along fractures in granitic rocks and spread out horizontally in overlying sedimentary rocks to form bedded deposits.

Evidence collected during my longer study indicates that the deposits are of different ages and origins and that they formed by the following sequence of events.

1) Numerous pitchblende veins and stringers were deposited by hydrothermal solutions rising along fractures in the batholith.

2) The batholith was partly eroded and a drainage system developed along which abundant carbonaceous material accumulated.

3) Vein-bearing batholithic rock continued to erode and weathered deeply. Uranium in the veins was taken into solution by ground and surface water. Uranium-bearing meteoric waters, derived from the entire drainage basin, funneled through the main drainage channels.

4) Uranium was deposited under reducing conditions in the numerous, carbonaceous "filter traps" located along the stream channels.
5) The deposits were buried by Challis pyroclastics and flows.

6) The deposits were fractured by post-Challis deformation.

The following evidence supports the sequence of events outlined above:

1) The mineralogy of the two types of deposits is different. Vein deposits contain quartz, chalcedony, uraninite, pyrite, stibnite, molybdenite, sphalerite, and cinnabar(?). Bedded deposits contain uraninite, coffinite, pyrite, and marcasite but do not contain vein quartz or chalcedony. Semiquantitative spectrographic analyses indicate that a) the highest concentrations of Zn, Ba, Mn, Sb, Pb, Ce, Mo, and Hg occur in batholith vein structures containing U; and b) very high concentrations of As, Fe, and P occur in bedded deposits with carbonaceous material in association with U.

2) Numerous, nearly vertical, uranium-bearing veins have been discovered in the quartz monzonite-granodiorite that surrounds the belt of mineralized sedimentary rock; however, megascopically or microscopically, hydrothermal, vein structures are not present in mineralized beds.

3) At only one property has a uranium vein been reported to occur in granitic rock beneath a bedded deposit (unconfirmed).

4) Uranium does not occur in any of the numerous quartz veins and stringers that cut Challis rocks just northeast of the bedded uranium deposits.

5) Uranium deposits in sedimentary rocks are concordant with bedding.

6) Uraninite in vnotain is intimately associated with pyrite microfossils.

7) Uraninite and coffinite are disseminated through unfractured and unveined vnotain. Uranium mineralization almost certainly occurred shortly after deposition of the wood fragments and prior to or during vnotainization.

Laboratory evidence supporting a ground-water origin theory for sandstone-type uranium deposits, has been accumulated by numerous workers in recent years. Gruner has shown that uranium can be precipitated by cold solutions under strongly reducing conditions and has suggested that uranium in sediments has been concentrated by multiple migration—accrretion (1956). $^{32}S/^{34}S$ ratio determinations in-
dicate that iron sulfides accompanying uranium minerals in bedded deposits were precipitated by H₂S formed by bacteriological action (Jensen, 1955, p. 598-616; Miller, 1959, p. 87A). Pb 207/U 235-ratio determinations on Colorado Plateau ores show that at least part of the black uranium minerals are of the same age as their enclosing, sedimentary, host rocks (Donald Miller, oral communication).

Samples from bedded and vein deposits of the Stanley area were sent to the Special Projects Branch of the AEC at Grand Junction, Colorado, for S-isotope determinations. Results of the analyses, performed by Professor M. L. Jensen of Yale University, are given in Table 5. These data, as yet, have not been related to possible differences in genesis of the deposits.

**TABLE 5**

Results of S-isotope analyses of Stanley ores

<table>
<thead>
<tr>
<th>Property</th>
<th>Known sulfide minerals</th>
<th>Sample Lab. No.</th>
<th>S²⁸/S³⁴</th>
<th>S³⁴%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedded deposits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer Strike-Elk</td>
<td>Marcasite (no pyrite)</td>
<td>P D 3352</td>
<td>22.12²</td>
<td>+4.2</td>
</tr>
<tr>
<td>East Basin No. 1</td>
<td>Marcasite (no pyrite)</td>
<td>P D 3361</td>
<td>22.08⁰</td>
<td>+5.5</td>
</tr>
<tr>
<td>East Basin No. 1</td>
<td>Marcasite (no pyrite)</td>
<td>P D 3362</td>
<td>21.00⁰</td>
<td>+18.8</td>
</tr>
<tr>
<td>Coal Creek No. 1</td>
<td>Marcasite</td>
<td>P D 3359</td>
<td>22.08⁰</td>
<td>+5.9</td>
</tr>
<tr>
<td>East Basin No: 1</td>
<td>Marcasite, pyrite</td>
<td>P D 3360</td>
<td>22.25³</td>
<td>-1.9</td>
</tr>
<tr>
<td>Shorty No. 2</td>
<td>Pyrite (no marcasite)</td>
<td>P D 3355</td>
<td>21.71⁹</td>
<td>+22.5</td>
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<tr>
<td>Vein deposits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lightning No. 2</td>
<td>Molybdenite, some pyrite</td>
<td>P D 3356</td>
<td>21.75²</td>
<td>+21.0</td>
</tr>
<tr>
<td>Lightning No. 1</td>
<td>Pyrite</td>
<td>P D 3358</td>
<td>22.01³</td>
<td>+9.4</td>
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<tr>
<td>P and B</td>
<td>Pyrite</td>
<td>P D 3354</td>
<td>22.06⁵</td>
<td>+5.7</td>
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<tr>
<td>Alta</td>
<td>Stibnite</td>
<td>P D 2956</td>
<td>22.51</td>
<td>-13.4</td>
</tr>
<tr>
<td>Silver Dollar</td>
<td>Stibnite</td>
<td>P D 3373</td>
<td>22.07⁰</td>
<td>+6.3</td>
</tr>
</tbody>
</table>
A total of 7,767 tons of ore with an average grade of 0.18 percent U₃O₈ had been shipped by the end of the mining season of 1960. Of the total, 90 percent came from bedded deposits and 10 percent came from vein deposits; average grade of each type of deposit was also 0.18 percent. Production for each property is shown in Table 6.

**TABLE 6**

Uranium production, Stanley area, Custer County, Idaho*

<table>
<thead>
<tr>
<th>Property</th>
<th>Company</th>
<th>Year</th>
<th>Production (tons)</th>
<th>Grade (% U₃O₈)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Strike-Elk</td>
<td>Phillips Pet.</td>
<td>1960</td>
<td>1,895</td>
<td>0.23</td>
</tr>
<tr>
<td>Coal Creek No. 1</td>
<td>&quot;</td>
<td>&quot;</td>
<td>1,360</td>
<td>0.14</td>
</tr>
<tr>
<td>Coal Creek No. 4</td>
<td>&quot;</td>
<td>1958-59</td>
<td>450</td>
<td>0.25</td>
</tr>
<tr>
<td>East Basin No. 1</td>
<td>Western Fluorite</td>
<td>1958</td>
<td>1,100</td>
<td>0.20</td>
</tr>
<tr>
<td>&quot;</td>
<td>Vitro - Idaho</td>
<td>1959</td>
<td>773</td>
<td>0.18</td>
</tr>
<tr>
<td>Shorty No. 2</td>
<td>Sidney Mining</td>
<td>1959</td>
<td>1,400</td>
<td>0.146</td>
</tr>
<tr>
<td>Bedded deposits, total</td>
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<td></td>
<td>6,978 @</td>
<td>0.18</td>
</tr>
<tr>
<td>Lightning No. 2</td>
<td>Vitro - Idaho</td>
<td>1959</td>
<td>271</td>
<td>0.15</td>
</tr>
<tr>
<td>&quot;</td>
<td>Mr. Henry Childs</td>
<td>1960</td>
<td>420</td>
<td>0.18</td>
</tr>
<tr>
<td>Lightning Upper Pit</td>
<td>Western Fluorite</td>
<td>1958</td>
<td>48</td>
<td>0.28</td>
</tr>
<tr>
<td>Hardee No. 3</td>
<td>Phillips Pet.</td>
<td>1959</td>
<td>50</td>
<td>0.17</td>
</tr>
<tr>
<td>Vein deposits, total</td>
<td></td>
<td></td>
<td>789 @</td>
<td>0.18</td>
</tr>
<tr>
<td>Combined bedded and vein</td>
<td></td>
<td></td>
<td>7,767 @</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*All values by written communications from the mining companies.

All companies that have mined uranium in the area to date have done so at a loss. This economic picture should be expected for a new mining district in rugged country far from a mill. Exploration and road construction expenses have been high compared to the amount of ore produced. It should be noted, even so, that actual mining expenses at the Deer Strike-Elk and Coal Creek properties were less than ore payments.

The future for uranium mining in the Stanley area is uncertain. All deposits discovered to date are small; ore mined as well as known reserves for the largest deposit, the Deer Strike-Elk property, total less than 7,000 tons. If large economic deposits are found, they will probably be of the sedimentary type. Such deposits probably exist.
beneath the thick cover of Challis Volcanics. Discovery of deposits beneath Challis Volcanics will have to be done by deep drilling or by underground drift. The most promising exploration targets are possible linear extensions, beneath Challis rocks, of known ore bodies at the East Basin, Uranus, Shorty, and similar properties.

Most of the uranium-bearing veins and stringers are too thin and too far apart to be mined. The Lightning and Baker claims are the most promising of the vein-type deposits. Very possibly the shaft being sunk on the ore shoot at Lightning No. 2 may intercept a larger unaltered ore body below the water table.

In summary, the known ore bodies are small and can be mined only at great financial risk. Because discovery and mining of new deposits will be very expensive, extensive exploration under present market conditions cannot be encouraged.

**Exploration, mining, and ore upgrading**

**Exploration**

*Geochemical and geobotanical prospecting* It should be possible to use geochemical and geobotanical techniques to discover new uranium deposits in the Stanley and adjacent areas. In most cases, geochemical prospecting would be more practical than would geobotanical. Numerous perennial streams drain the well-dissected Stanley area. Waters in these streams already contain anomalously high amounts of uranium in solution. Only systematic sampling and testing of the stream waters would be necessary to find many of the source areas of the uranium. Stream-water sampling can be supplemented by soil sampling and the use of a radioactivity counter to find local areas containing anomalously high amounts of uranium along the ridge slopes. Charles Illesley of the AEC performed a reconnaissance survey of the uranium content in Stanley area streams during the summer of 1960; however, the results of this work are not yet available.

Geobotanical techniques were successfully used by Don Laub of Phillips Petroleum Company in prospecting on Potato Mountain (oral communication). Laub collected several hundred samples of twigs and leaves from trees and shrubs. The samples were burned and the ashes were tested chemically for uranium.

In a few cases, the anomalous presence of certain types of vegetation may indicate the presence of uranium. In granitic rocks, uranium occurs along fault zones. These zones are good conduits for water seepage and promote luxuriant vegetation. At the Alta discovery, aspens grow on the slope below the main uranium-bearing fault; the tree line even V's with the fault where the fault crosses a shallow gulch. Aspen groves grow above most of the deposits of the sedimentary type. Probably the semi-consolidated sedimentary rocks contain more water than most of the fractured granitic rocks. At the Deer Strike-Elk claims, a double row of tall spruce trees grows along a spring line directly above the uranium deposit.
Use of bulldozers  In the granitic rocks, where most of the uranium near the surface has been leached from mineralized fractures, the radioactivity is generally low. In many cases where talus covers much of the outcrop line of mineralized sedimentary rocks, anomalous radioactivity cannot be detected through the overburden. A bulldozer used in conjunction with a radioactivity detector is an effective prospecting tool for uncovering uranium bodies in both types of deposits.

Many previously unsuspected zones of anomalous radioactivity were uncovered during construction of the mining roads.

Radiometric assaying  The most serious problem in the exploration and mining of uranium deposits in the Stanley area was accurate evaluation of uranium content in rock exposed in drill holes or excavations. In general, attempts at radiometric assaying, even by companies experienced in uranium exploration, were unsuccessful. The size of almost all the deposits was overestimated by a factor of 2 to 4, and the grade by a factor of 2 to 10. Inaccurate evaluations by radiometric assaying cannot be blamed on the geologists who performed them. The unreliability and poor performance of available radioactivity-measuring instruments used in the field was partly responsible. The main reason for the inaccurate evaluations, however, was that neither analyses of conditions affecting radioactivity of uranium-bearing rocks nor a logical process of evaluating radiometric assaying records was available.

The Product Evaluation Division of the Atomic Energy Commission at Grand Junction, Colorado, is developing more accurate radioactivity-measuring instruments and has solved most of the problems of accurately evaluating a deposit’s uranium content from radioactivity logs. Recent equipment developed by the AEC includes:

1. the face scanner that permits accurate evaluation of ore exposed in a pit or underground by "balancing-out" mass effects and background radioactivity;

2. accurate drill-hole probing instruments;

3. manufactured "drill holes" the walls of which contain known amounts of uranium, for calibration of probing instruments (these holes can be used by the general public for calibration of privately owned equipment).

The AEC technique of evaluating uranium content in a deposit is explained in detail in two recent AEC releases: "Qualitative Interpretation of Gamma-Ray Logs" (RME-136) and "Gamma-Only Assaying for Disequilibrium Correction" (RME-135) by J. Scott, P. Dodd, and others.

A summary of the more important phenomena affecting radioactivity measurements is here included because it may help explain the difficulties encountered in mining Stanley
uranium deposits from 1958 through 1961. The following statements are based on field observations and discussions with Phil Dodd and Jim Scott of the AEC.

1. Radiometric-assaying instruments do not measure the amount of uranium directly, but measure the radioactivity of certain daughter products. Radiometric field instruments measure gamma rays. Most gamma rays are emitted by Pb$^{214}$ and Bi$^{214}$ which are two of the short, half-life isotopes that follow Rn$^{222}$ (radon) in the uranium decay series. Radon is a gas whose isotope Rn$^{222}$ has a short half-life of 3.825 days. If radon can escape from a deposit, the only two important gamma-emitting isotopes will rapidly become deficient and radiometric readings will be low. If uranium ore in disequilibrium can be sealed and loss of radon gas prevented, conditions approaching equilibrium will be reached in 20 days.

   Escape of radon gas, with the consequent reduction of Pb$^{214}$ and Bi$^{214}$, caused the marked decrease in radioactivity in ore broken during mining operations at the Shorty and other pits in the Stanley area. Evaporation of water contained in broken ore aided radon gas escape.

2. Radiometric-probing instruments normally receive 95% of monitored gamma rays from a sphere of influence 4.0 - 4.5 feet in diameter. For accurate quantitative radiometric assaying, probing instruments should be calibrated with standards having diameters of 4.5 - 5.0 feet. Babbet-type probes used in the Stanley area were generally calibrated with small cylindrically-shaped standards mounted on the holding reels; diameter of the standards was approximately 3 inches. Estimates of ore grade by this technique were too high by factors as great as 10. Figure 17 compares chemical assays with ore-grade estimates from logging records from the Lightning No. 3.

   The largest calibration standard used in the Stanley area consisted of a 55-gallon drum containing a homogeneous mixture of chemically assayed ore; diameter of a 55-gallon drum is only 2.8 feet.

3. Radioactivity-probe readings cannot be used as direct measures of uranium contained in a rock. In Figure 16, the amount of radioactivity of uniformly mineralized bed x is represented by curve y. Maximum radioactivity occurs at the center of the bed; inflection points m and n occur at the boundaries of the mineralized bed. The area within curve y is directly proportional to the amount of uranium in bed x (assuming equilibrium conditions) and can be used as a quantitative measure for the determination of amount and grade of ore. However, the radiometric reading at any point cannot be used as a direct measure of the amount of uranium at that point.

   A common practice in the Stanley area was to calibrate a radiometric probe instrument with a standard of small mass and then, if radiometric readings exceeded 0.15 percent U$_3$O$_8$, to record all sections of a drill hole as containing ore-grade mineralization.
Twenty-seven samples of Stanley ores were analyzed for radiometric equilibrium by personnel of the AEC. Radiometric analyses were made by the Gamma-Only method; Results are shown in Table 7. The ratios of $\%_{\text{ch}} \text{U}_3\text{O}_8$ to $\%_{\epsilon} \text{U}_3\text{O}_8^*$ ranged from 0.50 to 2.00 and averaged 1.11 for the bedded deposits. The extreme values were obtained on proteres entirely of secondary origin at the margin of the bedded deposits. For vein deposits, the ratios ranged from 0.80 to 1.25 and averaged 0.97. The average for all 27 samples was 1.05.

**TABLE 7**

Radiometric equilibrium values for 27 samples of Stanley uranium ores

<table>
<thead>
<tr>
<th>Property</th>
<th>$%_{\text{ch}} \text{U}_3\text{O}<em>8$/$%</em>{\epsilon} \text{U}_3\text{O}_8$</th>
<th>(Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Creek No. 1</td>
<td>0.69, 1.03, 1.03, 1.30</td>
<td>1.01</td>
</tr>
<tr>
<td>East Basin No. 1</td>
<td>0.50, 0.58, 0.90, 1.00</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>1.00, 1.14, 1.25, 2.00</td>
<td></td>
</tr>
<tr>
<td>Shorty No. 2</td>
<td>1.06, 1.16, 1.25, 1.83</td>
<td>1.32</td>
</tr>
<tr>
<td>(16 samples)</td>
<td></td>
<td>1.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Property</th>
<th>$%_{\text{ch}} \text{U}_3\text{O}<em>8$/$%</em>{\epsilon} \text{U}_3\text{O}_8$</th>
<th>(Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Hill</td>
<td>0.81, 1.18</td>
<td>1.00</td>
</tr>
<tr>
<td>Lightning No. 1</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td>Lightning No. 2</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>Hardee No. 3</td>
<td>0.63, 0.95</td>
<td>0.79</td>
</tr>
<tr>
<td>Baker</td>
<td>0.80, 1.19</td>
<td>1.00</td>
</tr>
<tr>
<td>Bell Cross</td>
<td>0.95, 1.10</td>
<td>1.03</td>
</tr>
<tr>
<td>Enterprise</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>(11 samples)</td>
<td></td>
<td>0.97</td>
</tr>
<tr>
<td>(all 27 samples)</td>
<td></td>
<td>1.05</td>
</tr>
</tbody>
</table>

* $\%_{\text{ch}} \text{U}_3\text{O}_8$ = percent $\text{U}_3\text{O}_8$ by chemical assay

$\%_{\epsilon} \text{U}_3\text{O}_8$ = percent equivalent $\text{U}_3\text{O}_8$ by radiometric assay.
Figure 17  Graphs showing comparisons between chemical and radiometric analyses, Lightning No. 3 drill holes.
Mining techniques, problems, hazards, and costs

Seasonal limitations The severe winters of the Stanley area cause most uranium-mining operations to close down between the middle of November and the first of April. Most uranium operations are on mountain slopes at elevations near 7,000 feet. Thick snow covers most of the country, and mining roads are difficult to keep open. The temperature occasionally reaches 50 degrees below zero and has been known to reach 60 degrees below zero.

Mining roads Most mining roads have been bulldozed in weathered quartz monzonite. Blasting generally was not necessary. West of Basin Creek most of the mountains have slopes between 20 and 25 degrees; east of Basin Creek, the Challis-capped ridges have slopes between 25 and 35 degrees. Ore-haulage roads on the steeper slopes are expensive to build and maintain. Slump debris and downed timber must be cleared each spring. Construction costs of 7 miles of road serving the Coal Creek, Deerstrike-Elk, and Hardee claims were $13,000.

Drilling Most surface, exploration drilling was of the rotary, churn-drill type. Most drill holes were between 50 and 150 feet deep. A few diamond-drill holes were sunk to collect cores for checking radioactivity-probing records obtained from churn-drill holes.

Many of the deposits are several hundred feet above available water and most holes were drilled dry with compressed air. At several properties, drill bits were ruined when churn drills stuck in wet seams. Diamond-drill bits were ruined in dry drilling if compressed air was lost even momentarily: loose, angular quartz grains would cut matrix cement from around the diamonds.

At Lightning No. 3, holes were drilled wet by using water raised several hundred feet from Hay Creek. Loss of water was frequent because of failures in the plastic tubing used in the upper portion of the pipe system.

Cost of churn drilling ranged from $0.55 per foot in gently dipping, moderately faulted sedimentary rocks to $1.50 per foot in steeply dipping and highly faulted sedimentary rocks. Diamond-drilling costs ranged from three to five times the cost of churn drilling.

Open-pit mining Open-pit mining of Stanley uranium ores has been only partially successful. In most cases, deposits are located on hillsides with steep slopes. Most of the sedimentary-type deposits occur in beds that dip into hillsides. In this type of deposit, the width of the open pit in the down-dip direction is generally limited from 150 to 200 feet. Serious dilution of ore has occurred in most open-pit mining operations. The two largest open pits are on the Shorty No. 2 and East Basin No. 1 claims.
(Shorty No. 2) Shorty No. 2, atop a ridge, is one of the few deposits located on relatively flat ground. The uranium is in highly-fractured, poorly consolidated, sedimentary rock. A D-8 cat and can, assisted by a D-6 cat equipped with a ripper tooth, was used for stripping all waste rock. Blasting was not necessary. Maximum depth of the pit is 40 feet (Fig. 35). A total of 24,000 cubic yards of waste rock was removed at a cost of $0.57 per yard. Selective blasting was used, however, for mining the highly-fractured ore (Fig. 15).

(East Basin No. 1) East Basin No. 1 is located on the side of a hill. At the pit, hill slope is 20 degrees and sedimentary rocks dip gently into the hill. All poorly-consolidated, sedimentary rock overlying cap rock was stripped by bulldozer without blasting. Stripping operations in the portion of the pit mined by Vitro-Idaho required approximately 500 hours of bulldozer time (D-8 Caterpillar). Large, radial, tension fractures developed in sedimentary rocks around the periphery of the pit, and limited the extent of open-pit operations (Fig. 31).

The 7 feet of hard, massive cap rock above the ore were drilled, blasted, and stripped as two separate layers; the upper layer was 4 feet thick and the lower layer was 3 feet thick. Drill holes were spaced 2 1/2 feet apart. Using the same spacing, the 3 1/2-foot ore bed was drilled, loaded with light charges, and blasted (Fig. 18). The light charges did not scatter ore out of the pit, but did break much of the ore into large blocks, from 2 to 3 feet across. All ore in pieces larger than 12 inches across had to be broken with concrete air hammers or by hand sledge to meet mill specifications.

Extreme variations of grade in the ore bed, both laterally and vertically, required that ore be sorted under careful supervision. Ore was separated into piles of three different grades by use of a Geiger counter and a front-end loader.

Underground mining Most Stanley uranium deposits that extend into hillsides more than 100 feet, should be mined by underground techniques. In general, underground mining here is difficult and dangerous. Most vein deposits are located along steeply dipping fault zones. Pitchblende, which is sporadically distributed along the fault zones, requires highly selective mining. Danger of large blocks falling from fractured hanging walls, such as in the Lightning No. 2 drift (Fig. 21), is high.

Many deposits in sedimentary rocks are difficult to mine, even underground because 1) uranium is unevenly distributed in mineralized beds and 2) mineralized beds in many deposits have been displaced and badly fractured by faults.

At the Deerstrike-Elk mine, flat-lying beds have been displaced by several sets of high-angle faults and by bedding-plane faults (Fig. 27). This faulting has made ore beds difficult to follow and dangerous to mine. Most faults are lined with wet gouge, and large blocks fall from fractured stope-backs without any warning from splitting or creaking. One seemingly secure, 15-ton block of ore was drilled for blasting.
Figure 19  Drilling gently dipping ore bed and collecting broken ore with a front-end loader, East Basin No. 1 pit. Note massive "cap rock" that overlies the ore bed.

Figure 24  Slusher mining at Lightning No. 1, using clam shell and bulldozer with a power take-off; a method used to drive many of the adits in the uranium area.

Figure 32  Carbonized plant roots in a 3-foot block of the arkosic sandstone that caps the uranium-bearing beds at the East Basin No. 1 pit.
but fell from the stope-back before the holes could be loaded.

At the Shorty No. 2 pit, some of the highest-grade ore was mined by use of a short drift. Roof bolts failed to stabilize the highly-fractured back, and the entire back collapsed an hour after the miners were called out of the drift.

Most underground mining has been done on a contract basis. Approximate cost of short, slusher drifts (Fig. 24) has been $28 per foot; longer, rail-and hand-car drifts have cost about $32 per foot. Stope-development costs have ranged from $6 to $9 per ton of ore removed.

**Ore transportation** All ore shipped has come from pits east of Basin Creek. In 5- to 6-ton loads on 1 1/2- or 2-ton trucks, ore is moved from the pits down steep mining roads to a transfer point on Basin Creek. The distance from transfer point to Ketchum is 70 miles and to Mackay, 100 miles. Ore is shipped from Basin Creek to railheads at Mackay and Ketchum in 28-ton trucks. From railheads, ore is shipped in 50- or 70-ton cars to the Vitro Corporation mill in Salt Lake City.

Trucking costs range from $4.80 per ton for ore from the Coal Creek pits to $5.80 per ton for ore from the Shorty pit. Rail costs are $4.19 per ton.

**Possible upgrading techniques**

Truck and rail shipping costs for transporting uranium ore to the mill are high. It is possible to upgrade substantially much of the Stanley ore at the pit. Ninety percent of the ore is of the sedimentary type. Most uranium in the sedimentary rocks occurs as fine particles that fill voids in poorly- to moderately-cemented siltstone and sandstone. From 70 percent to 95 percent of the ore consists of barren quartz grains. Removal of just the coarser quartz grains would upgrade most sedimentary ores by factors ranging from 3 to 1 to 10 to 1.

At Monument No. 2, Monument Valley, Utah, sedimentary rock containing 0.04 percent U₃O₈ is upgraded to ore containing 0.40 percent U₃O₈ (Phil Dodd, AEC, oral communication). After the protore is crushed in a jaw crusher, the sand grains are abraded in a wet process by a rod mill. Sand and uranium-bearing slime are separated in a settling tank; the slime overflow is dried by the sun in the summer and by a furnace in the winter.

A small, well-designed, portable mill might upgrade Stanley ores by factors greater than 10 to 1. The critical design problem would be to separate quartz grains without crushing them. Quartz grains in sandstone have been separated at the University of Idaho by using a rod mill in which the rods were covered with hard rubber (Joseph Newton, oral communication). Some of the feldspar grains would probably withstand the abrasion process and could be separated with the quartz.
At some pits, special situations exist that can be used to upgrade ores. At the Side Hill pit, autinite crystals are disseminated through deeply-weathered quartz monzonite. Quartz grains and large phenocrysts of microcline can be separated from autinite and plagioclase by dry screening. A 10-pound sample was upgraded in the field from 0.11 percent $\text{U}_2\text{O}_8$ to 0.22 percent $\text{U}_3\text{O}_8$ by use of an ordinary window screen (Ben Dickerson, Sidney Mining Co., oral communication). I collected a 100-pound sample of protore and increased the grade from 0.02 percent $\text{U}_3\text{O}_8$ to 0.06 percent $\text{U}_3\text{O}_8$ with Tyler screens.

At Coal Creek No. 1, uranium occurs in the matrix surrounding well-rounded, cobbles and boulders of a stream-channel fill. A wet process using an oversized cement mixer and a trommel should increase the ore grade. The quartzite boulders would act as balls for breaking up the matrix.

**Property descriptions:** vein deposits in granitic rocks

**Lightning, Aspen, and Copperite**

**Location and ownership** There are 61 claims in the Lightning, Aspen, and Copperite groups. The claims form a strip 3,000 feet wide that extends along Basin Creek from Kelley Creek to Little Basin Creek, and a strip that extends up Hay Creek three-fourths of a mile (Fig. 8). The claims were leased by Western Fluorite Mining Company in 1958, and by Vitro-Idaho Minerals Corporation in 1959. In 1960, Lightning No. 2 was being developed by Henry Childs of Hailey; the rest of the claims have reverted to the original stakers, Bill Brooks and Melvin Peterson of Hailey.

Developments in granitic rocks consist of the Lightning No. 2 workings, Lightning No. 1 adit, Lightning upper pit, and Aspen No. 4 pits.

**Geologic setting** Most of the rock exposed on the claims is quartz monzonite or granodiorite. Challis sedimentary and volcanic rocks crop out along the ridges east of Basin Creek. Several easterly-trending, porphyry dikes cut granitic rocks north of Hay Creek.

**Lightning No. 2** The Lightning No. 2 workings are just south of Hay Creek, less than 50 feet above creek level and a few hundred feet east of Basin Creek. Country rock is coarse-grained quartz monzonite. Mineralization is concentrated along a series of parallel fractures within a fault zone that strikes N38W. The main fractures dip 65NE. Little gouge occurs in the fractures but several fractures have slickensided walls.

In 1958, a cut was bulldozed for 250 feet across the fault zone. Radioactivity along the cut, in 1959, ranged from a normal background of 0.02 millicuriegens per hour up to a maximum of 2.00 millicuriegens per hour (Fig. 20). The highest radioactivity occurred along a series of closely spaced faults that formed a zone 4 to 5 feet thick. Secondary uranium minerals coated the fractures, but no primary uranium minerals were visible. Late in the fall of 1959, Vitro-Idaho Minerals Corporation drove a
Figure 20: Geologic Map of a portion of the Lightning group

- Mineralized fault zone, 4-5" thick, w/Berrezi & usmanite coated fractures
- Quartz monzonite - granodiorite

EXPLANATION
65 Fault, showing dip
to
70 Joint, showing dip
to
38 Radioactivity in rock/legends
X 1000
Elevation reference point

Scale
0 40 80 Feet

- 12-ton ore pile (0.025% Cu, 0.05% Pb)
- Lightning 2 workings
- Minersitized fault zone, 4-5" thick, unmineralized pitchblende below water table
- Lightning 1-2 pit
- Lightning 3 pit and upper Lightning pit

Footnotes:
- 6.0 Mina
- U.S. 93

Base replicated from Vigo-pha Minerals Corp. Map.
EXPLANATION
80° 10°
Strike & dip of faults, showing bearing & plunge of slickensides
60°
Strike & dip of joints
θ = .35
Radon activity in microcuries / hr
0 → 4
Probe hole

NOTES
Brunton & tape survey
Only the most prominent fractures shown
Radioactivity readings not corrected for mass effect
Country rock, quartz monzonite-granodiorite

Scale
0 10 20 Feet

Quartz latite porphyry dike
15°
33°
10° 2" gauge, Fe stained
1.5' of 0.40% U₂O₆ all other holes barren
Quartz monzonite-granodiorite highly brecciated, chloritized near dike contact
Timbered, back lagged
4' gauge, 1' calcite veinlet
4' hole
Fracture zone
85° 93°

Figure 21 — Underground workings, Lightning #1 & #2 claims
50-foot adit along this zone and shipped 271 tons of development ore with a grade of 0.15 percent U₃O₈. In 1960, Childs widened and deepened the adit and drove a lower adit along the fault zone down-dip from the upper adit (Fig. 21). During 1960, Childs shipped a total of 420 tons of ore with an average grade of 0.18 percent U₃O₈ from the two adits. Most of the ore came from a stope in the upper adit. The stope is 23 feet high and, because of overbreakage, 16 feet wide. The fractured hanging wall of the stope is unsupported and is in danger of caving.

The present stope sill is at the water table and contains monomineralic pitchblende stringers. In polished sections of specimens collected from the adits and dump, minor pyrite, gold, and molybdenite were observed in vein quartz. A grab sample from the Lightning No. 2, collected by the AEC, contained, in percent: Fe, 4.; Zn, 3.; Ti, 0.5; Ba, 0.4; Mo, 0.2; Ce, 0.09; Sb, 0.07; Mn, 0.04; La, 0.04; Pb, 0.01; Sr, 0.09; (semi-quantitative spectrographic analysis); and U₃O₈, 1.22 (chemical). Ore-grade mineralization is restricted to a steeply pitching shoot 25 feet long and 4 to 5 feet wide. The shoot is a tabular stockwork composed of many thin but closely spaced veins and veinlets.

Pitchblende formed partially by open filling and partially by replacement. Former openings filled by pitchblende consist of the N38W-trending faults, narrow breccia zones along the faults, and numerous small fractures sub-parallel to the faults. The thickest vein observed was 1 inch thick. Throughout the shoot, veinlets diverge from the narrow pitchblende veins to form miniature "horsetail" structures.

Ore grade has increased with depth. Mill assays of the eight car loads of ore shipped in 1960 are, in order of shipment, 0.12, 0.12, 0.17, 0.17, 0.21, 0.17, 0.26, and 0.20 percent U₃O₈. Some low-grade ore was included in the last shipment. Because of dilution during mining, the grade of the ore shipped was substantially less than the grade of the ore in the shoot.

A test hole, drilled on a 40 degree incline, superperpendicular to the vein, intercepted the vein at an elevation 65 feet lower than the adit's sill. An 8 1/2-foot section of core, (7 1/2-foot vein thickness) contained 1.42 percent U₃O₈ (H. Childs, oral communication).

The ore shoot on the Lightning No. 2 contains the highest-grade uranium mineralization yet exposed in the granitic rocks. Higher-grade ore should be present in the unaltered zone below the water table. Further exploration is justified.

**Lightning No. 1 adit** The Lightning No. 1 adit is 820 feet NNE of the Lightning No. 2 workings and about 100 feet above Basin Creek (Fig. 20). The 43-foot adit is along the fault contact between granitic rock and a thick porphyritic dike. Granitic rock and dike rock have been badly brecciated. The most conspicuous fault exposed in the adit strikes N67E and dips 65SE (Fig. 21). Much of the granitic rock near the contact has been altered to chlorite.
Dike rock is light green and contains abundant quartz and feldspar phenocrysts. Some of the quartz phenocrysts are clear and some are smoky.

Anomalous radioactivity is mainly along fractures in the granitic rock. Only one probe hole in the southeast wall of the adit contains ore-grade mineralization (Fig. 21).

**Lightning upper pit** The Lightning upper pit is up the slope and 400 feet southeast of the Lightning No. 1 adit (Fig. 20). The pit is approximately 150 feet long and 80 feet wide. Production was 48 tons of ore with a grade of 0.28 percent U₃O₈.

Mineralization occurs along a fault zone with an attitude N60W70NE. Fractures within the zone are spaced from 1 inch to 1 foot apart. All mining was restricted to the oxidation zone. Exposed uranium minerals are secondary and occur mainly as coatings on fractures. Childs stated that the shipped ore contained mostly secondary yellow uranium minerals, but that some sooty pitchblende was uncovered at the base of the pit just before mining was halted in 1958. Minor amounts of stibnite was in the ore shipped (Bill Brooks, oral communication).

The fault zone exposed in the pit probably extends to the northwest. The Baker claims, west of Basin Creek, are along the strike line of the zone. If the Lightning No. 1 adit were extended, it should intercept the fault zone between 135 and 150 feet. There is no surface indication, however, that such an extension would encounter mineralization.

**Aspen No. 4** Aspen No. 4 development consists of several shallow bulldozer cuts on the west side of Basin Creek about three-quarters of a mile north of Hay Creek. Host rock is a coarse-grained, porphyritic quartz monzonite. The main cut is along a mineralized and highly brecciated zone about 4 feet thick. This fault zone has an attitude of N42W 70NE; slickensides bear N20W and plunge 20NW. The most intense mineralization exposed occurs in a pod 4 inches thick and 10 feet long; maximum radioactivity measured was 0.45 milliroentgens per hour. The pod contains yellow and orange, secondary uranium minerals.

The fault zone at Aspen No. 4 is probably a continuation of the mineralized fault zone at Lightning No. 2.

**Baker and Potato Hill**

The five Baker and two Potato Hill claims lie along a ridge west of Basin Creek. The surface workings are at the end of Sawmill Creek road, 4.1 miles from Kelley Creek, and are near the NW corner sec. 1, T11N, R 13E. The claims, staked by Jerry Korfist of Baker, California, partly overlie the Golden Day property.

The original workings consisted of four short benches bulldozed across a north-west-trending fault zone in quartz monzonite. Fractures along the zone contained autunite;
the maximum radioactivity measured in 1959, was 0.70 millicurie-seconds per hour. In 1960, Jack Keller and Pete Yarosh leased the property and stripped the overburden from highly mineralized rock along the fault zone. The new pit is 60 feet long, 30 feet wide, and 4 to 10 feet deep. The 20-degree slope of the pit floor parallels the hill slope.

Host rock exposed in the pit is a soft, deeply weathered quartz monzonite. The mafic-rich, coarse-grained quartz monzonite contains scattered microcline phenocrysts. Several small pegmatite and aplite dikes are exposed in the pit and along the road cut.

Most of the faults in the pit strike N50-55W and dip 48-62NE. The most conspicuous fault, however, has an attitude of N42W 84NE. The faults are normal and movements were predominantly strike slip.

At the lower end of the pit, the fault zone contains ore-grade mineralization for a thickness of 8 1/2 feet. Here, autunite is disseminated throughout the weathered quartz monzonite, but is especially abundant along closely spaced fractures and along uraniumiferous (?) chalcedony stringers. The stringers are less than 1 mm thick. An aplite dikelet that forms the hanging wall of the mineralized zone locally controlled uranium deposition. The under side of the dikelet is coated with limonite. Carbonaceous material formed from recently decayed tree roots, fills some fractures and may have aided the precipitation of autunite from meteoric water. Maximum radioactivity measured was 2.30 millicurie-seconds per hour. The mineralized band narrows towards the top of the pit, and at the top, is not ore.

Approximately 30 tons of handpicked and cobbled ore has been stockpiled. Grade of the ore pile is probably between 0.30 and 0.40 percent U₃O₈. Mining was halted because Keller and Yarosh ran out of money.

Mineralization at the Baker claims is along the same set of faults as at Lightning No. 2 and Aspen No. 4. Anomalous radioactivity can be traced from the Baker pit southeast to the Lightning claims and northwest towards the Aspen claims (J. Keller, oral communication).

The ore shoot at the Baker pit is thicker and contains more secondary uranium mineralization than any other shoot in the Stanley area. Resumption of mining is justified.

Hardee

The nine Hardee claims are along the west fork of Upper Harden Creek in secs. 10, 11, 14 and 15, T11N,R14E. The workings at Hardee No. 3 can be reached by an extension of Coal Creek road via the Little Joe claims; the Hardee workings are 3.7 miles from Basin Creek. Staked by Bill Brooks and Melvin Peterson, the claims were
developed by Phillips Petroleum Company. Mine workings, consisting of several surface cuts and a 150-foot adit, are part way up the slope west of the creek.

Country rock on the Hardee claims is a coarse-grained, porphyritic quartz monzonite. Quartz monzonite containing abundant phenocrysts of microcline has been intruded by numerous aplite and pegmatite dikes.

In a cut directly above the adit, quartz monzonite and dikes have been brecciated along a fault zone that trends N45W (Fig. 22). The brecciated rock contains thin stringers of grayish-black chalcedony. The chalcedony stringers contain pitchblende and minor stibnite. A 10-foot channel sample, cut across the zone, assayed 0.25 percent \( \text{U}_3\text{O}_8 \) (Phillips Petroleum Company). Much of the plagioclase in the quartz monzonite along the zone has been kaolinized; quartz in the pegmatite stringers is smoke colored.

Before the adit was driven, 2 core-drill and 30 churn-drill holes were sunk in the cut. The two cores were assayed: each contained an average of 8 feet of 0.16 percent \( \text{U}_3\text{O}_8 \). Radiometric probing indicated that 14 of the holes contained ore and that one hole contained 20 feet of 0.49 percent \( \text{U}_3\text{O}_8 \) (Fig. 22).

Ore in the adit was of a much lower grade and more erratically distributed than drill-hole probing had indicated. Much of the uranium is restricted to stringer-filled fractures. Most stringers are paper thin; the largest stringer observed was 1/2 inch thick. Several small pods of ore have been mined. The pods occurred where stringers intersected faults or brecciated aplite and pegmatite dikes (Fig. 22). A brilliant, canary-yellow, secondary uranium mineral coats the stringers and pods.

Mining was halted because the stringers are too widely spaced to compose a stockwork and too thin to mine individually.

The adit at the Hardee No. 3 is the only place in the Stanley area where I saw fresh pitchblende. The pitchblende occurs in stringers with chalcedony. In polished section, it could be determined that the chalcedony and pitchblende were emplaced at different times; however, age relations between the two minerals could not be determined.

Chalcedony contained minute euhedral crystals of auriferous (?) pyrite. A grab sample of mineralized rock from the adit assayed 0.18 oz. Au and 0.50 oz. Ag per ton.

Numerous radioactive anomalies occur on the Hardee claims. Many of these anomalies are in rock along the creek and along a small tributary that branches off the creek, just below the adit (Fig. 1). A swamp on this tributary and one-quarter mile west of the adit is anomalously radioactive.
Figure 22
Underground and Surface Maps,
Hardee No. 3 Claim
(modified after D. Leb)
Alta

There are 11 Alta claims; the Alta Discovery and Alta Nos. 1-10 (Fig 8). The claims lie mainly between the east and west forks of Upper Harden Creek and are mostly in the NE1/4 sec. 14, T11N,R14E. Claim workings can be reached by Lower Harden Creek road and are 4.4 road miles from U. S. 95. The claims were staked for uranium by Harry McClure. Workings consist of an adit and raise, exploratory bulldozer cuts, and several small prospect pits. All workings are on the east slope of the ridge between the two forks of the creek.

Mr. S. S. Stokes of Stanley stated that the Alta property was a gold-silver prospect before the discovery of uranium. According to Stokes, much of the ore assays about $4 of Au and Ag per ton and some assays up to $8 (oral communication). However, a grab sample collected from the discovery pit above the adit contained no Au or Ag when fire assayed.

Country rock is porphyritic quartz monzonite. Seven or eight subparallel, pegmatite dikes crop out on the ridge slope. The dikes are 1/2 foot to 3 feet thick, strike N70-80E, and dip 56-69SE. Quartz monzonite and dikes are cut by a set of faults that strike N45-55E and dip 45-70SE. The faults are spaced from 50 to 150 feet apart. Most displacements along the faults are right lateral and range from 5 to 30 feet.

Most development work has been restricted to a conspicuous fault half way up the ridge. The fault is subparallel to the ridge slope and at the discovery pit has an attitude of N3E59SE (Fig. 23). Slickensides plunge 15E; the latest movement was reverse.

Several pods of high-grade ore along the fault have been explored with small prospect pits. The pods are composed of chalcedony or quartz with finely disseminated pitchblende and minor stibnite. Secondary uranium and antimony minerals are plentiful. Alteration products include uranophane, gummite, and an unusual boxwork after stibnite rosettes. The pod at the discovery pit (Fig. 23) is about 13 feet long and has a maximum thickness of 2 feet. A grab sample of uraniferous chalcedony ore assayed 2.492 percent \( \text{U}_3\text{O}_8 \) (Kern, 1959, p. 31).

Ore pods occur along the fault for over 400 feet; however, the pods are not connected by a continuous vein. Most of the pods occur where the fault has intercepted pegmatite dikes.

In the adit that intercepts the fault directly down dip from the discovery pit, the fault is only slightly radioactive and no vein is present (Fig. 23). Fourteen feet northwest of the fault the adit intercepts a uraniferous chalcedony veinlet about 1/2 inch thick. The veinlet strikes east. An inclined raise, driven from the veinlet to the surface, is reported to intercept mineralization along the fault about 20 feet above the adit. Broken rock blocked the raise in the fall of 1960. Probably
mineralizing solutions rose along the veinlet to the fault, and then rose directly up
dip along the fault.

A few hundred feet down the slope from the adit, several shallow cuts have
been bulldozed across thin chalcedony stringers and radioactive fractures in quartz
monzonite. The cuts are just southwest of a hairpin turn in the road. The stringers
are uniform in thickness and do not form pods. The maximum measured radioactivity
was 0.22 miliroentgens per hour.

A 3-foot pegmatite dike crosses the top of the ridge 100 feet southeast of the
NW corner post of the Alta Discovery claim. A 1-inch uraniumiferous chalcedony vein-
let is "plastered" to the bottom of the southeast-dipping dike. At the exposed vein-
let, the dike has been offset and somewhat brecciated. Maximum radioactivity is 0.28
miliroentgens per hour.

Ore-grade mineralization has not been uncovered on the Alta claims. Further
exploration is not economically justified. The small uniform stringers were probably
the source of the ore pods that lie along the northeast-trending fault. Most of the
pods formed in brecciated rock along the intersections of the fault and the pegmatite
dikes.

Enterprise

The 16 Enterprise claims are on the east slope of Potato Mountain and, in part,
overlap the Golden Day claims. Staked by A. W. Swank, the claims were developed by
Phillips Petroleum Company. The claims can be reached by Sawmill Creek road; the
turn-off to the workings is 3.3 road miles from Kelley Creek. Development consists
of three bulldozer pits and an adit (Fig. 25). Only minor work has been performed since
Kern's visit in 1958 (1959, p. 23-24). No ore has been shipped.

Country rock is, in general, a medium-grained quartz monzonite. In places
quartz monzonite is fine-grained, and in other places it is somewhat porphyritic. A
few large phenocrysts of microcline are present. Small flakes of biotite occur as
segregation clumps.

All openings are explorations of a slightly mineralized fault zone that strikes
N30-50W and dips southeast. Autunite and sooty pitchblende(?) that coat fractures in
the large upper pit, form the most radioactive zone exposed at the surface. Closely
spaced fractures in the lower pit are moderately radioactive.

The adit follows the most conspicuous fault within the zone for 450 feet. Up to
8 inches of gouge and 2 feet of breccia occur along the fault. Movement was almost hor-
zontal. Some of the rather complex cross faults are shown in Figure 25. At the 105-
foot station, the fault cuts a N65E fault; at the 210-foot station the fault is offset right
laterally by a N70W fault.
EXPLANATION

Strike & dip of fault, showing bearing & plunge of slickensides and direction of movement

Strike & dip of vein

Radioactivity readings in milliremgerms/hr.

Prospect pit

Discovery pit: Greenish-black chalcedony vein, 6'-8' thick, abundant secondary U minerals, fine-grained stibnite, no quartz

Blind raise towards discovery pit

Inclined raise to surface

Main fault at surface

Black chalcedony veinlet in adit, 1' - 1½' thick, Fe stained zone, 3' - 4' thick

Figure 23
Geologic Map, Alta Claim
Figure 25 — Geologic map, Enterprise #1 Workings
In the adit, the only anomalous radioactivity in the fault zone occurs directly down dip from the lower and upper pits. A 1-inch, radioactive stringer is exposed in the southwest wall below the lower pit. Down dip from the upper pit, 40 feet of crosscuts were driven into the footwall of the fault zone. A cross fault with an attitude N68W55NE is exposed at the face of one crosscut (Fig. 25). Gouge along this fault contains a pod of sooty pitchblende(?). Maximum radioactivity is 0.50 milliroentgens per hour.

The adit is 183 feet lower than the upper pit; however, the adit is still above the water table and within the zone of oxidation. The fault zone, particularly the footwall portion, is acting as a conduit for uranium transportation by down-seeping surface waters. Mineralization below the water table may be, but probably is not, of ore grade. If substantial amounts of pitchblende were present along the fault zone, more secondary uranium minerals should be exposed in the workings.

Side Hill

The four Side Hill claims are in secs. 13 and 14, T11N, R14E and adjoin the Big Hank group to the southwest. The claims were staked by Bill Brooks and Melvin Peterson and are under lease to the Sidney Mining Company. A road via the Big Hank claims leads to the main pit at Side Hill No. 1 (Fig. 36). Workings at the time of Kern's visit consisted of a series of five cuts aligned in a northwest direction (1959, p. 32). In 1959, overburden was stripped from mineralized rock at the site of the discovery pit. The new pit is 150 feet long, 40 feet wide, and 5 to 12 feet deep. The pit floor dips 22SW parallel to the slope of the hill.

Host rock exposed in the pit is a porphyritic quartz monzonite that contains abundant microcline phenocrysts up to 1 1/2 inches long. The quartz monzonite is so thoroughly weathered it can be crushed with the hand. The microcline phenocrysts are relatively fresh; however, most of the plagioclase has been altered to clay minerals.

Mineralization occurs in a "hot dog" shaped body that trends N55W along the pit. This trend is parallel to mineralized faults in granitic rock at other properties; however, no conspicuous northwest fracture is observable in the pit.

Autinite--as crystals disseminated through the weathered quartz monzonite--was the only uranium mineral observed in the pit. Averaging 2 millimeters across, autinite crystals preferentially replace altered plagioclase. The most intense mineralization observed occurs in a zone 2 feet thick at the lower end of the pit. A sample from this zone contained 0.23 percent U3O8 (Sidney Mining Company). Pegmatite dikes flanked both sides of the zone.

Several holes were drilled in the pit floor along the mineralized body. Radiometric probing indicated that mineralized rock is 6 feet deep and contains 0.10-0.11 percent U3O8. A 100-pound, composite representative sample of rock in the entire
pit floor contained 0.02 percent $^{\text{U}}_3\text{O}_8$. A 35-foot channel sample cut by Kern (1959, p. 33) from the original pit contained 0.05 percent $^{\text{U}}_3\text{O}_8$. Mining was not attempted because of the low grade of the mineralized body.

P and B

The three P and B claims are on the steep north slope of the Salmon River canyon about one-half mile west of Basin Creek; they are mostly in the SE 1/4 sec. 21, T11N, R14E (Fig. 8). The claims were staked by Maurice Patterson and John Benzer on October 27, 1958. Development consists of small prospect pits on P and B No. 1 and No. 3.

Mineralized granitic rock on the P and B claims is in the large shear zone located on the ridge between Basin Creek and Mormon Bend of the Salmon River (Fig. 1). The shear zone is at the intersection of four sets of closely-spaced faults. The fault sets have attitudes of N55-70E 45-65NW, N50-60W 60-80NE, N70-75W 50-55NE, and N30-35E 80-85SE. Much of the brecciation was caused by the Salmon River fault.

A prominent, quartz latite, porphyry dike extends from U. S. 95 over the nose of the ridge and down to Basin Creek. The dike has been displaced along several faults that have a general attitude N72W 53NE; slickensides plunge 43NE.

The small discovery pit on P and B No. 1 is about 300 feet up the slope from the intersection of U. S. 95 and the porphyry dike. The pit exposes a short segment of basalt dike that has been offset by faulting. Trending northwest, the dike segment is bounded on the southeast by a fault with an attitude N30E 82SE. Basalt near the fault has been replaced by vein quartz which is almost black. Thin pyrite stringers cut vein quartz and silicified basalt.

Maximum radioactivity measured in the pit was 2.70 milliroentgens per hour. The highest radioactivity is in gouge clay along fractures that strike N60W and dip 80NE. Specimens collected from the dump contain pitchblende stringers up to 1/8 inch thick. A grab sample collected by Patterson contained 0.6 percent $^{\text{U}}_3\text{O}_8$.

The only other anomalous radioactivity found on the property occurs on the ridge crest several hundred feet to the southwest. Four small prospect pits have been dug in a northwest-trending basalt dike. Northeast-trending fractures contain quartz and opal. The maximum radioactivity is 0.13 milliroentgens per hour. No metallic minerals were observed.

Drilling or underground exploration cannot be justified by the surface showings on the P and B claims.
Abbie Lou and Fool Proof

The three Abbie Lou and three Fool Proof claims lie along Basin Creek in secs. 20 and 21, T11N, R14E (Fig. 8). The Abbie Lou claims are southwest of the creek; the Fool Proof claims are northeast of it. The claims were located by Ralph Patton, Maurice Patterson, John Benzer, and M. R. Knight in September, 1955.

The pitchblende at the Abbie Lou No. 1 discovery pit was the first uranium found in place in the Stanley area. The discovery was made by Patton. Abbie Lou No. 1 has been restaked as the Hot Rock claim. Only a small amount of exploratory work has been performed on the two groups of claims; no ore has been produced.

Country rock is highly fractured quartz monzonite. The lower portion of Basin Creek follows a fault zone that strikes N50W. The 50-foot, quartz latite dike that crosses Basin Creek and the P and B claims has been offset right laterally for over 300 feet along this fault zone. Several hot springs flow from the under side of a displaced segment of the dike. Another set of faults strike from N80W to N80E, and dip north.

The small Abbie Lou No. 1 discovery pit is several hundred yards upstream from the forest service camp ground at the mouth of Basin Creek. The pit is about 200 feet above creek level. Mineralization is along closely-spaced fractures that strike N80E and dip 80SW. The fractures contain thin pitchblende stringers and secondary uranium minerals. Hand specimens containing pitchblende stringers up to 1/4 inch thick are reported to have been collected from the pit. Maximum radioactivity measured was 1.70 milliroentgens per hour. Three 6-inch samples, taken from along one fracture contained 0.34 percent U3O8 (Bill Brooks, oral communication). The samples were spaced 50 feet apart. Mineralized fractures in a nearby pit strike N83W and dip 80SW.

The Fool Proof No. 1 discovery pit is a bulldozer cut located about 100 feet above Basin Creek road. A mineralized fault zone exposed in the pit has an attitude of N80E 72SW. A sample, 3 1/2-feet long, cut across the zone, contained 0.186 percent U3O8 (Bill Brooks, oral communication). The only other known anomalous radioactivity on the Fool Proof claims occurs just south of the Salmon River across from the mouth of Basin Creek (Fig. 9).

Fractures on the Abbie Lou No. 1 have been more highly mineralized than fractures on the other five claims. The small hand-dug pits on this claim should be deepened and extended along strike before the properties are abandoned as uneconomical.
Bell Cross

The 16 Bell Cross claims form a north-trending strip 1,500 feet wide on the south slope of Potato Mountain. The main development is a large pit located near the center of sec. 10, T11N, R13E. The pit is on the west fork of Sawmill Creek road and one-half mile beyond the fork in the road. The claims are held by the Bell Cross Corporation.

The main pit, over 200 feet long and 100 feet wide, trends northeast across the zone of mineralization. The pit was dug with a D-8 dozer equipped with a ripper tooth; because of the highly fractured nature of the rock, little blasting was necessary. At the time of Kern’s visit (1959, p. 21) the pit was 15 feet deep; it is now 45 feet deep. No increase in mineralization has been exposed with depth. Four or five tons of ore have been stockpiled near the pit; no ore has been shipped.

Country rock is a coarse- to medium-grained, nonporphyritic, quartz monzonite that has been intruded by aplite and pegmatite dikes. Four sets of fractures cut the rocks. A vertical set that strikes N45W contains uraniferous chalcedony stringers and veins. Most of the chalcedony is grayish white to grayish black; some is cinnamon brown.

Uraninite is disseminated in minor amounts throughout the chalcedony veins and stringers. Small zones enriched in uraninite occur where the veins intersect pegmatite and aplite dikes. Though pods probably are present, none was observed.

Broken rock in the ore pile contains more secondary uranium minerals and is more radioactive than rock in place along the main mineralized fracture at the bottom of the pit. This fracture contains a chalcedony vein one foot thick, but is only moderately radioactive. Fractures in the vein contain minor amounts of uranophane. A chip sample cut across the vein at a higher level by Kern (1959, p. 21-22) contained 0.60 percent U3O8.

Cinnabar was reportedly uncovered in the pit during mining; however, none was observed in broken ore or in place during my visit. However, a sample collected from the pit by AEC personnel contained 0.2 percent HgO (semiquantitative spectrographic analysis). Some of the placer cinnabar from Kelley and Stanley creeks is in a cinnamon-colored chalcedony gangue similar to that in the Bell Cross pit and at the H and M property.

It is doubtful if further exploration will uncover ore at the Bell Cross pit.

H and M

The 16 H and M claims were staked on August 11, 1937, by John Halverson and Kenneth Morgan of Jerome, Idaho. Development consists of seven bulldozer pits, aligned one above the other on the southeast slope of Potato Mountain. The pits are in
the SE 1/4 sec. 3, T11N, R13E. The main pit which is 30 feet deep is at the end of the road 0.7 mile beyond the main Bell Cross pit.

Most of the rock exposed on the claims is coarse-grained, porphyritic quartz monzonite that has been intruded by narrow aplite and pegmatite dikes. At the main pit, quartz monzonite, aplite, and pegmatite have been intensely silicified for approximately 50 feet on each side of a cinnamon-colored chalcedony vein.

No metallic minerals or secondary uranium minerals have been exposed in the pits. A maximum radioactivity of 0.10 milliroentgens per hour was measured along the chalcedony vein.

**Lower Harden**

The Lower Harden group of at least two claims is in the SW 1/4 sec. 24, T11N, R14E. Several pits are on the west side of Lower Harden Creek road about 1/2 mile beyond the fork in the creek. The claims were staked by E. K. Evans in 1958.

The pits expose slightly mineralized fractures that have an attitude of N60E 58NW. Small pods of mineralized rock occur where the fractures intercept an aplite dike.

**Main Diggings**

The Main Diggings are in the NW 1/4 sec. 11, T11N, R13E. Workings consist of a number of bulldozer cuts along the slopes east and west of the east fork of Sawmill Creek. The claims were staked by E. K. Evans of Ketchum.

Porphyritic and nonporphyritic, quartz monzonite country rock has been intruded by pegmatite and rhyolite dikes. Quartz monzonite exposed in cuts along the west slope has been partially silicified. A maximum radioactivity of 0.11 milliroentgens per hour was measured in these cuts. There are no surface indications that ore exists on the property.
Property descriptions: bedded deposits in sedimentary rocks

Deer Strike and Elk

Location and ownership The Deer Strike No. 1 and No. 2 and Elk No. 1 claims, located near the head of a small tributary of Coal Creek, are in the SW 1/4 sec. 15 and SE 1/4 sec. 16 of T11N, R14W (Fig. 8). The claims adjoin the Little Joe group to the north and are serviced by a good mining road. The Deer Strike claims were staked by Melvin Peterson and William Brooks of Hailey. Phillips Petroleum Company leased the group from Peterson and Brooks and subsequently staked the Elk No. 1. Underground mining on these three claims has uncovered the largest and the highest grade ore-body yet discovered in the Stanley area.

Mine workings and production Five drilling benches and an underground mine compose the mine workings. The horizontal drilling benches are spaced roughly 100 feet apart and trend northwest in subparallel alignment along the hillside (Fig. 26). In November, 1960, underground workings consisted of a main adit 180 feet long, 440 feet of drifts, one large stope 100 feet long and up to 35 feet across, and several small stopes (Fig. 27).

The portal of the adit enters the hillside in quartz monzonite 125 feet downslope from the lower (main) drilling bench. All underground workings were open in October, 1960, except the large stope north of drill-hole 16, which was badly caved. Only minor water seepage occurs in the mine. All sills slope toward the portal and permit natural drainage. Drifts and crosscuts in quartz monzonite stand without timbering except at the portal and in highly fractured zones. Drifts in bedded sedimentary rock are untimbered but most stopes require support. Mining of ore in the badly fractured, gently dipping, sedimentary beds is dangerous because large blocks fall from stope-backs without warning (see Underground mining).

Mining commenced in the late fall of 1959 and continued through the severe winter months; 835 tons of ore averaging 0.235 percent $U_3O_8$ were shipped prior to cancellation of AEC production bonuses in the spring of 1960. From June to December, 1,060 tons of ore were mined and shipped. On December 13, 1960 the mine was closed for the winter; total production to date has been 1,895 tons of ore averaging 0.23 percent $U_3O_8$. Estimated ore reserves of 5,000 tons of 0.20 percent $U_3O_8$ are divided into 2,000 tons of indicated ore and 3,000 tons of inferred ore (D. Laub, written communication).
Figure 26
Map and Logs of Drill Holes, Deerstrike and Elk Claims

(Base from Phillips Petroleum Co. map)
Geology The Deer Strike and Elk claims are located on a down-faulted block of sedimentary rock bounded by quartz monzonite on the northeast, southeast, and southwest. The down-faulted block is probably a graben with minor displacement on its southwest side and major displacement on its northeast side. Overburden covers most bedrock; contacts are not exposed in natural outcrops. Good rock exposures in the complexly faulted graben(?) exist only in underground workings and in surface bulldozer cuts. Logs of over 35 churn-drill holes sunk on the three claims, aided geologic interpretation.

The only fault bounding the graben(?) exposed to date occurs in the main adit 102 feet from the portal. Fault attitude is N69E 57NW; slickensides bear N77W, and plunge 34NW. The fault that forms the northeast side of the graben(?) is not exposed; however, it passes between holes 29 and 34 (Fig. 26). Hole 34 has its collar at elevation 6,950 feet and was drilled entirely in quartz monzonite. In hole 29, 145 feet to the south, quartz monzonite was penetrated at elevation 6,762 feet. From these data, it is inferred that the fault is steeply dipping and that a minimum vertical separation of 188 feet exists. The fault probably passes between holes 36 and 33 and between holes 30 and 34; if so, the fault strikes northwest. Northeast-trending Coal Creek fault is probably one-quarter mile northwest of the mine; thick soil and talus cover the fault.

Uranium mineralization is restricted to bedded, sedimentary rocks; quartz monzonite is not mineralized.

Underground, sedimentary rock in the mineralized zone consists of intercalated beds of massive, coarse-grained, arkosic sandstone; fine- to medium-grained arkose; and thin-bedded, fine-grained siltstone containing numerous seams of vitrain. Arkose and sandstone compose three-quarters of the rock in the mineralized zone; siltstone composes one-quarter.

Average grain size in arkosic sandstone is 1 to 2 mm; a few pebbles up to one-half inch across were observed. Grain size in the finer grained arkose is less than 0.5 mm. Large, coalified wood fragments were not found.

Color of the sedimentary rock depends upon the amount of interstitial carbonaceous material in it. Coarse-grained sandstone, containing little carbonaceous material, is light gray. Fine- to medium-grained arkose, containing minor to moderate amounts of carbonaceous matter, is light to medium light gray. Abundant carbonaceous matter colors fine-grained siltstone dark gray to grayish black. Vitrain seams are jet black.

Thickness of individual beds and lenses ranges from a fraction of an inch to several inches. Arkose and sandstone beds are generally thicker than siltstone beds. Vitrain seams in siltstone are concordant with bedding and range from paper thinness up to one-half inch thickness. Crossbedding and truncation of beds are common;
graded bedding is not present. Irregularity of bedding is general; individual beds can rarely be traced more than a few feet because they pinch out in short lateral distances.

The site of sediment deposition now occupied by the ore body was probably a broad stream bed of moderate gradient in which water was neither still nor fast-moving. Still water would have permitted accumulation of large fragments of wood; fast water would have deposited coarse gravel. The sinuous shape of the anomalously radioactive zone, as drawn from drill-hole logs, also indicates that the ore body may occupy a former stream channel (Fig. 26). Irregularity and noncontinuity of beds indicate that sediments were not deposited in a pond or small lake.

Sedimentary rock exposed underground is cut by bedding-plane faults and by numerous high-angle faults of diverse attitudes (Fig. 27). In general, fault displacements range from a few inches to several feet.

Most of the high-angle faults are normal and dips range from 42° to 88°. In contrast to that of faults studied in most other parts of the Stanley area, movement was not predominately strike-slip. Rakes of slickensides generally range from 30° to 60°.

Bedding-plane faults form gently undulating surfaces that follow thin-bedded lenses of vitrain and siltstone. Surfaces of these faults are coated with a grayish-white, high-sheen gouge formed from sheared vitrain. Bedding-plane faults cut all high-angle faults.

Bedding in sedimentary rocks is disrupted and has diverse attitudes in different fault blocks. In the northeast drift, beds strike northwest and dip gently southwest. In the northwest drift, beds strike northeast and dips range from 10° to 35° to the southwest. Drift sills roughly follow the quartz monzonite-sediment contact. Beds exposed in surface bulldozer cuts strike N20-65W and dip 20-35NE into the hillside. Attitude of the quartz monzonite-sediment, depositional contact exposed at the main drilling bench, is N75W 23NE.

The uranium mineralization is proportionally related to the amount of carbonaceous material present in the sediments. Carbon-rich siltstone is selectively mineralized in preference to carbon-poor, massive, coarse-grained arkosic sandstone. Color can be used as a fairly reliable guide for underground exploration; that is, the darkest rocks contain the largest amounts of uranium.

Yellow secondary uranium minerals are not found underground. Black uranium minerals are probably uraninite and coffinite; however, X-ray identifications were not obtained on Deer Strike-Elk specimens.

Pyrite was not found on the property. Marcasite was observed only in one lens of carbon-rich siltstone in the stope north of drill-hole 26.
In much of the mine, mineralized sedimentary rock is just above the quartz monzonite contact; the richest ore occurs at the contact. In the big stope north of drill-hole 16, ore-bed thickness ranged from 2 to 7 feet and grade of ore averaged 0.235 percent U₃O₈ equivalent.

The most highly mineralized rock encountered in the mine occurs in the stope at the end of the northeast drift. In this stope, the grade of much of the in-place ore is greater than 0.30 percent U₃O₈ and thickness of the ore bed ranges from 2 to 8 feet (D. Laub, oral communication). Carbonaceous siltstone is highly mineralized and fine-grained arkose is moderately mineralized in this stope. Arkose has a "speckled" appearance caused by color contrast between smoky quartz and bleached feldspar crystals. Laub stated that the ore bed is 15 feet above quartz monzonite. Probably the bed is the middle one of the three beds that drill-hole logs indicate to be present in this part of the mine (Fig. 26).

Much of the mineralized sedimentary rock is bounded by high-angle faults. As exposed along a drift wall, sedimentary rock in a fault block may be highly mineralized and rock in an adjacent fault block may be barren. Faults are probably of post-mineralization age. Detailed megascopic and microscopic examinations failed to reveal any form of vein structures in mineralized rock or in faults. Uranium mineralization would be difficult to explain by hydrothermal processes. Laub stated that mineralized rocks within a few inches of faults were commonly deficient in uranium (oral communication). Probably faults are channel-ways for solution of uranium by ground water.

Lightning No. 3

Location and development Seven drilling benches composing the developments on Lightning No. 3 are on the slope north of Hay Creek, 0.7 mile by road from the turn-off at Hay and Basin creeks. The benches, at an elevation approximately 465 feet higher than the adit on Lightning No. 2, are in the NE 1/4 sec. 1, T11N, R13E. The claim is part of the Lightning group staked by Bill Brooks and Melvin Peterson.

Two core-drill and 36 churn-drill holes were driven during the summer of 1959 while the property was under lease to Vitro-Idaho Minerals Corporation. Information obtained from drilling indicated that the mineralized zone does not compose an ore body; therefore, mining was not attempted.

The topographic and geologic map of Figure 28 was drawn from field notes and from drill-hole logs supplied by Vitro-Idaho Minerals Corporation. Discussion and illustrations of the mineralized zone on Lightning No. 3 is presented here because of the geologic significance of the relatively detailed data available on this property.

Geology At the drilling benches, the hillside slopes 20-25SW. Sedimentary beds strike N60W, generally paralleling contour lines, and dip 18NE into the hill (Fig. 28).
The quartz monzonite-sediment, depositional surface forms a relatively flat plane, indicating that the local area of sediment deposition had low relief (Fig. 29), cross-sections AA’ and CC’.

Mineralization is confined to a buried, former stream channel. Stream-channel base was cut in quartz monzonite; sediment channel-fill extends to the surface (Fig. 29). The meander stream channel, as drawn from structural contours, parallels a zone of closely-spaced fractures in quartz monzonite. Fractures have an attitude N25W 75SW and are spaced from 6 inches to 1 foot apart, which gives a sheeted appearance to the quartz monzonite. Probably the stream channel developed on, and followed this pre-existing zone of weakness in quartz monzonite. The buried stream channel parallels the present Basin Creek, whose course is controlled by northwest-trending fractures. The present attitude of rocks near the buried stream channel was probably caused by post-mineralization block-faulting and northeastward tilting.

North of the protore body, the stream channel is cut into quartz monzonite to a depth of 6 feet and a width of 30 feet (Fig. 29, cross section CC’). Cross-sections AA’ and BB’ across the shovel-shaped, anomalously radioactive zone, show that most mineralization occurred in a broad meander of the stream (Figs. 28 and 29). The stream bed at the meander is cut into quartz monzonite to a depth of 12 feet and a width of 80 feet; part of the meander-fill has been eroded.

Drill cuttings indicate that the channel fill is composed of intercalated beds of mudstone, sandstone, arkose, lignite, and minor conglomerate. J. Jeffries stated that all holes were drilled into quartz monzonite and that quartz monzonite was invariably barren (geologist, Vitro-Idaho Minerals Corporation, oral communication). Color of drill cuttings, and mica composition were important in determining if the drill bit was cutting quartz monzonite or arkosic sediments. When wet, cuttings from unaltered quartz monzonite were greenish black and contained unaltered biotite. Cuttings from arkosic sediments ranged in color from white, through gray, to black. The upper 5 to 10 feet of quartz monzonite beneath the sediments is highly weathered; biotite in the weathered zone is partly altered to muscovite.

Mineralization occurs in multiple horizons as rich, but thin, beds and lenses in carbon-rich sediments. Graphs plotted from probe-hole, radioactivity logs indicate that mineralized beds have a maximum thickness of two feet (Fig. 17). Most beds are only a few inches thick. Probing records indicate that the richest mineralization occurred just above the quartz monzonite contact; however, mineralized beds occur up to 20 feet above the contact.

At first, probe-hole, radioactivity logs were interpreted by company geologists to indicate that the mineralized beds were of ore grade and averaged 4-5 feet in thickness (J. Jeffries, oral communication). As a check, diamond-drill corings were made in holes 27A and 28. Chemical analyses were made on splits from consecutive sections of core, each section being 1 foot long. Chemical analyses were also made on
NOTES
For section locations, see geologic map, figure 28.
Section B-B', drill-hole locations projected perpendicular to section line, figure 28.
Section B-B', graphs of drill-hole probing records, represent point-by-point measurements of radioactivity
of specific area. See figure 18 and text (Radionuclide mapping).
Drill-hole elevations adjusted to conform with section lines.
Drill-hole data collected by Vitro Idaho Minerals Corp.
No vertical exaggeration.

Figure 29 – Cross-Sections, Lightning # 3.
drill cuttings along sections 2 feet long from churn-drill holes 1, 2, and 3. Figure 17 shows curves of radioactivity readings, as well as chemical analyses, from each hole. The curves show that radiometric ore-grade estimates were too high by factors of 10 or more; the Babbage-type probe used was calibrated against a standard of small mass (see Radiometric assaying). Thickness of ore-bed estimates were too high because radioactivity readings along the drill hole were interpreted to be proportional to uranium contained in the rock at the point of reading (see Radiometric assaying).

Chemical analyses were made on two samples collected from mineralized beds exposed in bulldozer cuts. A channel sample across a bed 18 inches thick assayed 0.398 percent U3O8; a grab sample of vitrain and carbonaceous-rich matter assayed 11.15 percent U3O8 (Vitreo-Idaho Minerals Corporation).

Ten feet south of drill hole 3, a normal fault is exposed in a bulldozer cut; the footwall block is quartz monzonite and the hanging wall block is bedded sedimentary rock. The fault contains a seam of radioactive carbonaceous material 2 inches thick. Probably ground water solutions deposited the carbonaceous matter and the near-surface radioactive minerals.

**Coal Creek**

**Location, ownership, and production** The Coal Creek group (Coal Creek No. 1-11) and the Badger claim cover the outcrop area of basal Challis sedimentary rocks along Coal Creek and along the slopes east and west of Coal Creek. The claims are mainly in sec. 16, T11N,R14E. Phillips Petroleum Company has the claims under lease from the original stakers, Bill Brooks and Melvin Peterson. The claims are serviced by a good mining road up Coal Creek.

Developments include an open pit on Coal Creek No. 1 roughly 310 feet long and 180 feet wide, and an open pit on Coal Creek No. 4 roughly 150 feet long and 100 feet wide. Exploratory drilling has been performed on Coal Creek No. 10.

Ore shipped consists of 1,360 tons containing 0.14 percent U3O8 from the Coal Creek No. 1 pit and 450 tons containing 0.25 percent U3O8 from the Coal Creek No. 4 pit. The claims are inactive at present.

**Coal Creek No. 1** At the Coal Creek No. 1 pit, uranium occurs in the matrix surrounding pebbles and cobbles of a poorly cemented conglomerate that fills an old, buried stream channel. The stream-bed, cut in quartz monzonite (Fig. 30), bears N40W and plunges 35SW. Tuffaceous sedimentary rocks above the pit have an attitude of approximately N33E 28SW. The hillslope slopes 30SW, approximately parallel to mineralized rocks. Physical conditions favor open-pit mining.

The stream bed parallels a fracture set in quartz monzonite. Probably the stream developed on, and followed, pre-existing fractures in quartz monzonite.
Two fracture sets in sedimentary rock strike east and northeast and dip south and southeast, respectively. Minor movement has occurred along most fractures. Many fractures contain yellow and brown iron stains.

The channel-fill conglomerate is much coarser than any other water-borne sedimentary material observed in Stanley area rocks. Pebbles and cobbles are well rounded. Average size of the coarse aggregate is two inches. Most of the coarser aggregate is less than 6 inches in diameter (Fig. 19); the largest cobble observed measured 9 inches across. Coarse aggregate is composed mostly of dark-gray quartzite of the Wood River Formation; some vein quartz and pegmatite; and minor, highly-weathered quartz monzonite. Bornite and chalcopyrite were observed in a few of the well-rounded quartzite cobbles. The copper minerals, as well as their enclosing hosts, are detrital.

Ore occupied two channels in the former stream. The two channels were partly separated by a low ridge. Average thickness of ore in the channels was 5 feet; ore over the saddle was 1 to 2 feet thick. Overburden above the ore was 2 to 6 feet thick. Drilling has indicated that mineralized rock in the channels extends beneath the dump at the southeastern end of the pit, but is too low grade to mine.

Carbonaceous material is present as fine-grained trash disseminated throughout the conglomerate matrix, and as lignite, sub-bituminous coal, and vitrain seams overlying the conglomerate. A small amount of coal has been cobbled from dump material and used as fuel by Stanley residents.

Minerals identified in the matrix by the AEC include uraninite, pyrite, marcasite, and the arsenic sulfides, realgar and orpiment (Ben Bower, oral communication).

The highest-grade ore occurred in a grayish-black layer 6 inches to 1 foot thick, at the base of the main channel. An 11-foot channel sample of this material cut by Kern (1959, p. 29) assayed 0.718 percent U₃O₈. Mineralization at Coal Creek No. 1 was as intense as at Coal Creek No. 4 (described below); however, the presence of the large number of barren cobbles and boulders reduced the ore grade to almost one-half the grade at No. 4. Don Laub (Phillips Petroleum Company, oral communication) stated that the ore body was only two-thirds the size and one-half the grade indicated by drill-hole probing records (see Radiometric assaying).

Most if not all iron-oxides formed from surface waters seeping along fractures. The secondary uranium mineral, autunite, occurs with abundant limonite along the fractures. Autunite is the only uranium mineral in quartz monzonite, and autunite mineralization extends into quartz monzonite for only a few inches along fractures. The amount of iron oxides decreases rapidly with depth beneath the surface. Veins are not present in quartz monzonite or sedimentary rocks. Source of the uranium and most of the iron in fractures is the uraninite, coffinite(?), marcasite, and pyrite disseminated in the conglomerate matrix. Some iron was probably derived from disintegration of iron-bearing
Figure 30  Map, Coal Creek No. 1 Pit
(After D. Louis)
minerals during the weathering of the quartz monzonite.

Coal Creek No. 4 Mineralization at Coal Creek No. 4 occurs in an arkosic sandstone that contains a few small rounded cobbles. The mineralized bed of arkosic sandstone overlies quartz monzonite and underlies a 2- to 3-foot bed of barren claystone. The claystone contains thin seams of coal and carbonaceous material. Carbonaceous material is disseminated in the sandstone. The presence of bedded sandstone and claystone, rounded cobbles, and carbonaceous seams indicates that the sediments were probably deposited in a stream of low gradient.

Mineralization is known to occur in a zone roughly 120 feet long and 45 feet wide. The ore bed within the mineralized zone was sinuous in shape and trended roughly N-NW. Thickness of the ore bed ranged from 2 to 8 feet and averaged 5 feet. Width of the ore bed ranged from 15 to 30 feet. Most of the ore came from two pods within the ore bed. One pod was parallel to, and cut by, a fault with a strike N42W. The fault-ore age relation was not determined. The grade of ore in the pod cut by the fault, was the same as the grade of ore in the second pod (Don Laub, oral communication).

Laub collected hand specimens of the highest grade ore from each pod; both specimens assayed about 4 percent U₂O₈ (oral communication).

Minor autinite coated fractures beneath the ore body, but only extended for a few inches beneath the quartz monzonite surface (Don Laub, oral communication).

Coal Creek No. 10 Seven churn-drill holes were drilled on Coal Creek No. 10. The holes are a few hundred feet east of Coal Creek and southeast of the Coal Creek No. 1 pit. Two holes penetrated mineralized, carbonaceous, arkosic sandstone; five holes were barren. The two mineralized holes are 15 feet apart; mineralization is 35 feet below the surface. Probing records indicate that the mineralized bed in one hole is 2 1/2 feet thick and contains 0.57 percent U₂O₈ and the other hole is 2 feet thick and contains 0.60 percent U₂O₈ (Don Laub, oral communication). The mineralized bed was not considered large enough to mine.

East Basin

Location, ownership, production, and ore grade The 11 East Basin claims lie along East Basin Creek and are in sec.s. 17 and 18, T11N, R14E. All claims except No. 8 have their longitudinal axes perpendicular to East Basin Creek (Fig. 8). Trout No. 1 and No. 2 lie just downstream from the East Basin claims. Other groups bordering East Basin claims include the Shorty, Lazy Jack, Sunday, Uranus and Lucky Strike (Fig. 8). The East Basin claims were staked by Jerry Kofist of Baker, California. Development and mining on the claims were performed by Western Fluorite Mining Company and Vitro-Idaho Minerals Corporation. The property, inactive at the present, is held by E. K. Evans of Ketchum, Idaho.
A good mining road, 2.3 miles long, goes up East Basin Creek to the large open pit on East Basin No. 1. The pit is approximately 300 feet west of East Basin Creek; the pit floor is approximately 120 feet above creek level (Fig. 31). Maximum height of the amphitheater-shaped pit wall is 70 feet; the pit floor is 220 feet long and 180 feet wide.

Total production consisted of 1,100 tons of ore with a grade of 0.20 percent U₃O₈ mined by Western Fluorite and 773 tons of ore with a grade of 0.18 percent U₃O₈ mined by Vitro-Idaho.

The grade of the ore mined was substantially lower than the grade originally indicated from drill-hole probing (see Radiometric assaying). Radiometric probing records had indicated that the ore mined by Western Fluorite had a grade of 0.49 percent U₃O₈ and that the ore mined by Vitro-Idaho had a grade of 0.46 percent U₃O₈. Prior to stripping operations, Vitro-Idaho cut several channel samples across the face of the ore exposed by Western Fluorite's previous mining. Chemical analyses indicated the grade of the ore bed was 0.30 percent U₃O₈. This reduction from the grade indicated by the chemical analyses is probably explained by:

1) the limited extent of sampling for chemical analyses;
2) extreme variations in ore grade;
3) dilution of ore during open-pit mining;
4) loss of uranium-rich fines during each transfer in shipping.

Geology  Mineralization at the East Basin pit is mainly restricted to a 3-foot basal bed of Challis sedimentary rocks that overlies quartz monzonite. Conglomerate forms the lower 6 inches of the mineralized bed; arkosic sandstone forms the upper 2 1/2 feet. Well-rounded, quartzite pebbles in the conglomerate are from the Wood River Formation; the largest pebble observed was 3 1/2 inches across.

A hard, massive, arkosic sandstone that overlies the ore bed forms a cap rock that had to be removed by blasting during open-pit mining (see Open-pit mining). Intercalated beds of poorly consolidated coal, shale, siltstone, claystone, arkosic and tuffaceous sandstone, and tuff overlie the cap rock (Fig. 19). A detailed description of the section of sedimentary rocks exposed in the pit wall is given on page 13. The sediments that formed the rocks at the East Basin pit were probably deposited in a stream that at times, was ponded. Semi-swamp conditions probably existed during the deposition of much of the carbonaceous material. Numerous fossil roots in the cap rock indicate that the thin carbonaceous shale overlying the cap rock is a "fossil" soil (Fig. 32).

Mineralization within the ore bed is very unevenly distributed. Uranium is intimately associated with carbonaceous material, most extensively with carbonaceous trash filling voids in conglomerate and sandstone. Better-grade ores are dark gray to grayish black. The richest uranium ore is the vitrain seams and the vitrainized fossil,
Figure 31
Map of East Basin No. 1 Pit
wood fragments and branches. Several specimens of vitrain have been assayed to contain between 10 and 15 percent U₃O₈. All vitrain seams are concordant with bedding. Uraninite was identified in several specimens of vitrain by X-ray. Fossilized pyrite micro-organisms occur with the uranium in vitrain (see Mineralogy and paragenesis). Marcasite fills voids in arkosic sandstone that is relatively poor in carbon. Macroscopic or microscopic vein structures are not present in the ore. Tests performed by Vitro-Idaho indicate that unaltered ore containing black uranium minerals is very close to being in equilibrium (G. Quigley, Vitro-Idaho Minerals Corporation, oral communication).

The ore bed and the cap rock, as exposed in the pit during mining, were not badly brecciated or complexly faulted. Only two normal faults cut the rock. The most conspicuous of the two faults, exposed in the southwest wall of the pit, has an attitude of N40W 50NE (Figs. 19 and 31). The ore bed northeast of this fault has been displaced downward several feet. Numerous fractures, cutting the ore bed with little or no displacement, contain limonite.

Cap rock and ore had a relatively uniform attitude of N50E 7NW. Beds exposed in the pit wall have steeper dips but have probably been affected by slumping.

The ore bed extends down dip from the pit and was penetrated by drill holes 1, 5, 7, and 8 (Fig. 31). Drilling records indicate that at least 4,000 tons of ore are present and that the grade of the ore is about the same as that of the ore already mined (G. Quigley, oral communication). Because of the precarious condition of the pit wall, any further mining will have to be by underground techniques. The hard, massive cap rock should make a strong back for drifts and stopes.

East Basin Creek fault has a strike of N23E and generally follows East Basin Creek (Fig. 1). Vertical separation of the basal, sedimentary bed is approximately 170 feet; the southeast block is displaced downwards.

Directly across East Basin Creek from the pit and a short distance above the creek, is a small prospect pit. The mineralized, basal bed exposed in the pit is anomalously radioactive and contains abundant marcasite filling voids in sandstone lenses. The centers of the mineralized lenses are unaltered; however, the margins have been deeply stained an intense yellow brown where marcasite has been altered to limonite by ground water seepage.

**Shorty, Sunday, and Lazy Jack**

**Location, ownership, and production** The Shorty, Sunday, and Lazy Jack groups form a block of 50 claims that extend from Hay Creek to Coal Creek (Fig. 8). The claims are in secs. 5, 6, 7, 8, 9, and 18 and are now controlled by the Sidney Mining Company. Shorty Nos. 1-14 were staked in 1957 by Harold Schafer, Bill Brooks, and Melvin Peterson. Shorty Nos. 14-34 and the 14 Sunday claims were staked by Sidney
Mining Company. The two Lazy Jack claims were staked by Jack Keller and Pete Yarosh.

The major development is a large open pit located on top of the ridge between Short and East Basin creeks. The Shorty No. 2 pit is east of, and approximately 700 feet higher than, the East Basin No. 1 pit. A steep but good ore-haulage road, 1.2 miles long, joins East Basin Creek road at East Basin pit. Roads up the nose and west slope of the ridge also reach the Shorty pit.

Sidney Mining Company has shipped 1,400 tons of ore with a grade of 0.14 percent U3O8. About 350 tons of ore with an approximate grade of 0.18 percent U3O8 and some 1,000 to 1,500 tons of protore with a grade between 0.10 and 0.15 percent U3O8, are stockpiled at the transfer point on Basin Creek (M. Brown, Sidney Mining Company, oral communication). Stripping and mining were performed during the summer and fall of 1959 (see Open pit mining). Some exploratory drilling was performed in 1960 and more is planned for 1961 (M. Brown, written communication).

Brown stated that the most serious problem encountered during mining was radiometric evaluation of ore grade. Up to 80 percent reduction in radioactivity occurred during the blasting, loading, and shipping of the ore (see Radiometric assaying). Because of variations in porosity and water content, escape of radon gas from broken ore was erratic and uneven.

**Geology** The Shorty pit is on a fault zone that strikes N5-10E; bedded sedimentary rocks have been downfaulted against quartz monzonite. Country rock southwest of the pit is quartz monzonite; northeast of the pit, Challis flows and tuffs overlie the sedimentary rocks and dip to the east and northeast.

Sedimentary rocks are mostly interbedded coal, carboniferous mudstone, and arkosic sandstone. Most sedimentary rocks exposed in the pit have been badly faulted, deformed, and drag folded.

The most prominent fault in the fault zone has an attitude of N5-10W 85E; the footwall is quartz monzonite (section AA', Fig. 35). Forty feet to the east, a second fault has an attitude of N5-10W 35-40E. Thick, gouge clay coats both fault planes. The wedge of sedimentary rock between these two faults is cut by numerous cross faults of diverse attitudes (Fig. 35).

A N62W fault that extends from Coal Creek across East Basin Creek and that probably crosses the ridge close to the pit, may have produced some of the rock deformation at the pit. Uncovered during stripping, a faulted nappe-like, drag fold over 18 feet across is possibly associated with this fault.

Uranium mineralization is restricted to bedded sedimentary rocks; ore-grade mineralization is generally restricted to carbon-rich beds. All ore mined to date has come from a limited zone within the wedge of sedimentary rocks between the two main N5-10E faults (Fig. 35). The mineralized zone extended across the 40-foot width of the fault
wedge and extended approximately 80 feet along the fault wedge. It can be argued that the uranium was deposited by solutions rising along the fractures. However, veins are not present in fractures or in mineralized sedimentary rocks. In addition, sedimentary rocks within the fault wedge, north and south of the ore zone, are not mineralized.

Possibly an extension of the mineralized zone has been downfaulted to the east. If mineralized rock occupies a former stream channel, the ore body will be linear in shape. Any projected ore body would probably not be directly down-dip because most fault movements had substantial strike-slip components. Any further drilling program should include holes positioned east of holes 1 and 4 (Fig. 35).

The thickness of sedimentary rocks between the mineralized beds and the depositional contact with quartz monzonite is not known. Hole No. 1, drilled through the upper main fault, intercepted quartz monzonite 37 feet below the pit floor; however, this section of sedimentary rock has been affected by cross faults. In most Stanley sedimentary deposits the basal bed is more highly mineralized than overlying beds.

Ores from the Shorty pit contain uraninite, coffinite, pyrite, and marcasite. The highest-grade hand specimens collected are vitrained, fossil branches that contain up to 15.0 percent \( ^{238} \text{U} / ^{235} \text{U} \). Uraninite and coffinite in vairain are intimately associated with frambooidal pyrite micro-fossils (see Mineralogy and paragenesis).

Uranus

The Uranus claims are on the east side of East Basin Creek across from the East Basin No. 1 pit (Fig. 8). The claims are mainly in the E 1/2 sec. 8, T11N, R14E. The claims can be reached by a road that branches off from East Basin Creek road.

Development consists of three bulldozed benches located on the north side of a draw that leads off East Basin Creek. Five churn-drill holes were sunk on the lower drilling bench by Vitro-Idaho Minerals Corporation.

The contact between quartz monzonite and sedimentary rocks is exposed on the southwest end of the drilling bench. Exposed sedimentary rocks consist of thinly interbedded siltstones and carbonaceous shales overlain by a bed of massive, fine-grained, arkosic sandstone. The beds have a general attitude of N90E 15N. Several high-angle faults have displaced the beds; most movement was normal. Twelve feet of vertical separation has occurred on one fault which has an attitude of N90E 80E.

Uranium is present on the Uranus claims but exploration has been too limited to indicate the extent and degree of mineralization. A maximum reading of 0.60
milliroentgens per hour was measured in carbonaceous beds exposed on the drilling bench. Any further exploration should include drilling holes that would intercept the basal sedimentary bed down-dip from where it is mineralized at the lower bulldozer cut.

Moderate to intense faulting has occurred in rocks throughout the Uranus group. Challis tuffs above the bulldozer cuts have been intensely fractured and brecciated; breccia fragments have been cemented by calcite and opal. The most conspicuous stringer-filled fractures have attitudes of N2 E65W and N48E 80-85NW. A few hundred feet southwest of the bulldozer cuts, Challis rocks have been downfaulted several hundred feet. The fault has a strike of N63W; the southwest block has moved down relative to the northeast block (Fig. 1).

Big Hank, Pine Hen, and Little Spring

The three Big Hank, six Pine Hen, and four Little Spring claims are on the ridge between Lower and Upper Harden creeks and are mostly in secs. 13 and 14, T11N, R14E (Fig. 8). A road via Lower Harden Creek reaches the claims from U.S. 93. All claims were staked by Melvin Peterson and Bill Brooks; the Big Hank and Pine Hen groups are under lease to Rare Metals Corporation and the Little Spring group is under lease to Sidney Mining Company. The claims adjoin the Side Hill group on the northeast. No ore has been shipped from the properties.

Mineralization on the three groups of claims is mainly in an outlier of arkose and arkosic sandstone that lies on top of the ridge. The outlier, approximately 2,800 feet long and 1,800 feet wide, trends northwest. Some deeply weathered quartz monzonite beneath and at the margins of the outlier is also mineralized. The closed isorads shown on Figure 36 indicate that mineralization occurs mainly in two northwest-trending, sinuous belts.

In 1958, four exploratory pits were bulldozed across the anomalously-radioactive belts. Pits Nos. 1 and 2 cross the belt on Big Hank Nos. 1 and 2, and pits Nos. 3 and 4 cross the belt centered on Pine Hen Nos. 2 and 4 (Fig. 36). Pits Nos. 1, 2, and 4 are in sedimentary rock and Pit No. 3 is in quartz monzonite. In 1959, several drilling benches were bulldozed and 53 churn-drill holes were sunk (Fig. 36). All holes were drilled into quartz monzonite; the deepest hole was 116 feet deep.

The most intense mineralization discovered occurs in sedimentary rock on Big Hank Nos. 1 and 2. A cross section from drill holes 7 to 13 is shown in Figure 37. Limited drill-hole data indicate that mineralization occurs as several lenses in a broad, northwest-trending stream bed and that most of the mineralization occurs just above quartz monzonite in a channel at the center of the stream (Fig. 37).

Average depth to quartz monzonite at the northeastward-most drilling bench is 50 feet. Quartz monzonite is exposed on parts of the southeastern-most drilling bench
Figure 36
Geologic Map, Big Hank, Pine Hen
& Side Hill groups
(modified after Rare Metals Corp. maps)
Figure 37 Cross-section, Big Hank

(Scales apply to both Figures)

Figure 38 Cross-sections, Lucky Strike No.2

Section from Drill Hole No.8 to Drill Hole No.2

Section from Drill Hole No.7 to Drill Hole No.14

Section from Drill Hole No.13 to Drill Hole No.7
where maximum depth to quartz monzonite is 16 feet; most of the mineralized beds have been removed by erosion.

The average thickness of mineralized beds penetrated by drilling was 1 1/2 feet. The thickest bed, at hole 11, was 5 1/2 feet thick; the average grade of this bed is probably about 0.30 percent U₃O₈. The average grade of thinner beds is probably about 0.15 percent U₃O₈.

Lignite or coal beds were not observed. Drill cuttings indicate that carbonaceous material occurs mainly as pore fillings in the arkose and sandstone.

Where exposed in the pits, quartz monzonite is moderately to highly iron stained and contains partially altered biotite. The presence or absence of biotite in drill cuttings was the main criterion used for differentiating quartz monzonite from sedimentary rocks during drilling. The porphyritic quartz monzonite is cut by pegmatite stringers.

Weathered quartz monzonite in drill-holes 7 and 8, in pit No. 3, and in the Side Hill pit No. 1 is mineralized (Figs. 37 and 36). Whether this mineralization is primary or secondary is unknown.

Lucky Strike

The Lucky Strike group of six claims is located near the head of Tick Creek in the NE 1/4 sec. 17, T11N, R14E. The Lucky Strike group lies between the Coal Creek and East Basin groups. The group, staked by William Brooks and Melvin Peterson, is under lease to the Rare Metals Corporation of America.

Bedded sedimentary rock is exposed in four bulldozer cuts. Since Kern's visit (1959, p. 28), a road has been built to the property and a total of 29 churn-drill holes have been driven on three drilling benches (Fig. 39). Most of the holes were driven to quartz monzonite; the deepest hole, No. 16, is 155 feet deep. Thirteen holes contain anomalous radioactivity. Twelve of these holes are on the lower and middle drilling benches. The middle drilling bench is 37 feet higher than the lower drilling bench.

The hillside has a 20° slope to the southwest. The mineralized, sedimentary beds strike northwest and dip 35-45NE into the hill. Limited data from drilling logs indicate that the depositional contact between the quartz monzonite and sedimentary rocks also dips into the hill and generally conforms with the bedding (Fig. 39). The depositional contact at the upper drilling bench does not conform to that at the lower and middle drilling benches. A fracture zone, exposed at the western end of the lower drilling bench, strikes N45W. Probably a northwest-trending fault separates the upper drilling bench from the two lower benches; the southwest wall of the proposed fault would be displaced downward. At the Deer Strike-Elk claims, a northwest-trending fault has displaced the southwest block downward a minimum of 188 feet.
Sections along the lower and middle drilling benches indicate that mineralization occurs in several horizons; beds range in thickness from 0.5 feet to 2.5 feet (Fig. 38). Mineralization is restricted to sedimentary rocks containing carbonaceous material. The only mineralization of ore grade occurs beneath the lower drilling bench.

Mining of the deposit has not been attempted because mineralized beds are thin and are relatively low-grade. Open-pit mining would be difficult because the beds dip steeply into the hill. Serious dilution of ore would occur with open-pit or underground mining.

Little Joe

The four Little Joe claims are located near the top of the ridge east of Coal Creek and are in the W 1/2 sec. 16 and E 1/2 sec. 17, T11N, R14E (Fig. 8). The claims border the Elk No. 1 to the south and can be reached by Coal Creek road. The claims were staked and developed by Jack Keller of Sunbeam and Pete Yarosh of California.

Three large pits and several small cuts have been bulldozed along the road between the Elk No. 1 and the top of the hill. The upper pit is approximately 20 feet deep, the middle pit is 10 feet deep, and the lower pit is 15 feet deep. Ore-grade mineralization was not encountered and the property is inactive.

Exploration at the Little Joe claims has been concentrated on a belt of highly fractured sedimentary rocks that lie along the Coal Creek fault zone. The fault zone strikes N30-33E; faults within the zone dip from 75NW to 75SE. The main fault is exposed on the northeast wall of the upper pit. Sedimentary rocks form the northwest block and quartz monzonite forms the southeast block. Drag folds in the sedimentary rocks indicate that movement was predominantly strike slip. A breccia zone, 4 feet thick, occurs along the fault.

The sedimentary rocks consist of interbedded coal, mudstone, arkosic sandstone, and cobble conglomerate. Most of the carbonaceous beds are thin; however, one bed 3 feet thick was observed at the middle pit. Soil overlying the sedimentary beds is swampy and contains abundant carbonaceous matter of recent origin.

Several small basalt dikes cut sedimentary rocks in the middle pit. One 2-foot dike has an attitude of N60E 88NW and parallels the Stanley River fault. The dike crosses a N70W 72SW fault.

Only moderate amounts of mineralization were uncovered in the pits. A maximum reading of 0.16 milliroentgens per hour was obtained in the upper pit and 0.50 milliroentgens per hour in the middle pit. Autinite was observed in fractures of freshly broken, carbon-rich rock. Radioactivity readings, taken over a period of several months, indicate that uranium is being actively transported through the water-saturated fractured rocks and through the overlying swampy soil.
Figure 39
Geologic Map, Lucky Strike Group.
(Modified after Rare Metals Corp map.)
Four holes were drilled in and near the middle and lower cuts. The average depth to quartz monzonite in two holes was 40 feet; both holes were barren. The other two holes were 45 feet deep but did not reach quartz monzonite; neither hole could be probed.

Ore-grade mineralization was not encountered at the Little Joe claims and only a small area of unexplored sedimentary rock remains. Further exploration is not justified.

Mandate

The Mandate claims are on top of the ridge between American and Lower Harden creeks approximately one-quarter mile south of the road that leads to the American Creek placer grounds. The claims are in the NW 1/4 sec. 24, T11N, R14E, and were staked by C. F. Weaver, J. Weidman, and A. Shrank in 1958. Little work has been performed on the property since Kern’s visit in 1958.

Several pits and a caved shaft in quartz monzonite are old gold-silver prospects. Recent exploration for uranium has been concentrated on a small outlier of sedimentary rock that overlies quartz monzonite. The matrix of a poorly consolidated, channel-fill conglomerate contains some uranium. Much of the rock is brecciated and is highly stained with limonite. A fault in quartz monzonite with an attitude of N80W 48N is parallel to a fracture set that controls much of the Salmon River between Basin Creek and Yankee Fork.

A radiometric assay by Kern (1958, p. 35) indicated that mineralized rock contained less than 0.10 U₃O₈. The low grade of mineralization and the smallness of the deposit indicates that uranium cannot be mined profitably.

Miscellaneous claims and anomalies

Bill Brooks and Melvin Peterson have staked 14 Kelley Creek claims along the southwest side of Basin Creek, south of Kelley Creek. Several radioactivity anomalies occur in the granitic rock on these claims. Brooks and Peterson also hold two horse-shoe claims staked on granitic rock that they report to be highly radioactive; the claims are 1 1/2 miles up the first large gulch south of Noho Creek (oral communication). Slight radioactivity occurs in a bulldozer pit on the Shamrock claim located on the east fork of Upper Harden Creek. Two claims have reportedly been staked on several anomalies that occur along Elkhorn Creek.

In 1958, several anomalies were discovered during an airborne radiometric survey. The locations of these anomalies are shown on Figures 1 and 9. One is northwest of Blind Creek, five are in the Rankin Creek-Sawmill Creek area, and three are in the Valley Creek Lake-Hindman Lake area. Most of these anomalies are in granitic rock. When investigated on the ground, they were found to be associated with small pegmatite dikes. No ore was discovered.
GOLD, SILVER, AND FLUORITE VEINS

General statement

Gold and silver occur in veins and stringers in much of the Stanley area. Most of these veins and stringers are too small to mine; however, their number and distribution are such that they have contributed measurable amounts of placer gold to nearly all streams in the area.

Fluorite has been discovered only in the following three localities:

1) In a northerly trending belt, 1 3/4 miles long and 3/4 mile wide, that crosses the Salmon River at Big and Little Casino Creeks approximately 3 1/2 miles east of lower Stanley; gold and silver are intimately associated with much of the fluorite in a host rock of quartz monzonite-granodiorite.

2) On a mountainside in the northern part of the Yankee Fork district, 1 mile west of Jordan Creek-Mayfield Creek pass; fluorite forms veins in Challis tuffs and is unaccompanied by gold or silver.

3) On Hindman Peak ridge 1 1/4 miles southwest of Red Mountain; a single fluorite vein cuts Challis tuffs and is accompanied by gold and silver.

Most of the lode gold and silver mined in the Stanley area has come from bonanza-type veins in the Yankee Fork district. These veins are described in an Idaho Bureau of Mines and Geology report by A. L. Anderson (1949); only brief summaries of Anderson's findings are included in this report. Mines in the Yankee Fork district are shown on Figure 1.

Gold and silver veins studied during this investigation are mainly in the Stanley mining district; most veins are within 6 miles of Stanley.

Mineralogy and paragenesis

Minerals reported by Anderson (1949, p. 3) to occur in the Yankee Fork district include pyrite, chalcopyrite, sphalerite, tetrahedrite, galena, arsenopyrite, enargite, stephanite, miargyrite, pyrargyrite, argentite, electrum, gold, and gold and silver selenides. The more important minerals are argentite, electrum, gold, and the silver sulfantimonites and selenides. The ratio of silver to gold in most of the ore is 80 or 90 to 1.

Outside of the Yankee Fork district, the mineralogy of the auriferous veins studied is relatively simple. Primary vein minerals are mainly quartz, fluorite, pyrite, and gold. Silver occurs with gold in all veins where gold is present. Mineral assemblages
are mainly of three types:

1) quartz-pyrite-gold
2) quartz-pyrite-gold-fluorite
3) fluorite

Pyrite and gold also occur in some fault zones with pitchblende; however, the pyrite and gold probably are not genetically related to the pitchblende. Minor to trace amounts of chalcedony, calcite, galena, sphalerite, and chrysocolla were observed at some properties.

Veins are of the epithermal type; they formed partly by replacement and partly by open filling. Primary openings occur along vein centers, especially in thicker veins that contain late-stage fluorite. Perfect, singly terminated crystals encrust most cavities and vugs.

The paragenetic sequence of mineral deposition is shown below:

```
Quartz
Pyrite
Gold
Fluorite
Quartz
Pyrite and gold
```

This sequence is almost perfectly developed in zoned veins at the Bright Star and Homestake mines in the Casino creeks area. Many of the thin stringers in granitic rock throughout the Stanley area contain only the first three stages—quartz, pyrite, and gold. Primary openings are not common in these stringers. In the Jordan Creek–Mayfield Creek pass area, only fourth-stage fluorite is present.

Quartz, the main mineral in most veins, generally grades from a massive, milky-white, bull quartz at vein walls to a clear, comb quartz towards vein centers. Minor amounts of a fine-grained, second-generation, grayish quartz following fluorite were observed at some properties. This quartz is like much of the fine-grained quartz in the Yankee Fork district (Anderson, 1949, p. 17).
Pryte overlaps and follows first-generation quartz. At all properties examined, pyrite is accompanied by gold. Much of the pyrite in the Casino creeks area occurs as stringers of coalesced pyritohedrons that coat comb-quartz structures. Most stringers are 1/16 to 3/4 inch thick; small grape-like pods occur along some stringers. Subhedral pyritohedrons occur scattered within late, first-generation quartz. The pyritohedrons average 3 to 5 mm across. At most properties, pyrite has been altered hydrothermally; pyritohedrons are composed of relict cores of unaltered pyrite and rims of hematite. In many cases, hematite has been altered to limonite by weathering. At the Iron Crown mine, pyrite cubes have been completely altered to hematite. The replaced cubes are surrounded by limonite halos. At several properties, second-generation auriferous pyrite forms tiny unaltered cubes disseminated in the grayish, second-generation quartz.

In most cases, gold formed simultaneously with or shortly followed pyrite. In polished section, gold occurs as blebs in pyrite and as irregularly shaped grains disseminated in quartz close to pyrite. At the Iron Crown mine, gold both molds former pyrite cubes and occurs as wire gold in very thin quartz stringers. Silver occurs in natural alloy with gold* in all properties studied; in nearly all cases silver exceeds gold quantitatively. In polished section, the gold is generally pale yellow; very little color variation occurs in gold from different properties to indicate the wide range in silver content. Table 8 shows the amount and relative percentages of gold and silver contained in some of the samples collected from properties throughout the Stanley area.

*The term gold is used in the report to include all natural gold-silver alloys including argentiferous gold and electrum.
TABLE 8
Amount and relative percentages of gold and silver in samples from properties throughout the Stanley area*

<table>
<thead>
<tr>
<th>Sample location</th>
<th>Au oz/ton</th>
<th>Ag oz/ton</th>
<th>% Au</th>
<th>% Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright Star No. 1 shaft, dump</td>
<td>0.74</td>
<td>15.58</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>Bright Star east adit, dump</td>
<td>0.56</td>
<td>5.94</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td>Homestake middle adit</td>
<td>0.17</td>
<td>1.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homestake upper adit</td>
<td>0.82</td>
<td>0.88</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>Gold Chance upper adit, dump</td>
<td>0.15</td>
<td>0.25</td>
<td>33</td>
<td>63</td>
</tr>
<tr>
<td>Vaught property, dump</td>
<td>1.20</td>
<td>2.52</td>
<td>32</td>
<td>68</td>
</tr>
<tr>
<td>Iron Crown upper adits, dumps</td>
<td>0.60</td>
<td>0.46</td>
<td>57</td>
<td>43</td>
</tr>
<tr>
<td>Mountain Girl raised stope</td>
<td>0.41</td>
<td>0.92</td>
<td>31</td>
<td>69</td>
</tr>
<tr>
<td>Mountain Girl adit</td>
<td>0.42</td>
<td>2.46</td>
<td>15</td>
<td>85</td>
</tr>
<tr>
<td>Golden Day, dump</td>
<td>0.21</td>
<td>0.39</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>Hygrade Mine, upper adits, highest dump</td>
<td>0.54</td>
<td>6.96</td>
<td>7</td>
<td>93</td>
</tr>
<tr>
<td>Hygrade Mine, upper adits, lowest dump</td>
<td>0.42</td>
<td>6.12</td>
<td>6</td>
<td>94</td>
</tr>
<tr>
<td>Hygrade Mine, dump at Yankee Fork</td>
<td>0.64</td>
<td>1.66</td>
<td>28</td>
<td>72</td>
</tr>
<tr>
<td>Hardee No. 3 adit</td>
<td>0.18</td>
<td>0.50</td>
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</tr>
<tr>
<td>Crystal, dump</td>
<td>0.44</td>
<td>2.88</td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>Independence, dump</td>
<td>0.46</td>
<td>1.22</td>
<td>27</td>
<td>73</td>
</tr>
<tr>
<td>Anderson prospect, Montana Gulch</td>
<td>0.27</td>
<td>2.13</td>
<td>11</td>
<td>89</td>
</tr>
</tbody>
</table>

*Fire assays performed by M. H. Alief, Minerals Analyst, Idaho Bureau of Mines and Geology

Fluorite follows pyrite-gold in some veins and occurs alone in others. Fluorite is green, lavender, or colorless. Some fluorite veins are composed of uniformly colored fluorite; others are delicately banded. Vugs and cavities along vein centers commonly are lined with perfect fluorite cubes and tetrahedrons. Beryllometric assays indicate that the fluorite veins west of Jordan Creek-Mayfield Creek pass contain trace to minor amounts of berylum.

**Economic potential**

Only sporadic, small-scale mining for vein gold and silver has been attempted in the Stanley area since the thirties. Annually increasing mining costs in relation to government controlled fixed prices of gold and silver have progressively reduced the chances of successful operation of new ventures.
Outside of the Yankee Fork district and possibly the Red Mountain area, it is doubtful that any of the known gold-silver veins in the Stanley area could be profitably mined even if the price of gold and silver were increased several fold. Several thousands of feet of workings have been driven along many of these narrow veins in the hopes of finding ore pods or lenses thick enough to mine. In almost all cases, the veins had uniform thicknesses and any ore shoots encountered were far too narrow to mine. A typical example is the Homestake mine in which $16,000 was spent to drive 725 feet of the north adit. Total production from the property was less than $1,600 in hand-cobbled ore derived from quartz stringers which had a maximum thickness of four inches. Possible exceptions are the Golden Day and Mountain Girl mines. Thickness of mineralized structures on these properties justifies preliminary low-cost sampling and exploratory drilling programs.

In the Red Mountain area, exploration has been too limited and sampling too sporadic to justify even preliminary evaluation. A low-cost program of cleaning out old workings and of extensive sampling is justified by exposed mineralization.

The production record of the Yankee Fork district justifies the risk of rather expensive drilling programs in search of possible extensions of former ore bodies or blind ore bodies along the district's known zones of mineralization. The recent rise in the price of silver may initiate such exploration. However, the unusually high risks involved require that exploration programs be guided by only the most expert of geologic advice. Sampling should be extensive and thorough.

Small investors should be warned that the numerous showings of free gold throughout the Stanley area have been used in the past to promote rather flamboyant stock offerings.

**Property descriptions: gold-silver-fluorite veins**

**Bright Star**

**Location, mine workings, and ownership** The Bright Star mine located on the nose of the ridge northeast of Copper Creek is in the NE 1/4 sec. 30, T11N, R14E. The workings, 1/4 mile northwest of U. S. 93, can be seen from the highway.

Mine workings comprise three adits, two shafts, and a number of prospect pits and trenches (Fig. 40). A map of the 500 feet of workings in the badly caved west adit is shown on Figure 44. The portal of the east adit is caved, as is much of the upper adit. The No. 1, 40-foot shaft and the No. 2, 90-foot shaft are partly filled with water.

The property was discovered by George McGowan and was briefly mentioned in the Challis "Silver Messenger" of August 30, 1895, as containing sylvanite ore.
Figure 41
Hideout No.1 Adit

EXPLANATION
Strike and dip of fault: 70° 15'
No. 1 Fault; 70° 15' dip.
Favorable bearing and plunge of alteration zones.
Radioactivity in milliroentgens/hr.

Figure 42
Giantspar Adit

Figure 43
Mountain Girl Mine

Figure 44
West adit, Bright Star Mine
Most of the underground workings were driven by John Benzer of Stanley in the late 1940's and early 1950's (J. Benzer, oral communication). The property was held for a short time by the J. R. Simplot Company for its fluorite content and was restaked for its gold by Benzer on October 6, 1956.

Production figures are not available. It is doubtful that more than a few tons of hand-cobbled gold ore have been shipped.

Geology  Country rock is quartz monzonite-granodiorite. From the main workings, two porphyritic rhyolite dikes trend north along the ridge for approximately one-half mile. The light-gray rhyolite contains small scattered phenocrysts of a pale pink potassium feldspar. Both dikes are badly brecciated and have been offset by numerous faults.

Mineralization is along a shear zone at least 60 and possibly 120 feet thick; the zone is composed of closely spaced faults, veins, and lenses of brecciated wall rock. The hanging wall of the shear zone is well exposed in the collar of shaft No. 2 where it has an attitude of N10E 83W. The hanging-wall block at the shaft is brecciated dike rock. The footwall of the shear zone was not observed at the surface; however, it is exposed in a short crosscut at the bottom of the flooded shaft No.1 (J. Benzer, oral communication).

Veins in the shear zone range from a fraction of an inch to 3 feet thick. Vein minerals are quartz, fluorite, pyrite, and native gold.

According to Benzer, gold mineralization occurs mainly in a thin, rich vein at the footwall of the shear zone and in a narrow seam at the hanging wall. Veins within the shear zone contain a maximum of $5 in Au per ton (J. Benzer, oral communication).

Hand specimens that came from the footwall vein were collected from a small ore pile by shaft No. 1. These specimens indicate that the vein is 1 to 3 inches thick, composed of quartz, pyrite, and gold. The vein formed by open filling; vein walls are lined with comb quartz and primary openings occur along the vein center. Aureiferous pyrite, as coalesced subhedral pyritohedrons, forms a discontinuous band up to 1/2 inch thick in the vein center. Most of the pyrite has been altered to limonite; some pyritohedrons consist of relict pyrite cores rimmed by limonite shells. In a few hand specimens, blebs of gold were observed in the altered pyrite with the unaided eye. A grab sample of the vein material assayed 0.74 oz. of Au and 15.58 oz. of Ag per ton. Assays of samples collected by Benzer from the footwall vein ranged from $1 to $550 per ton in Au and Ag (oral communication).

Gold at the hanging wall is sporadically distributed and is probably present mostly as free gold in gouve. A specimen of hematite-stained dike rock, collected five feet from the surface in shaft No. 2 contained free gold on fracture surfaces. The gold forms minute circular flakes "plastered" to fracture walls and may be of supergene origin.
Several fluorite veins occur within the shear zone. The most abundant fluorite observed is in a composite vein exposed in a short uncleaved portion of the upper adit. The vein is 3 feet thick and has an attitude of N4W 84E. The composite vein, containing 60 to 80 percent fluorite, is composed of fluorite veins up to 6 inches thick and non-pyritic quartz stringers. Fluorite at the Bright Star is generally green to colorless; some purple fluorite occurs near the centers of some veins. Colorless fluorite cubes up to 1 inch across line many of the vugs.

Telluride minerals were looked for, but not observed, in polished sections. A sample of fine-grained grayish quartz submitted to the U. S. Bureau of Mines for analysis, contained tellurium in trace amounts.

Giant Spar

Location The Giant Spar group is a quarter-mile south of the Salmon River in secs. 29, 30, and 31, T11N, R14E. The group extends from Big Casino Creek southwestward across Little Casino Creek. Four patented claims (Giant Spar, Giant Spar No. 2, Giant Spar No. 3, and Metallic No. 2) along with the unpatented Elizabeth claim compose the group (Fig. 40). Short roads extending up both creeks can be reached by a bridge across the Salmon River east of Big Casino Creek. The group is adjoined to the northeast by the Gold Chance claims and to the west and southwest by the Homestake claims. The Giant Spar, Homestake, and Gold Chance claims cover a northeast-trending, highly-sheared, mineral belt containing fluorite and gold-silver quartz veins.

Mine workings Mine workings include an old adit, 150 feet long, and a series of bulldozer cuts. The adit's portal is timbered; it walls and back are untimbered but are in good condition. The original wooden rails are still in place. All bulldozer cuts are partly slumped.

History The adit is reported to have been driven in early days by two Italian miners newly arrived from the California gold fields. The miners drifted along the conspicuous fluorite vein system expecting to strike a gold bonanza similar to those they had encountered in California. Gold mineralization was not found and the property was abandoned (John Benzer, Stanley, oral communication). Benzer staked the property during World War II and then sold his holdings to the Aluminum Corporation of America. ALCOA explored the property by bulldozer and diamond-drill coring. Four holes were drilled on a 45 degree incline; the vein system was intercepted at a maximum depth of 280 feet. Vein locations and vein thicknesses as determined by ALCOA geologists are included in the geologic map of Figure 40. A few truck loads of fluorite shipped during or shortly after World War II comprises the only known production. The property is now inactive.
Geology  Fluorite is more abundant and forms thicker veins on the Giant Spar claim than at any other known locality in the Stanley area. Fluorite mineralization occurred as open filling in faults and breccia zones in quartz monzonite country rock. Measurable amounts of gold or silver have not been found with fluorite. Surface mapping and diamond-drill coring by ALCOA indicate that several sinuous branching veins form a vein system that trends northeast (Fig. 40). Individual veins dip steeply northwest and strike N10-50E. A maximum vein thickness of 14.8 feet was measured by diamond drilling.

At the portal of the Giant Spar adit a composite vein 10.6 feet thick is exposed. An 18-pound sample chipped from above the portal and across the vein contained 71.5 percent CaF_2 and no Au or Ag. The composite vein consists of several closely spaced, badly brecciated, fluorite veins. The north wall of the composite vein is formed by a conspicuous fault with an attitude N29E 84NW; slickensides plunge 18SW. The fault cuts fluorite, and brecciated fluorite occurs in fault gouge. Southwest and northeast of the adit, the vein strikes N10-15E.

Underground, badly brecciated massive fluorite is exposed for 43 feet from the portal along the adit's north wall and for 22 feet along its south wall (Fig. 42). Narrow broken segments of granitic rock extending into the vein indicate that repeated fault movement took place along a series of closely spaced fractures. Both walls, between the 43-foot station and the face, are highly altered quartz monzonite containing numerous fluorite veinlets and stringers.

Fluorite is non-radioactive and non-fluorescent but is distinctly triboluminescent. Veins are banded and are composed of pale-lavender, colorless, and pale-green fluorite. Perfect fluorite tetrahedrons line some vugs, and minor second-generation fluorite fills fractures in early fluorite. Minor chalcedony and minute cubes of unaltered pyrite that filled vugs in fluorite, were observed in a vein 67 feet from the adit's face. The only other pyrite observed occurs in a stringer 1/16 inch thick located at the portal.

Intense hydrothermal alteration of quartz monzonite wall rock just south of the portal has produced a narrow zone of gneissic rock with a "lemon drop" texture.

Two or more basalt dikes are poorly exposed in bulldozer cuts up the slope and north of the portal of the Giant Spar adit. The dikes are badly weathered but have the same appearance as basalt dikes cutting arkose and Challis tuffs on the Little Joe uranium claims. One dike with a strike N15E was estimated to be 8 feet thick and to be nearly vertical. The dikes are fractured and contain stringers of calcite and chalcedony. Probably the dikes are post-Challis.

At least one, and probably two, rhyolite dikes cross the Giant Spar group. Rhyolite is gray to greenish-gray in color and has a fine-grained, sugary texture. Quartz and potassium feldspar phenocrysts are either absent or are few in number. Vitreous
chilled border zones have a maximum thickness of 1 foot. Dike segments just east of Little Casino Creek have strikes ranging from N33W to N53W and dips ranging from 62NE to 70NE. Thickness of the north (?) dike is 75 feet and thickness of the south (?) dike is 60 feet. Dike rock at the creek has been intensely faulted.

Two fault zones intersect rhyolite dike rock at the creek. One fault zone, which strikes approximately N15E, may merge with the fault at the Giant Spar adit. The second fault zone, which strikes N60E, is probably post-mineralization. The N60E faults are associated with the Salmon River fault. Rhyolite dike rock has been subjected to right-lateral displacement by both fault systems. Approximately 290 feet of lateral displacement along N15E faults was measured from dike offset.

In addition to faults described above, other faults with NE strikes are present on the Giant Spar group. Because recurring movement took place along most faults, fault-vein age relations are difficult to interpret.

**Homestake**

**Location** The Homestake mine consists of several adits and prospect pits located one-third mile south of the Salmon River and between Little Casino Creek and the ridge crest to the west. The Homestake adjoins the Giant Spar on the east and south-east and is in the SE 1/4 sec. 30 and the NE 1/4 sec. 31, T11N, R4E.

**Mine workings and history** The most extensive underground working is the 900-foot, east adit located 1,500 feet south of the Salmon River and 50 feet above creek level (Fig. 40). The adit is crooked and partly caved; rotten timbers offer poor support to a weak back of deeply altered granitic rock. The first 175 feet of the adit were driven in early days; a 725-foot extension was completed in 1942 by Arnold Woolard of Stanley, at a cost of $16,000.

The middle adit, 300 feet to the east, is caved from the portal for 50 feet. The remaining 60 to 80 feet of adit is open but is almost inaccessible. Wooden rails still in place indicate that the 370-foot north adit was driven in early days. The short, partly caved, upper adit was driven by Woolard in the 1940’s.

Only known production is that by Woolard who shipped between $1,000 and $1,600 of hand-cobbled gold ore from the east, middle, and upper adits.

The Homestake is now claimed by Maurice Patterson of Stanley.

**Geology** The Homestake is located on the southwest end of the mineralized belt that crosses Big and Little Casino creeks. Quartz monzonite country rock is cut by rhyolite dikes. Country rock and dikes have been badly brecciated and sheared by at least two and possibly three sets of faults. Veins and stringers of quartz with fluorite and gold-silver bearing pyrite fill some fractures. Movement has recurred along many of the vein-filled fractures. Underground explorations indicate that the veins are too thin to be mined.
Economically.

**East adit** The first part of the adit was driven along a prominent fault zone in deeply weathered and highly altered granitic rock. Attitudes of individual faults in the fault zone range from N50E 80°E to N70E 75°W. The most pronounced fault has an attitude N65°E 90°E; deep slickensides plunge 12NE. The fault zone is associated with the Salmon River fault.

Brecciated wall rock, thick gouge seams, and quartz veins and stringers are exposed along most of the adit. Fifty feet from the portal, the intersection of two high-angle faults has been explored with a stope and a winze. The vein exposed in the stope back has a maximum thickness of 2 feet.

The portion of the adit driven by Woolard forms a haphazard pattern that follows numerous auriferous pyrite-quartz stringers, which are rich but average only 2 inches in thickness. Hand-picked ore assayed up to $1,400 per ton in Au and Ag (A. Woolard, oral communication).

Vein minerals observed in the adit and on the dump included quartz, pyrite, and some green fluorite.

**Middle adit** At the middle adit, cleavage fractures in brecciated rhyolite dike rock contain stringers and small pods of quartz with auriferous pyrite. Several stringers occur in a zone 8.5 feet wide exposed along the walls and at the head of the caved portion of the adit. Average thickness of the stringers is less than 1 inch. Small pods up to 2 feet long and several inches thick occur along the stringers. Attitude of the stringers is N42°E 73°W.

Auriferous pyrite is abundant in the stringers; average size of the pyritohedrons is 5 mm in diameter and pyrite "clots" up to 15 mm across were observed. Pyrite is generally earlier than quartz and is concentrated along vein-wall contacts. Subordinate pyrite is disseminated in rhyolite close to vein contacts.

A selected sample collected by Wollard assayed 186 oz. of Au per ton and 180 oz. of Ag per ton (oral communication). A composite sample that I took from across the stringers assayed 0.17 oz. of Au and 1.33 oz. of Ag (per ton).

**Upper adit** The upper adit explores a quartz vein two to three feet thick, that forms the top of the ridge for several hundred feet. The vein occupies a fault zone with an attitude N44°E 78°W. Slickensides plunge 20°E and imperfectly developed chatter marks indicate that movement was normal.

Vein minerals are quartz, fluorite, pyrite, and free gold. Quartz is probably of two generations. Early, barren, bull quartz forms most of the main vein. Late quartz forms stringers in narrow fractures. Most pyrite is plastered to walls of fractures filled with late quartz. Minor pyrite is disseminated in quartz stringers.
Fluorite younger than quartz, fills vein centers and is colorless, white, green, or purple. Colorless and pale-lavender fluorite cubes line openings in vein centers. Gold is intimately associated with pyrite. One 8" x 14" specimen of brecciated rhyolite containing free gold, was found on the dump. Over 300 pyrite crystals, averaging 4 mm across are exposed on a fracture face of the specimen. Nearly all the subhedral pyrithedrons contain one or more megascopic gold crystals, the largest of which is 2 mm. long.

Auriferous pyrite mineralization at the upper adit is concentrated at the intersection of the fault and a narrow rhyolite dike.

North adit  Little mineralization occurs in the north adit. The adit cuts several sequences of rhyolite dike rock and quartz monzonite (Fig. 46). Faults are abundant and all rock is badly brecciated.

Gold Chance

Location  Several mine workings and prospect pits are located on the northeast end of the mineralized belt that crosses Big and Little Casino creeks (Fig. 40). The workings are in the N 1/2 sec. 29, T11N, R1E, and are located between Big Casino Creek and the ridge crest to the east. Most claim notices have been destroyed; therefore, all workings are included here as part of the Gold Chance group.

Mine workings  The main workings consist of a lower adit, an upper adit, and a caved shaft. The lower adit, reported to be 400 feet long, is caved at the portal. The adit is approximately one-half mile from the Salmon River and 400 feet northeast of the creek. The only mine working open in 1960 was the upper adit, which consists of 490 feet of drifts and crosscuts (Fig. 45). The upper adit is near the ridge top, northeast of the lower adit. A 20-foot shaft located half way up the ridge and above the lower adit was destroyed during construction of a temporary mine road to the upper adit.

History  Information on the history of the group was obtained from John Benzer of Stanley. About 1893, a specimen of vein quartz float containing abundant free gold was found in the shallow gulch 200 feet north of where the lower adit is now located. The specimen was approximately 6 inches across and assayed $17,500 (per ton). A Mr. Richardson staked the property and between 1893 and 1910 drove the lower adit and 390 feet of the upper adit. Richardson mined $6,000 in gold from a pocket at the portal of the upper adit. No other production from the group is known.

John Benzer thoroughly prospected the gulch in which the specimen gold was found and hand screened all overburden. No additional specimen gold was found either in place or as float.

Geology  Country rock is quartz monzonite-granodiorite of the Idaho batholith. The most extensive mineralization occurs in a northeast trending zone between the lower adit and the caved shaft (Fig. 40). A 1-foot quartz vein, with attitude N50E 72NW is exposed at the head of the caved portion of the adit. Rock at the adit is highly brecciated and silicified and contains numerous quartz stringers. A narrow, porphyritic rhyolite dike with attitude N60E 61NW is cut off at the fracture zone. Purple fluorite
and vein quartz containing small scattered pyrite cubes can be found on the dump.

The caved shaft is a few hundred feet up the slope and on the strike line of the lower adit vein. Exposed granitic rock is brecciated, silicified, and highly iron-stained. Vein quartz on the dump contains limonite-stained, honeycomb boxworks after pyrite. Open-filling textures in vein quartz predominate and small, singly-terminated quartz crystals that line vugs are common. Minor amounts of purple and sugar-textured white fluorite were found on the dump. One specimen of limonite gossan contained minute flakes of free gold. Benzer stated that samples from the shaft assayed a maximum of $20 per ton in Au and Ag (oral communication).

Two partly caved prospect pits are located on top of the ridge above Benzer's shaft. Their dumps contain silicified granitic rock, vein quartz, and chalcedony, but no pyrite or fluorite. Iron-stained fractures with an attitude N65E 60SE are exposed in the largest pit.

Little mineralization occurs in the upper adit or in weathered granitic rock outside the portal. A few quartz stringers cut the portal's limonite-stained east wall. Dumps contain small amounts of chalcedony and pyrite-bearing quartz. Rock in the adit has been cut by numerous faults. The youngest fault, with an attitude N22E 11NW, produced a conspicuous gouge zone. Early-day miners drifted along this fault and explored it with short crosscuts to the northeast and southwest (Fig. 45). Anomalous radioactivity up to 0.30 milliroentgens per hour occurs in cross-faults in the north-east crosscut.

**Vaught Prospect**

Several old adits and prospect pits are along Little Casino Creek approximately one-half mile upstream from the Giant Spar group. The portals of all the adits are caved. Country rock is quartz monzonite-granodiorite.

The portals of two adits on the west side of the creek are about 50 feet apart. Pyritiferous vein quartz and minor amounts of pale-lavender fluorite can be found on the dumps. Jason Vaught of Stanley stated that the upstream adit is about 300 feet long and follows a gold-bearing quartz stringer. The adit intersects a 1 1/2-foot fluorite vein approximately 150 feet from the portal (Vaught, oral communication).

A 9-inch quartz vein exposed at the portal of the downstream adit has an attitude of N45E 62NW. Several quartz stringers near the portal fill fractures in a set that has an attitude of N15E 65W. Little Casino Creek parallels this fracture set.

On the east side of Casino Creek adits were driven on three levels along an auriferous pyrite-quartz vein.
**Hide Out**

**Location and geologic setting** Several surface and underground workings are along Lynch Creek in the SE 1/4 sec. 19, T11N, R14E. Few of the workings had claim notices posted and all are included here as part of the Hide Out group.

Fluorite and quartz veins up to 3 feet thick are exposed in the workings. The veins follow faults and fault zones that cut the quartz monzonite-granodiorite country rock. Vein attitudes range from N5E 90° to N12W 66SW. Portions of Lynch Creek parallel fault sets with attitudes of N10W 83E and N65W 80NE.

**Adit No. 1** Adit No. 1 is on the northeast side of Lynch Creek 1/4 mile north-west of U. S. 93. The 91-foot adit follows a brecciated quartz vein for 66 feet (Fig. 41). At the portal, the vein is 3 feet thick and contains a few scattered pyrite cubes. The vein is parallel to a well-defined fault with an attitude of N10W 83E; s里程-sides plunge 58°. Exposed at the face is a mineralized 2-foot fault zone with an attitude of N5E 78E. Anomalous radioactivity of 0.45 milliroentgens per hour was measured in a short crosscut.

**Lower cuts** Shallow bulldozer cuts in a dry gulch just downstream from adit No. 1 expose a narrow vertical fault zone. Strikes of individual shear planes range from north to N30W. A vertical quartz vein that ranges in thickness from 2 to 6 inches and strikes north, contains massive and sugar-textured quartz with scattered pyrite crystals up to 3 mm across; small cavities contain fine-grained pyrite. Stringers paralleling the quartz vein contain purplish-black and green fluorite. Anomalous radioactivity up to 0.11 milliroentgens per hour was measured along the vein. Granitic rock up to three feet from vein walls has been kaolinized.

**Adit No. 2** An old adit with caved portal is located across Lynch Creek and downstream from adit No. 1. The caved portion of the adit bears S15W. Medium-sized trees growing on the dump indicate that the adit was driven in early days. Dump material indicates that the miners were following a vein at least 1 foot thick. Vein minerals include sugar-textured quartz as well as quartz crystals that line vugs and openings; purple and colorless fluorite in thin veinlets and as perfect cubes that line vugs; and minor pyrite as subhedral pyritehedrons.

**Adit No. 3** Adit No. 3 has its caved portal a few feet above creek level near the junction of the north and west branches of Lynch Creek. Size of the dump indicates that over 100 feet of underground workings exist. Dump material contains sugar-textured vein quartz cut by veinlets of colorless, green, or purple fluorite. Fluorite veinlets are 1 to 2 inches thick. Vein quartz contains some boxwork and is moderately iron-stained. The miners were following a set of mineralized, closely spaced fractures with an attitude of N65W 80NE.
Upper cuts A hand-dug trench and a bulldozer cut about 500 feet up the slope from adit No. 3, expose fluorite and quartz veins. A zoned vein at least two feet thick is poorly exposed in the trench. The vein contains white chalcedony and sugary quartz in the outer zone, purple fluorite in an intermediate zone, and green fluorite in the inner zone. The total fluorite thickness is four inches.

The bulldozer cut, 200 feet north of the hand-dug trench, exposes a 3-foot, zoned vein with an attitude of N12W 66SW. The inner two feet of the vein are composed of fluorite, most of which is green. Scattered pyrite crystals line the boundary between the inner fluorite zone and an outer quartz zone. Small fluorite cubes with perfect transparency line vugs along the vein center.

Lamb prospect

Fluorite was discovered in the northern part of the Yankee Fork district by Van Lamb of Stanley in 1960. The fluorite occurs in a series of veins, stringers, and breccia fillings along a northeast-trending zone at least 1 mile long and several hundred yards wide. The northeast end of the zone of known mineralization crosses the Jordan Creek-Mayfield Creek divide about 3/4 mile west of the road to the Loon Creek Ranger Station. The thickest fluorite veins discovered to date are about one mile west of the lowest hairpin turn in the road south of the pass (Fig. 1). These veins crop out on the bare southern and eastern slopes of the mountain one mile southeast of Mount Jordan.

Host rocks are highly fractured andesite and rhyolite flows of the Challis group. The andesite flows are generally massive and grayish green in color, whereas the rhyolite flows have imperfectly developed columnar structures, contain small quartz and pink orthoclase phenocrysts, and are buff colored.

On the eastern slope, fluorite was observed for about 300 feet along a vein system that has a general attitude of N10W 20SW. Thickness of individual stringers and veins ranged from a fraction of an inch to 14 inches. A sample taken across the main 14-inch vein contained 49.2 percent CaF₂. The vein system has been displaced by a fault with an attitude of N65E 45NW.

On the southern slope, fluorite forms veins and breccia fillings along a fault zone with an attitude of N45E 64NW. The main vein, traceable for 600 feet, ranges in thickness from a few inches to four feet. Besides fluorite, the vein contains calcite, chalcedony, quartz, and breccia. A four-foot sample, cut across the vein, contained 39.4 percent CaF₂.

Although fluorite throughout the mineralized area is mostly colorless, some is pale green or very pale lavender. Fluorite veins and stringers are accompanied by calcite, chalcedony, and quartz; however, no metallic minerals were observed. The two samples collected for assaying contained no gold or silver. Several samples,
collected by Lamb and assayed with a laboratory beryllometer by Adolph Poston, contained trace amounts of beryllium (assay chemist, U. S. Bureau of Mines, Salt Lake City). The highest value of 0.08 percent BeO occurred in a sample composed mostly of selvage and cementing material (V. Lamb, oral communication).

During the summer of 1961, Lamb continued prospecting for fluorite and staked several claims along fluorite veins because of their trace to minor beryllium content.

**Property descriptions: gold-silver veins**

**Iron Crown**

The Iron Crown mine is near the head of Joes Gulch and is in the SE 1/4 sec. 22, T11N, R13E. The mine can be reached by a fair jeep road from the headwaters of Kelley Creek or by a poor jeep road, 1.8 miles long, up Joes Gulch. Mine workings are in a steeply dipping, rhyolite porphyry dike and comprise a lower adit caved at the portal, a 316-foot middle adit, a 98-foot upper adit, and a small pit above the upper adit (Fig. 47). An abandoned 5-stamp mill is at creek level below the drifts.

The property was originally located by William Casto (Bill Sullivan, Stanley, oral communication). Earliest citation of the mine in literature is in the State Mine Inspector's report for 1905 (Bell, p. 49). Bell stated that during the winter of 1905 a 5-man crew was developing an ore shoot carrying average values of $10 to $12 per ton (Au at $20.67 per troy oz.). The mill was constructed about 1912-13 by the Jones Brothers of Three Forks, Idaho(?). Several attempts to operate the mill in ensuing years are reported to have been economically unsuccessful (Frank Preston, Stanley, oral communication).

Mineralization seems to have been restricted to fractures in the 30-foot dike, much of which is covered by mine dumps and thick soil. The dike strikes approximately N8W and dips from 62 to 80E. A high-angle fault cuts the dike between the middle and upper adits; the dike has been offset left laterally about 45 feet. The fault has different attitudes in different parts of the mine; an average attitude is NSE 85E. Just west of the portal of the middle adit, the fault follows the footwall of the dike and contains up to 2 feet of gouge; slickensides plunge 15N.

The dike is cut by three dominant sets of cooling fractures; two mutually perpendicular sets are also perpendicular to dike walls and the third set parallels the walls.

Mineralization occurred mostly as open fillings along the cooling fractures. The most intense mineralization is in fractures close to the high-angle fault. The main vein-minerals are quartz, pyrite (altered to hematite and limonite), and native gold-silver. One 1-inch calcite veinlet was observed in fault gouge 150 feet from the portal in the middle adit.
Figure 47 Sketch and Maps of Upper & Middle Adits, Iron Crown Mine
Mineralized cooling fractures are spaced from 6 inches to 3 feet apart. The quartz-pyrite-gold veinlets observed had an average thickness of 1/16 inch. The centers of most mineralized fractures are open and the vein minerals are "plastered" to both walls of the fractures. Euhedral quartz and altered pyrite cubes occur in about equal amounts along the fractures. All pyrite has been completely altered to hematite or limonite. A few altered pyrite cubes can be found along hair-line fractures several inches from cooling fractures.

Approximately 100 hand specimens containing free gold were collected from the dumps. The majority of the gold formed as small, irregularly shaped blebs and as wire gold, intimately intergrown with pyrite. Several of the specimens containing free gold were crushed and fire-assayed. The resulting sample contained 0.51 oz. of Au and 0.43 oz. Ag per ton.

A sample representative of any workable width of the dike would probably be of lower grade than the above sample. Rich gold stringers probably fill some fractures; however, barren dike rock between fractures would substantially reduce the grade of any mill-run ore mined.

Mountain Girl

Underground workings of the Mountain Girl, also known as the Apex and as the Golden Nugget, are a few hundred feet northwest of the SE corner, sec. 29, T11N, R13E. The mine is near the top of the low ridge southwest of Stanley Creek. The workings are reached by a jeep trail leading from Nip and Tuck Creek road.

The Mountain Girl was discovered and worked in the early days by Patrick Lynch (A. McGowan, Custer, oral communication). Most of the development work was performed in recent years by Fred and Earl Shirts of Hailey. Some ore from the mine was processed in a 5-stamp mill formerly located on Nip and Tuck Creek. Production and ore grade are unknown.

A sketch map of the underground workings are shown in Figure 43. The main development is a 225-foot adit that follows a vein with a general attitude of N30E 40SE. The adit's portal is caved and two inclined shafts that intercept the adits are badly slumped. Water standing in the two inclined winzes indicates that the oxidized zone is approximately 50 feet deep.

The vein follows a fault zone in granitic rock. Vein thickness, which ranges from a few inches up to 3 feet, averages about 18 inches. The vein is composed mostly of bands of massive bull quartz and stringers of comb quartz. Open-filling textures are common. Much of the vein has been badly brecciated and re-cemented with second-generation quartz. Minor copper occurs as small crystals of chrysocolla and uncommon malachite. Chrysocolla is accompanied by rather abundant secondary limonite. Boxwork textures indicate limonite replaced an anhedral iron
sulfide, probably chalcopyrite. No unaltered sulfides could be found in the mine or on the dumps.

Gold occurs in the ore but was not observed in hand specimens collected. A sample chipped from across the vein in the raised stope (Fig. 43) contained 0.41 oz. of Au and 0.92 oz. of Ag (per ton). A composite sample chipped from across the vein at several places along the adit's back and face contained 0.42 oz. of Au and 2.46 oz. of Ag. These limited data indicate that the Au-Ag value of the ore in the oxidized portion of the vein is about $16 per ton. Below the water table, unleached silver and copper might add substantially to the ore value.

Golden Day

The Golden Day group of 12 unpatented claims (Golden Day Nos. 1-12) are on the northwest side of Potato Mountain. The claims are aligned along the tops of the two ridges bordering Cabin Creek and form a crude V which faces east. The main mine workings comprise a 110-foot upper adit, containing a 50-foot shaft, and a 280-foot lower adit. The caved portals of the adits are beside the east fork of Sawmill Creek road, 3.5 miles from Kelley Creek. Walter Lynch made the original vein discovery, in the late 1800's or the early 1900's, by panning his way first up Basin Creek and then up Cabin Creek (Jesse Lynch, Stanley, oral communication). The property is now held by Ivan W. Day of Ketchum.

Two shipments of sacked ore were made by Day in 1937 (oral communication). The first shipment of 1,848 pounds contained 1.74 oz. of Au and 14.6 oz. of Ag per ton. The second shipment of 19,430 pounds containing 0.56 oz. of Au and 3.2 oz. of Ag per ton barely covered shipping and milling charges and mining was halted. Work was resumed in 1941 but was halted by government decree in 1942.

In 1960, slump material filled most surface cuts and covered any former vein exposures. A small ore pile beside the lower caved portal contains iron-stained granitic rock cut by quartz veins and stringers. Honeycomb boxwork textures are common in the vein quartz. Cavities with cubic and prismatical shapes indicate that pyrite was the main primary sulfide. Day stated that some chalcopyrite was encountered in the drift; however, smelter returns do not indicate that copper is present. Settlement assays show that the 1937, 10-ton ore shipment contained in addition to Au and Ag, 5.1 percent Fe, 2.3 percent Pb, 0.5 percent Zn, 0.1 percent As, and 0.7 percent S.

Mine maps supplied by Day, indicate that two veins were worked (Fig. 48). The lower adit intercepts a vein with an attitude of N72E 75N; the last 69 feet of the adit were driven southwest, parallel to the vein. In the adit, the vein ranged in thickness from 3/4 inch to 10 inches; however, pods occurred along the vein up to 3 feet thick (I. Day, oral communication).
Figure 48 Sketch Map, Claim Map, and Underground Workings; Golden Day Claims
The upper adit was driven along a vein with an attitude, probably, of N85W 85N (Fig. 48). A 50-foot shaft was sunk on the vein. Jesse Lynch, a miner in the 1941-2 operations, stated that the richest ore in the adit was in kidneys averaging 18 inches across. Lynch further stated that representative samples of the kidneys and of the 8-inch vein at the bottom of the shaft, assayed $200 and $160 per ton, respectively. These values are substantially higher than those shown on the mine map in Figure 48.

The locations of several veins, prospect pits, and shallow shafts not described above are shown on the sketch map in Figure 48.

Mountain Vein

The Mountain Vein prospect is high on the rounded ridge west of Stanley Creek and is near the SE cor. sec. 17, T11N, R13E. Workings consist of a hand-dug trench about 30 feet long and as much as 10 feet deep, and a small prospect pit a few hundred feet down the hill. Discovery was made by Walter Lynch in the early 1900's (Jesse Lynch, oral communication). The property was restaked by R. Davis and R. Niece in 1960.

The trench, in quartz monzonite-granodiorite, follows a fault zone with an attitude of N45W 62NE. The trench is within a few feet of the contact of a rhyolite dike. Fractures exposed in the trench contain quartz stringers up to 2 inches thick. A small ore pile contains vein material up to 6 inches thick. Small flakes of blue-green silver chloride and minor amounts of a black, silver (?) mineral were observed in the quartz. Lynch reportedly found pods of wire silver along the stringers.

The silver indicator plant *Eriogonum Ovalifolium depressum* (?) was observed growing downslope from the pit in a circular area about 300 feet in diameter.

Hygrade

The Hygrade claims are on the west side of Yankee Fork, 2.7 road miles north of Sunbeam. To reach the claims, it is necessary to ford Yankee Fork by foot, about 1/4 mile south of the dredge tailings. Workings consist of one caved adit about 100 feet above river level and three short adits located in a gulch approximately half way up the mountain.

Mineralized float can be found throughout the talus that covers the steep slope. The three upper adits were driven through talus to bedrock in attempts to discover the source of the vein float. A fault zone exposed at one adit has an attitude of N84W 44N; slickensides plunge 35NE. Fractures in the zone contain quartz stringers up to 2 inches thick. Most of the mineralized material on the dumps was probably collected from the talus. Besides quartz and chalcedony, vein minerals in dump material include galena, pyrite, molybdenite, and an unidentified radioactive mineral in gouge. Galena occurs in pods up to 3 inches across. Boxworks after galena and pyrite
are abundant in the vein quartz.

Gold and silver contained in three samples collected from the property ranged from 0.42 to 0.64 oz. of Au and 1.66 to 6.96 oz. of Ag per ton (Table 8).

Red Mountain area

Known mineralization in the Red Mountain area is confined to a zone several hundred yards wide and about two miles long that trends N45°-50°E from Hindman Peak ridge to Red Mountain. The workings on Hindman Peak ridge are reached by 18 miles of very poor jeep road from Valley Creek sawmill.

Host rock along the zone is highly fractured, hydrothermally altered Challis Volcanics. Gold and silver occur in rich but narrow shoots in quartz veins and in wide but low-grade breccia zones. Prospectors that have worked in the area report that the gold-silver ratio at Hindman Peak ridge is higher than at Red Mountain. The gold-silver ratio of 26 samples from Hindman Peak ridge was 1 to 4; a single sample from Red Mountain had a gold-silver ratio of 1 to 6 1/2 (following, this section).

The Independence group (Independence and Independence Nos. 1-5) at the end of the jeep road are held by Eddie Martin and Ralph Fieldman of Stanley. The main prospect pit is just below the road and a few hundred feet before the end of the road. In 1960, the pit was badly caved. Dump material contains fine-grained and drusy quartz, fine-grained pyrite, and colorless to pale lavender fluorite. Martin stated that the pit was sunk on a northeast-striking fault that dips steeply northwest. A quartz vein along the fault reportedly contained a high-grade shoot that ranged in thickness from 1 to 4 inches. A 5-foot sample cut across an intersecting vein reportedly contained $20 per ton in gold and silver as did a composite sample taken at random from the dump. Martin has in his possession assay reports on 26 samples collected from the Independence claims. Nineteen of the samples contained gold-silver values ranging from $1 to $44; five selected samples ranged in value from $100 to $356. A weighted average (obtained by dividing all values over $100 by 10) of these 26 samples is $16 per ton. The average relative percentage of gold to silver for the 26 samples was 20 percent gold and 80 percent silver. A 25-foot adit and a 35-foot adit downslope from the pit, both driven in 1959, do not intercept the veins exposed in the pit.

Above the Independence claims are the seven Hindman and Jumbo claims held by Rupert Niece of Stanley. The main workings consist of two long adits that extend almost through the ridge. The lower adit is caved at the portal and the upper adit is badly caved half-way back. Mineralization in these adits is confined to narrow seams and stringers rarely thicker than a few inches (Anderson, 1949, p. 36-37).
A large number of prospect pits are on the northeast side of the ridge. Jack Laning has two claims in a landslide area containing mineralized debris.

The main workings on Red Mountain consist of two adits, caved at the portals, on Rupert Niece's Crystal claim. The adits, driven in the old days, reportedly contained up to 300 oz. of Ag (per ton). No information is available on the thickness of the veins. A sample taken from the dump of the north adit contained 0.44 oz. of Au and 2.88 oz. of Ag (per ton).

A prospect pit was sunk by Martin on a silver vein at the base of Red Mountain on the north side of Park Creek. According to Martin, the vein was 2 feet wide, struck northeast, and contained up to 600 oz. of Ag (per ton). Work was halted because of an influx of spring water.

Yankee Fork district

Most of the following brief description of the ore deposits and mines of the Yankee Fork district is abstracted from Anderson's publication of 1947. Prior to World War II, approximately $13,000,000 in silver and gold was mined from the district. The little mining and development work performed since Anderson's investigation, has been confined mainly to the Lucky Boy, McPadden, and Charles Dickens properties.

The silver-gold deposits occur mostly in several zones of highly fractured and altered rocks of the Challis Volcanics. The deposits are mainly epithermal veins or breccia fillings of the bonanza type. The veins are composed mostly of fine-grained or coarser comb and drussy quartz. The rich ore mined in the early days occurred in shoots or pockets close to the surface. Metallic minerals exposed in present workings are generally very fine grained and sparsely distributed through the quartz. Wallrock alteration, a conspicuous feature of all mineralized zones, is an important exploration guide. Alteration minerals are mainly fine-grained quartz, sericite, chlorite, and pyrite. Many of the veins fill fissure faults with general attitudes of N70E or N70W.

The more important mines of the district grouped according to the zone of mineralization in which they occur are:
Custer area

General Custer
Lucky Boy
Badger
Vishneo
Mullan
Yellow Bird
Black
Fourth of July
Wire Silver
Continental
McClure
Idaho
Long View

Estes Mountain area

Montana
McPadden
Why Not
Golden Gate
Tonto
Charles Wain
Gold Star
Arcade
Snowdrift
Mountain Chief
Kwajalein

Sunbeam area

Golden Sunbeam
Jesse James

Dickens area

Charles Dickens
Morrison
Red Rock
Bonanza

Bachelor Mountain area

Gray Eagle
Dorthy

Whale area

Whale

Miscellaneous

Many of the miscellaneous properties, prospects, and occurrences listed below are difficult to find; several could not be located during the course of field investigations.

Arnold Woolard reported that 200 feet of underground workings of the Black Cube claim are about 2 miles up Little Casino Creek. The adit's portal is high on the ridge in thick timber on the west side of the creek. Mineralization is restricted to quartz stringers containing visible gold in pyrite. No ore has been shipped.

A two-inch auriferous quartz vein is exposed in a prospect pit along the upper reaches of Noho Creek (J. Benzer, oral communication). The pit is near an old cabin. Near-by float contains up to $90 in gold per ton.

An eight-inch, high-grade silver vein reportedly crosses Salmon River a short distance upstream from Aspen Gulch. The vein is supposed to be visible only during
low water.

Partly caved underground workings of an old gold mine are on top of the ridge west of Peach Creek. The mine reportedly had 1,000 feet of underground workings. Ore from the mine was processed by a mill formerly located on Peach Creek.

Narrow, gold-silver quartz veins have been explored at several places in the drainage of Rankin Creek. An old adit on the north fork of Rankin Creek is 0.4 mile west of the intersection of the two forks. A grab sample of highly limonitic stained rock cut by quartz stringers from the dump contained 0.54 oz. of Au and 6.96 oz. of Ag per ton. The Sunrise No. 1 and No. 2 claims are on the nose of the ridge between the two branches of the south fork of Rankin Creek. Four Sunset claims adjoining the Sunrise claims to the southwest contain an adit with caved portal. The adit was driven along a series of closely spaced, hematite-stained fractures in the nonporphyritic granitic rock. Rock near the fractures has been moderately silicified and sericitized. A series of cuts has been bulldozed in granitic rock on the ridge north of Rankin Creek.

The Fran Clara property is on the low ridge south of the south fork of Nip and Tuck Creek. Workings consist of a 70-foot timbered shaft, the bottom 40 feet are filled with water. The shaft, sunk by Jason Vaught and George Strowbridge in 1955-56, follows quartz stringers cutting granitic rock (J. Vaught, oral communication).

An adit, driven by Jesse Lynch in the thirties, is on the slope west of the Willis diggings on Stanley Creek. The adit follows a narrow gold-silver-quartz vein in the granitic rock (J. Lynch, oral communication).

The Yankee Fork dredge, while cutting weathered bed rock about 1 mile south of the mouth of the west fork of the river, intersected a wide pyrite vein. A large sample of the broken pyrite sent to the College of Mines at Moscow for assay, contained $100 in gold per ton (W. Staley, Prof. Mining Engineering, oral communication). The exact location of the dredge at the time of cutting the vein was not recorded; no above-water outcrop of the vein could be found subsequently.

It seems that every mining region must have a lost mine legend—the Stanley area is no exception. The "Lost Swim" mine, staked by Izack T. Swim, was recorded at Bonanza as being "10 to 15 miles more or less in a southerly direction from Bonanza." Swim kept the exact location of the mine a secret. About 1884 Swim sold a mule load of ore in Ketchum that is reported to have been fantastically rich. Swim disappeared during his return trip to the mine the following spring. After Swim's disappearance, George Blackman, an early Washington Basin prospector, reported finding a mill-site claim of Swim's far up Big Casino Creek.
ANTIMONY VEINS

Silver Dollar

The Silver Dollar, in the SE 1/4, SW 1/4 sec. 15, T11N, R13E is in the center of the low flat saddle between Kelley Creek and Doran Gulch (Fig. 1). The property is reached by the road along upper Kelley Creek. Workings consist of a 35-foot shaft which is two-thirds filled with water and a recent, shallow bulldozer trench. Stibnite float near the shaft was first discovered by Arthur McGowan of Custer while he was prospecting for the source of the cinnabar found in nearby placers. McGowan started the shaft about 1944-1945.

No exposure of the vein could be seen in 1960; alluvium covers the surface and the vein is not exposed in the collar of the shaft. Closely spaced, barren fractures in the granitic rock in the collar have an attitude of N78E 58SE. The shallow bulldozer trench bears N68E; however, no mineralization is exposed in the deeply weathered rock.

Primary minerals in ore on a small picked-over dump contained only stibnite and minor quartz. Some of the stibnite has been altered to whitish boxworks and yellowish massive crusts. Secondary alteration minerals probably include senarmontite, cervantite, and stibiconite.

The following information was obtained from McGowan. The shaft was sunk in fractured rock just to one side of the vein. At the surface the vein was paper-thin; however, in a short crosscut at the 25-foot level the vein was 3 feet thick. The vein—almost vertical—dipped north. Stibnite in the vein was very pure; gangue, probably quartz, occurred only on the margins of the vein. Pieces of pure stibnite up to 45 pounds in weight were removed during mining. Small shipments of ore contained $56 of antimony per ton; the ore contained no gold, silver, tungsten, or arsenic.

Jess Hutchinson of Salmon stated that he de-watered the shaft in the early 50's but ran out of ore after sinking the shaft a few more feet.

McGowan reported that stibnite had also been found

1) in a small prospect pit a few hundred feet south of the mouth of Doran Gulch; and

2) in a 2-foot vein in the Kelley Creek placer operations in the early days.

In summary, stibnite has been found in three places along a relatively straight line that follows Kelley Creek and Doran Gulch. Mineralization probably took place in open places along a shear zone that dips steeply north and strikes approximately N65E.
In addition to stibnite this shear zone probably also contains gold, silver, and uraninite; it may also contain cinnabar and possibly brannerite. Further exploration is certainly justified. Ore, if it occurs, will probably be in pods or shoots at fault intersections below the weathered zone.

**Miscellaneous**

Stibnite and its secondary alteration products have been found in minor amounts in veins at the Alta, Hardee, and Lightning uranium properties.

**TUNGSTEN AND MOLYBDENUM VEINS**

**Peach Creek Tungsten**

Scheelite and molybdenite on the five Peach Creek tungsten claims were first discovered during construction of a logging road up the east side of Peach Creek in May, 1959; the claims were staked by Wayne Cleutis, Bill Stricklen, and Bert Bohannon of Clayton. Development is limited to an upper and a lower cut along the roadway at the two hairpin turns approximately 2 road miles north of U. S. 93.

Known mineralization is limited to the contact zone between the batholith and the Wood River Formation. This contact zone has been offset in a series of en echelon wedges by a complex of east-west and north-south faults. Some of the mineralization may have occurred as a pyrometasomatic replacement during emplacement of the batholith; most, however, resulted from deposition of high-temperature quartz-sulfide veins along post-batholith faults.

At the upper cut, a vein containing quartz, pyrhotite, scheelite, and molybdenite follows a conspicuous fault with an attitude of N87E 87N. The exposed portion of the vein in October of 1960, had a maximum thickness of 1 1/2 feet. Cleutis stated that the highest grade mineralization exposed in the vein during bulldozing, was in a long lens; scheelite occurred mostly in the east end of the lens and molybdenite in the west end. (oral communication) A 12-foot sample, cut across the west end of the lens, contained 0.71 percent Mo; a 20-pound grab sample from along the center of the lens contained 3.56 percent WO3 and 3.0 percent Mo (W. Cleutis, oral communication).

Cleutis stated that an 8-foot vein containing, possibly 1/4 to 1/2 percent WO3 had been exposed during construction of the hairpin turn below the upper cut. High concentrations of scheelite can be obtained by panning the soil above the upper cut and in the draw several hundred feet to the southeast. Pieces of almost pure scheelite float up to 4 inches wide have been found in the draw.

Other than for the construction of the logging road, no exploration and very little prospecting has been done on the property. More is certainly justified.
At the scheelite mine on Thompson Creek, the next major drainage to the east, DMEA drilling has blocked out over 72,000 tons of ore containing more than 1 percent WO₃ in one block. Relations between mineralization and host rock on Peach Creek are almost identical to those on Thompson Creek.

Patricia Ann

The two claims of the Patricia Ann group are on the ridge west of Peach Creek, northwest of the Peach Creek Tungsten group (Fig. 1). Wayne Cleutis discovered scheelite on the ridge in December 1956, but did not stake the ground until May, 1959. The property contains no development and was not visited during this investigation. Cleutis stated that the mineralized body, on the batholith - Wood River Formation contact, is a zoned "tactite" consisting mostly of epidote-allanite and garnet lenses; garnet lenses are up to 3 feet thick. Spectrographic analyses indicated that the epidote-allanite zone contained niobium and tantalum in addition to a number of rare earths including cerium (W. Cleutis, oral communication).

HOT SPRINGS

Hot spring activity occurs in seven places in the area: all are along the Salmon River. Five of the seven hot springs are along the shear zone that extends from Stanley to Basin Creek.

From west to east, areas of hot spring activity are described below; temperatures listed were measured in September, 1960 (Fig. 1).

1) About 10 seeps, including the one that feeds the "Snake Pit", are on the northwest side of Valley Creek between Upper and Lower Stanley; the maximum temperature was 48° Centigrade. The seeps occur along a line about 270 feet long.

2) About 20 seeps, following a northerly trending line about 950 feet long, are on the southeast side of Valley Creek beside U. S. 93. The maximum temperature measured was 40° Centigrade; however, the orifice temperature at the bottom of the pool at Valley Creek Plunge was not measured.

3) Two springs occur just upstream from Elkhorn Creek; the smaller on the north bank of the river had a temperature of 56° Centigrade.

4) Three small springs are along the river bend 1/2 mile downstream from Mormon Bend.

5) Two hot springs flow from the foot wall of a fault-disrupted block of the 50-foot dike at the mouth of Basin Creek. Another hot spring is on the bank of the Salmon several hundred feet to the east. The maximum temperature was 59° Centigrade.
6) The Sunbeam Hot Springs are about 1 mile upstream from Yankee Fork; several hundred gallons of water per minute flow from the very hot upper springs (76° C).

7) The hot spring (53° C) and swimming pool at Robinson Bar Ranch are on the bar a few hundred feet east of Warm Spring Creek.

Three springs—Robinson Bar Hot Spring, Valley Creek Plunge, and the Snake Pit—are now being used for swimming or bathing purposes; the Sunbeam Hot Spring was formerly so used. With the further planned expansion of Forest Service camp sites along the Salmon and in Stanley Basin, most of the hot springs could be used to a much greater extent. All of the hot springs except the one at Robinson Bar are on Forest Service land. Permits for commercial development of the hot springs, on a royalty basis, can be obtained from the Forest Service.

All of the hot springs were checked with a scintillator; none was anomalously radioactive. Qualitative chemical tests for mercury and manganese on small pinkish nodules that form in the Valley Creek Plunge seeps were negative.

Water samples from the Robinson Bar and Sunbeam Hot Springs contained, respectively, 296 and 320 parts per million of contained solids (Ross, 1939, p. 65). Solids present in order of decreasing importance were silica, magnesium, sulphate, carbonate, bicarbonate, chlorine, and calcium.

PLACERS

General Statement

In the Stanley area, placer gold is second only to lode gold and silver in total mineral production. Economic deposits of placer gold, in most cases, were derived from numerous but non-economic quartz veins and stringers. Though auriferous veins cut all three major rock types cropping out in the area, the most receptive hosts were first, tuffs of the Challis Volcanics; and second, batholithic rocks, especially where cut by wide shear zones. In general, the richest placers are short distances down stream from such areas.

A large variety of equipment has been used in the area for recovering placer gold since the late 1860's; included are the pan, rocker box, ground sluice, sluice box and riffles (in great variety), drag line, dry-land dredge, dredge boat, including Idaho's largest), giant, and the automatic "Chinese gate" used in "booming". Equipment used depended on size of placer, water available, and cost.

All gold recovered was in natural alloy with silver; fineness generally ranged from 600 to 900. In vein deposits, however, the ratio of silver to gold ranged from 1:1 to 1:100. Possibly much of the silver alloyed with gold would be leached during the process of weathering and erosion. Because much of the silver in lodes with the higher silver-gold ratios, however, is probably present as microscopic to submicroscopic sulfide and telluride minerals, such silver would never reach a placer.
In all known cases, most of the placer gold is in the 18 inches of gravel above bedrock; much is on bedrock. In some places, as at Robinson Bar, pay dirt extends up to 4 or 5 feet above bedrock. In most of the placers, gold is not evenly distributed across bedrock beneath a valley floor but is concentrated in one or more long, meandering, buried stream channels. At Stanley Creek, though most of the gold is near bedrock, some is reported to be concentrated at different horizons in association with "false bedrock" clay layers in the overburden.

Because almost all of the recoverable gold lies close to bedrock, the placers can be compared by expressing their production in relation to the area of ground placered. If a placer is to be mined by first removing the overburden, the value of the placer decreases in direct proportion to the depth of the overburden (several of the early-day placers were mined by drifting on bedrock). Tentative values for four of the better placers in the area are:

1) Grubstake, Rough Creek, $2.90 per square yard
2) Joes Gulch, $3.60 " " "
3) Buckley Bar, Stanley Creek, $5.60 " " "
4) Sturkey diggings, Kelley Creek. $5.60 " " "

The early placers on Robinson Bar, Jordan Creek, and Montana Gulch were probably much richer than the above placers.

Five areas still containing substantial amounts of placer gold are:

1) the virgin ground on the West Fork of Yankee Fork north of Hindman Ridge and south of Red Mountain;
2) the virgin ground on the Grubstake placer on Rough Creek;
3) the dredge tailings on Yankee Fork;
4) the virgin and dredged ground on Stanley Creek; and
5) the ground not worked by drag line on Jordan Creek south of Estes Mountain.

In each of these areas, however, special problems exist; otherwise, the gold would have already been mined. It is doubtful that any of these areas could be economically worked today. Profitable mining might require all of the following:

1) use of modern earth-moving equipment,
2) custom-designed concentrating plants,
3) substantial increase in the price of gold, and
4) a sharp drop in the cost of labor.
Heavy-mineral assemblages of the placers reflect differences in their source rocks. Large percentages of augite, biotite, and hornblende occur in placers down stream from Challis rocks. Monazite, brannerite, euxenite, zircon, and garnet are found only in placers downstream from granitic rocks. Pronounced local variation, in total amount and relative percentages of heavy minerals, occurs in streams draining batholithic rocks. These differences could be advantageously used in any detailed study of the petrology of the Idaho batholith. Local variations observed include

1) high monazite-low magnetite and ilmenite in Joes Gulch;

2) very high ilmenite and high magnetite in Kelley Creek; and

3) very high sphene south of the Salmon River; generally low sphene north of the river.

Following are brief descriptions of most of the placers in the Stanley area.

Robinson Bar

Introductory statement

Below Sunbeam, most of the placers along the Salmon are on or near Robinson Bar. All of these placers are well above the river; most are on rock-cut terraces covered with thick deposits of stream gravel. Robinson Bar itself is a multi-terraced bar at the mouth of Warm Spring Creek. Both sides of the river alongside the bar contain dumps from early day operations. Probably the two most important placers in this area were the Great Centennial and the Centaurus workings. Little is known of the other workings; one, the Taylor diggings, was reportedly worked by Chinese for a while.

The Great Centennial

The great Centennial was the first placer staked on Robinson Bar. Though staked by Ebenezer Cunningham, it was worked jointly by the small band of prospectors that first came to this new discovery on the upper Salmon. Several of these miners, such as Centaurus and Sturkey, gained their first experience here and then struck out on their own to stake some of the most important placers in the Stanley area (Bill Centaurus, Challis, oral communication).

The old workings of the Great Centennial are on the southeast side of the Salmon River, 600 feet west of Warm Spring Creek. Mining was done by drifting on bedrock along pay streaks. Bedrock is a rock-cut terrace about 30 to 50 feet above the present Salmon. Extent of the old workings is unknown; all adits are caved. Dumps contain well-rounded gravel, cobbles, and boulders; some boulders are up to 8 feet in diameter. These giant boulders probably originated as canyon-wall slump blocks; rounding was accomplished
essentially in place by river action. It was behind such boulders that much of the rich-
est gold on bedrock was found.

According to his son Otto, Herman Centaurus stated that $100,000 in gold (Au at
$20 per oz.) was recovered from the Great Centennial (oral communication).

Centaurus workings

The Centaurus workings are on the north bank of the Salmon River, 400 feet north-
west of Marshall Creek (Fig. 49). The property, staked by Herman Centaurus, about
1870, was worked until the early 1900’s. Otto Centaurus, Stanley’s oldest resident,
assisted his father on the placer from the late 1880’s until it closed. Total production
from the placer was estimated by Herman Centaurus to have been between $80,000 and
$100,000, Au at $20 per ounce (Otto and Bill Centaurus, oral communication). In the
early 1950’s, during construction of U. S. 93 across the old workings, workmen re-
portedly found nuggets worth up to $5 each.

A description of early-day operations at the placer, as related by Otto Centaurus,
follows (oral communication).

In the Robinson Bar area, pay streaks occupied long, narrow, buried river chan-
nels which are subparallel to the present river. Herman Centaurus discovered the pay
streak at Marshall Creek by blindly driving an adit along bedrock. After the paystreak
was discovered, the channel-fill deposit was mined by driving drifts in both directions
along the center of the channel for the full length of the pay streak. At the end of each
drift, perpendicular crosscuts were driven to the pay streak boundaries. The remaining
deposit was mined by retreating towards the portals, each new crosscut being parallel
to and adjacent to the last crosscut. The large boulders were scraped clean and rolled
into the open crosscut previously mined out. The richest ground was the 2 feet of gravel
above bedrock; however, all of the lower 4 to 5 feet of gravel contained paying quantities
of gold. Drifts and crosscuts were 8 feet wide and, depending on depth of pay dirt, 4 to
5 feet high. Because the gravel was unconsolidated, all openings had to be fully timbered
and the backs lagged.

Mining was performed in the winter; the pay dirt was stored in bins below the
portal. Summer months were devoted to washing pay dirt accumulated during the winter’s
mining. Centaurus used a long series of three different types of riffles. Gold recovery
was excellent; most of the gold remained in the first set of riffles and less than $1
would be recovered from the last set. The daily wage paid by Centaurus to his 8-man
crew in the 1870’s was $6.

Jordan Creek

Placer gold on Jordan Creek was not discovered until after the discoveries at
Robinson Bar to the south, and Loon Creek to the north. The discovery was probably
made by miners traveling between these two camps. The first claims, the Morrison Nos. 1 and 2, were staked at the mouth of Jordan Creek by John L. Morrison in February, 1873 (county records, Challis). Because of the depth of the overburden, early-day mining was by drifting along bedrock. At one time, a drift extended from the mouth of the creek to Red Rock Gulch; another drift was at the "narrrows" above the gulch (A. McGowan, oral communication). No record exists of the gold recovered during these early operations; it is known, though, that Jordan Creek contained some of the richest placer ground in the state. One nugget, recovered from near the outcrop of the Morrison vein, is reported to have weighed 32 ounces; several others weighed 8 to 10 ounces and many weighed more than 1 ounce (Umpleby, 1913, p. 89). The size and amount of specimen gold known to have been mined from Estes Mountain and from the Charles Dickens and Morrison claims indicate that the reported size of the nuggets is not unreasonable.

Between 1948 and 1950, Jordan Placers, Inc., drag-lined the lower 1 1/4 miles of Jordan Creek, much of the same ground that had been worked by drifting in the early days. Holes, drilled prior to mining, indicated that ground along lower Jordan Creek ranged in value from $1.50 to $3.00 per cubic yard; the value of the northernmost ground tested was $0.97 per cubic yard (Jason Vaught, Stanley). Equipment used included a 1-cubic yard, drag-line bucket and a 70-ton washing plant mounted on caterpillar tracks. Maximum depth mined was 35 feet. Except at the mouth of Red Rock Gulch, all overburden down to bedrock was moved; bedrock was carefully cleaned. At the mouth of Red Rock Gulch, bedrock could not be reached because the overburden was too deep. Here, Jordan Creek is crossed by a broad shear zone which reportedly contains seven different veins. In the two, 5-month periods worked in 1948 and 1949, $233,000 was recovered; the amount recovered in 1950 is not exactly known (Table 9); an official of the former company stated that subsequent to mining, it was learned that an additional $150,000 "disappeared" during cleanups (oral communication). The average recovery was $0.54 per cubic yard and the average fineness was 611 (Table 9). The black-sand content was approximately 6 2/3 pounds per ton. Most of the placer ground on Jordan Creek of any appreciable size has been worked at least once; however, some of the remaining ground reportedly is very rich. Overburden on several of the mountain slopes, especially on Estes Mountain and below the Golden Sunbeam, contains substantial amounts of detrital gold (Jason Vaught, oral communication). Some of this ground might be profitably worked if gold mining were to become more economical. Much of the placer ground along the creek is covered by 8 unpatented claims now held by Jason Vaught of Stanley.

Early-day placering was also performed on the Jordan Creek tributaries, Red Rock Gulch and Montana Gulch. Montana Gulch, which lies along the southern base of Estes Mountain, is reported to have yielded nuggets up to 1 inch in diameter. In 1960, the gulch was being placered by L. L. Anderson of Burley. Most of the gold accumulated on short step-like flats along the very steep and narrow gulch. The gold is on bedrock beneath several feet of overburden.
Yankee Fork, the Salmon’s largest tributary within the area, has a valley floor several hundreds of feet wide for much of its length. The valley along its widest portion, extending from a point 3 1/4 miles north of its mouth to Jordan Creek, has been dredged (Figs. 49 and 50). Dredged ground is 5 1/4 miles long and approximately 400 feet wide. The floating dredge (Fig. 34), largest ever to have worked in Idaho, operated in 8 of the 13 years between 1940 and 1952 (Table 9). The dredge was operated successively by the Snake River Mining Company, the Warren Dredging Company, and the J. R. Simplot Company. The dredge and patented dredge grounds are now owned by the Simplot Company. Arthur McGowan of Custer stated that drilling performed prior to dredging had indicated that $11,000,000 in gold was present. At least $1,120,000 is known to have been recovered (Table 9). Locally, it is reported that substantially more than this amount was saved.

The 650-ton, 8-cubic foot, Bucyrus-Erie dredge was powered by a diesel electric plant. Twenty-five steel pontoons formed the boat. Maximum working depth of the 72-bucket digging ladder was 30 feet. On each side of the dredge were 16 fixed-slope, gold-recovery tables. All gravel that passed over the tables was dumped back on bedrock from short shoots on each side of the dredge at the rear. Any gold not saved would have been in this gravel. All coarse material rejected by the long 6-foot trommel passed down the center of the dredge and was dumped by the rear elevator, well back of the dredge. The largest nugget recovered was found wedged in the 1 1/2-inch trommel screen. The dredge worked on a 24-hour basis; cleanup was every 7 to 10 days.

McGowan, “gold man” aboard the dredge for several years, described gold-bearing ground as follows: The “paystreak” or “paychannel” extends in a meandering fashion, the entire distance from Jordan Creek to the mouth of Yankee Fork. The pay is in a very-distinct-appearing, decomposed clay with gravel. The pay streak is approximately 6 inches above bedrock, 8-10 inches thick, and 150 feet wide. On the bends, the gold was always to the inside. In the down-stream portions of the dredgings, below Rankin Creek, the pay streak was too deep to be reached; here, however, even the upper gravels contained gold in paying quantities. Upstream from Rankin Creek, the upper gravels were almost barren. The dredge buckets were able to dig 3 feet into the uneven granitic bedrock but could not dig into hard andesite; andesite bedrock, though, was smooth (oral communication).

In the virgin ground between Jordan Creek and Custer, the pay streak is approximately 50 feet wide and very winding; depth to bedrock is 18 to 20 feet (McGowan, oral communication). Reportedly the large dredge could not follow the pay.

McGowan estimated that only about 60 percent of the gold that boarded the dredge was saved. Because the ambitious bucket operators, in attempting to set yardage records, would overload the washing plant, much of the gravel would go through the circuit without even getting wet. Then, at times the dredge would be tilted, especially
TABLE 9

Yankee Fork and Jordan Creek Placer Production, 1940-1952

<table>
<thead>
<tr>
<th>Year</th>
<th>Au</th>
<th>Ag</th>
<th>Fine-ness</th>
<th>Yard- age</th>
<th>$/cu yd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oz.</td>
<td>$</td>
<td>Oz.</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>1940²</td>
<td>907</td>
<td>31,745</td>
<td>457</td>
<td>416</td>
<td>665</td>
</tr>
<tr>
<td>1941²</td>
<td>7,500</td>
<td>262,500</td>
<td>2,942</td>
<td>2,677</td>
<td>718</td>
</tr>
<tr>
<td>1942</td>
<td>4,787</td>
<td>167,545</td>
<td>2,412</td>
<td>2,195</td>
<td>666</td>
</tr>
<tr>
<td>1946</td>
<td>5,232</td>
<td>183,120</td>
<td>2,771</td>
<td>2,512</td>
<td>653</td>
</tr>
<tr>
<td>1947</td>
<td>2,584</td>
<td>90,440</td>
<td>1,493</td>
<td>1,359</td>
<td>634</td>
</tr>
<tr>
<td>1950²,³</td>
<td>(1,209)</td>
<td>(42,315)</td>
<td>(1,169)</td>
<td>(1,064)</td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td>5,129</td>
<td>179,515</td>
<td>3,308</td>
<td>3,010</td>
<td>607</td>
</tr>
<tr>
<td>1952²</td>
<td>1,832</td>
<td>64,120</td>
<td>1,170</td>
<td>1,065</td>
<td>610</td>
</tr>
<tr>
<td>Totals</td>
<td>29,180</td>
<td>1,105,930</td>
<td>16,891</td>
<td>15,362</td>
<td></td>
</tr>
<tr>
<td>Total $</td>
<td>1,120,000</td>
<td></td>
<td>Average fineness = 656</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                      |       |       |           |         |         |
|                      |       |       |           |         |         |
| Jordan Creek - drag line |
| 1948 | 3,603  | 126,105| 2,285     | 2,079     | 613     | 200,000 | 0.64 |
| 1949 | 2,957  | 103,495| 1,907     | 1,735     | 607     | 230,000 | 0.46 |
| 1950²,³| (1,209)| (42,315)| (1,169)   | (1,064)   |         |
| Totals | 7,769  | 271,915| 5,361     | 4,878     |         |
| Total $ | 275,000 |         | Average fineness = 611 |

1 From Minerals Yearbook, U.S. Bureau of Mines
2 Includes minor production from several small placers in the Yankee Fork district, probably amounts to 5 to 25 ounces per year.
3 Yankee Fork and Jordan Creek production not separated in Minerals Yearbook; here, 50 percent is arbitrarily assigned to each.
when digging bedrock. This tilting changed the slope of the fixed tables, drastically reducing gold recovery. In addition, probably only a small percent of the gold was picked up by the buckets. The largest cleanup ever made occurred at the mouth of Ramey Creek after the dredge made a single pass across ground that had been worked the previous fall. In other places the dredge missed the pay streak entirely. Between the mouth of the West Fork of Yankee Fork and Bonanza the dredge worked the center of the valley; the pay streak, however, was close to the cliffs on the west side of Yankee Fork. Just north of Ramey Creek, some of the richest portions of the pay streak had to be by-passed because the dredge camp had been built on top of it (McGowan, oral communication).

It is thought, locally, that most of the gold in Yankee Fork, as well as most of the gold on Robinson Bar, came down Jordan Creek from Estes Mountain. Drilling had indicated that Yankee Fork above Jordan Creek only contains $0.16 in gold per cubic yard, whereas, Jordan Creek, even after early-day mining, contained from $1 to $3 per cubic yard (Jason Vaught, Stanley, oral communication). It should be noted, however, that at least three-quarters of the production for the district came from the Custer area (Anderson, 1949, p. 14). Annual production figures for the dredge indicate that the fineness of the gold increases downstream from Jordan Creek (Table 9). This increase is possibly caused in part by the gradual solution of silver from the natural gold-silver alloy (electrum) as it travels downstream, and in part by higher-grade gold being contributed by downstream tributaries.

It should be possible to refit the dredge and economically rework Yankee Fork. Some streams in Boise Basin have been profitably worked as many as five times—first, by hand by white man and then by Chinese, and then up to three times by dredge. If the dredge were refitted, suction pumps should be used to complement the bucket ladder in cleaning bedrock.

Two tributaries of Yankee Fork have been hand placered. Rankin Creek has been worked extensively near its mouth, and to a lesser extent, upstream. Adair Creek, which drains much of the Custer area, still contains rich virgin ground. This ground is covered with very large boulders that early-day miners could not move. Wayne Cleutis and associates of Clayton are now mining the ground by use of a bulldozer and a long boom (for moving the boulders). Pay dirt is reported to be 8 feet thick.

**Kelley Creek**

**Introductory statement**

Kelley Creek, a small stream about 4 miles long, drains the southern slopes of Potato Mountain and flows northeastward into Basin Creek. Kelley Creek’s drainage basin has developed on deeply weathered granitic rock cut by small pegmatite dikes. The lower 2 1/2 miles of Kelley Creek follows a semi-linear path and partly occupies a fault zone with a strike of N65E.
Numerous gold placers line the creek from its mouth to its headwaters. Kelley Creek is known, mainly, as the locality from which the rare uranium mineral, brannerite, was first described (Hess and Wells, 1920). In addition to gold and brannerite, placers contain important amounts of cinnabar, monazite, and euxenite. Ilmenite and magnetite are the most abundant minerals in heavy-mineral concentrates; epidote garnet, zircon, sphene, rutile, and xenotime are also present.

The first placers in the Stanley mining district are reported to have been those staked by Lake and Moore on Spring Gulch, a tributary of Kelley Creek, probably in the early 1870's (Arthur McGowan, oral communication). Placers at Willow Flats, the Sturkey-Challis claims, and the Chinese workings on lower Kelley Creek quickly followed.

**Sturkey diggings**

The Sturkey diggings are on the northwest side of Kelley Creek, 2.8 miles from the creek mouth. Jesse Lynch of Stanley stated that $87,000 had been produced from the placer by Sturkey and his partner, Challis. Placered ground, roughly circular in shape, has an approximate diameter of 420 feet; depth to bedrock probably averaged about 15 feet. The value of the ground placered, calculated from the above figures, would be about $5.60 per square yard of area ($1.10 per cubic yard of ground). Most of the gold was produced prior to 1900; however, sporadic work continued until the early 1920's.

Water for hydraulic operations was stored in an earth-fill reservoir located on the flats north of the placer ground. Water for the reservoir was supplied by 7 1/2 miles of hand-dug ditches that lead from Stanley and Sawmill creeks. Overburden above pay dirt was removed by two giants; pay dirt was washed in sluice boxes. John Weidman of Stanley, stated that Sturkey only used a rise of 1/2 inch per foot for his sluice box; therefore, much of the gold was lost because of the heavy load of black sands (8.2 pounds per cubic yard).

**Willow Flats**

Willow Flats is a small meadow located near the head of upper Kelley Creek. Much of the meadow is virgin; most of the placering that has been done was performed in the early 1870's. Jesse Lynch of Stanley states that the shallow overburden along the upper stretches of Kelley Creek contain rich, but small and erratically located, "grass root" placer deposits. Lynch worked one small placer located on a gravel bench on the northwest side of the creek downstream from Willow Flats. Here, overburden contained 5 to 10 cents in gold per pan at the surface and 25 cents per pan on bedrock 3 feet below the surface. Between Willow Flats and the Sturkey diggings, most of the placering performed was on gravel benches rather than along the present stream channel.
Several small placers are also located on the creek to the east of upper Kelley Creek (Fig. 49). The road from Kelley Creek to Joes Gulch crosses this creek at the old placer of "One Snowshoe" Taylor.

Chinese workings

Kelley Creek, below Sawmill Creek, was worked in the early days by Chinese that arrived after the first white men. The creek bed has been placered from Sawmill Creek to a point 1 1/4 miles downstream. This portion of Kelley gulch is very narrow; placer ground was less than a hundred feet wide and only a few feet deep. No record exists of gold produced.

Weidman workings

John Weidman of Stanley holds 12 unpatented claims covering most of the flats at the wide pass between Kelley Creek and Doran Gulch (Fig. 1). The claims include the old Sturkey diggings. Ground placered by Weidman is on the northwest side of the creek just downstream from the Sturkey diggings (Fig. 49). Placered ground is 1,600 feet long and has a maximum width of 400 feet. Bedrock, beneath the flats, slopes gently towards Kelley Creek. The average thickness of the overburden, along the south bank of the virgin flats, is 10 feet; the former depth of the overburden, at the present channel of Kelley Creek, was probably about 20 feet.

Much of the bedrock exposed in the placer is highly brecciated granitic rock that has been silicified by numerous, cinnamon-colored chalcedony veinlets. Most of the non-silicified granitic rock is deeply weathered and iron stained. The granitic rock is predominately coarse grained, porphyritic; in places it grades to a fine-grained, non-porphyritic rock. Several porphyritic latite dikes cross the placer; one, about 35-feet thick, has an attitude of N15E.

Most of Weidman's work was performed in the depression years of the 1930's. Barren overburden, lying above the pay dirt, was flushed downstream by use of a giant fed from Sturkey's old reservoir (Fig. 33). Coarse material in the overburden is sub-angular and has an average diameter of 6 to 8 inches; some boulders have a maximum diameter of 2 feet. Weidman stated that pay dirt started 4 1/2 feet above bedrock; however, the richest gold was concentrated in the lower 18 inches. Weidman's washing plant contained a 12-foot sluice box and 24 feet of riffles. Burlap was used beneath riffles 1 inch high placed 1 inch apart. Because of the long series of riffles, Weidman only cleaned up once a month. Weidman stated that he had to use a steep rise of 1 1/2 inch per foot to carry off the large amount of black sands. Weidman did not know how much gold he had mined; he did state that the gold was about 715 fine. Weidman only tested the placer in one location; here, pay dirt was worth $1.63 per cubic yard (oral communication).
Figure 33 Angular boulders lying on bedrock beside abandoned giant in the old Wiedman placer workings.

Figure 34 Yankee Fork dredge—the largest to work in Idaho.

Figure 50 Dredge tailings along Yankee Fork: ponds behind these tailings form good salmon-spawning grounds.
Black sands

Several shallow diversion ditches cross the virgin flats just north of Weidman's workings. Heavy minerals have been concentrated at the small gates in these old ditches; at these gates, anomalous radioactivity in the soil can be easily detected with a scintillator. Samples panned from below these gates contained unusually high amounts of gold, cinnabar, and monazite in addition to two, metamict, radioactive black minerals. Specimens of both of the radioactive blacks were heated to 1,000$^\circ$C for 2 hours and then X-rayed. The diffraction pattern for one of the minerals agreed with published data for Kelley Creek brannerite. The other black mineral was identified as eugenite (below)

\[
\begin{array}{c}
\text{Eugenite, Kelley Creek}^1 & (3.04, 1.476, 1.842, 1.706; 10, 4, 3, 3) \\
\text{Eugenite, Ontario, Canada}^2 & (2.98, 1.487, 1.823, 1.723; 10, 4, 4, 4)
\end{array}
\]

1 Molybdenum radiation, zirconium filter
2 Mattawan Twp., Nipissing Dist., Ont.; Cu radiation: A S T M card #5-0603

Differences in intensities and line spacings should be expected because of differences in isomorphous substitutions.

Under the microscope, the eugenite grains can be seen to have a thick yellow-brown alteration coating. The surfaces of unaltered cores have a very rough texture, similar to Bear Valley (Idaho) eugenite. Unaltered eugenite is black to reddish brown in color and has resinous brown internal reflections. The brannerite grains have thin, yellow-brown to red-brown coatings. The surfaces of unaltered cores are smooth and are steel-blue in color. The radioactivity of the brannerite, measured with a scaler counter, is 1.9 times greater than that for the eugenite.

Brannerite can be cleanly separated from eugenite with a Frantz isodynamic separator; separation curves for Kelley Creek brannerite, eugenite, and monazite are shown below.

Monazite

Eugenite

Brannerite

Amperes (Side slope 25$^\circ$, forward slope 15$^\circ$)

\[
\begin{array}{c}
0.7 & 0.8 & 0.9 & 1.0 & 1.1 & 1.2 & 1.3
\end{array}
\]

\[
\begin{array}{c}
\text{d} & 1/I_0
\end{array}
\]
In 1952, the U. S. Bureau of Mines, while conducting a strategic minerals investigation of Idaho black-sand placers, sampled most of the flats on Kelley Creek. Ground sampled consisted of a strip, about 1 mile long and 900 feet wide, that extends along the flats by the Sturkey and Weidman workings, and an adjoining strip, about 1/2 mile long and 300 feet wide, that extends up upper Kelley Creek. Most of the ground sampled is on the Weidman claims. Fifteen holes were drilled. Hole depth (to bedrock) ranged from 5 feet to 30 feet: the average depth was 15 feet. Samples collected were evaluated for ilmenite, magnetite, monazite, garnet, and zircon but not for gold, silver, or cinnabar. The results of the sampling are shown in Table 10.

**TABLE 10**

Results of U. S. Bureau of Mines, black-sand drilling program, Kelley Creek, Custer County, Idaho (unpublished data)

<table>
<thead>
<tr>
<th>Black sand</th>
<th>Ilmenite</th>
<th>Magnetite</th>
<th>Monazite</th>
<th>Garnet</th>
<th>Zircon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. lbs/cu yd</td>
<td>8.16</td>
<td>4.92</td>
<td>1.41</td>
<td>0.13</td>
<td>0.03</td>
</tr>
<tr>
<td>Total pounds</td>
<td>15,608,000</td>
<td>9,402,000</td>
<td>2,696,000</td>
<td>254,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Total tons</td>
<td>7,804</td>
<td>4,701</td>
<td>1,348</td>
<td>127</td>
<td>26</td>
</tr>
</tbody>
</table>

Of special note is 1) the high amount of black sands (8.16 pounds per cubic yard); and 2) ilmenite exceeds magnetite by a factor of 3 1/2 to 1.

**Stanley Creek**

**Introductory statement**

Stanley Creek, a small perennial stream 7 miles long, flows into Valley Creek 4 1/2 miles west of Upper Stanley. Stanley Creek occupies a valley of unusual shape. The upper and lower portions of the valley are relatively narrow; the triangularly shaped central portion of the valley has a floor 1 1/2 miles wide (Fig. 1). The lower two-thirds of Stanley Creek is bounded by low rounded mountains with gentle slopes; valley sides in the upper part of the creek have slopes up to 35 degrees. The deeply weathered, quartz monzonite and granodiorite country rock is cut by dikes and dike swarms of acidic and intermediate composition. Dikes and country rock are cut by numerous but thin auriferous quartz veins.

Most attempts to recover gold from Stanley Creek have been along its upper shallower portions. Rich gold probably lies on bedrock beneath the wide valley floor along the central portion of the stream. Here, however, the overburden is probably too deep to mine. Three holes sunk by the U. S. Bureau of Mines across the upstream portion of this wide valley floor had depths of 50, 50, and 75 feet (Fig. 49). Depth to bedrock beneath the present level of Stanley Creek for much of the downstream valley floor,
therefore, is over 50 feet—in places it is probably much deeper. Because lower Stanley Creek is at a temporary base level (controlled by Valley Creek), no reasonable method is available for mining most of the lower valley. Some of the shallower terrace gravels, along the valley sides might be economically mined by diverting Stanley Creek.

Besides gold and silver, Stanley Creek placers contain monazite, cinnabar, and the radioactive blacks brannerite and euxenite. Neither cinnabar, brannerite, nor euxenite have ever been positively identified in place in the Stanley area.

Arthur McGowan of Custer has in his possession a flat specimen of pure cinnabar that he found along Stanley Creek—the specimen is 4.0 inches long, 1.8 inches wide, and 1.0 inch thick. Semi-quantitative spectrographic analyses have indicated that uranium samples from the Bell Cross property contained up to 0.2 percent Hg. Stanley and Kelley creek cinnabar probably came from the southwestern slope of Potato Mountain.

The presence of brannerite on Stanley Creek was known by old-time miners long before it was first described in 1920 by Hess and Wells. A July 4, 1899, issue of the Challis "Silver Messenger" contained the following note:

Radium ore has been found in Custer County. The ore is from Stanley Creek in Stanley Basin. Found by Benjamin Metzar, proven to be high grade uranium ore. No prospecting has been done to find source.

A German geologist is locally reported to have written an unpublished report in which he described an 18-inch vein of brannerite as being exposed in the floor of the Willis Diggings. However, most, if not all, known world occurrences of brannerite are of pegmatitic origin.

In 1952, the U. S. Bureau of Mines sank 5 holes along Stanley Creek for a reconnaissance evaluation of black sands (Fig. 49). Weighted averages in pounds per cubic yard obtained by the U. S. Bureau of Mines are: magnetite, 3.58; ilmenite, 2.89; monazite, 0.15; zircon, 0.10; and garnet, 0.09 (unpublished data). No attempt was made to evaluate gold, silver, or cinnabar. Brannerite and euxenite were not specifically evaluated; however, the radioactive blacks accounted for one-third of the total radioactivity.

Most of the placer ground on Stanley Creek below Doran Gulch is covered by 38 claims held by John Weidman of Stanley. Ground above Doran Gulch is covered by seven claims held by Mary E. Marton. Following are brief descriptions of most of the former placer operations along the creek.
Buckley Bar

Buckley Bar is a gravel terrace perched a few feet above recent stream alluvium. Two-thirds of the bar has been placerred by ground sluicing. The western third of the bar has not been placerred; however, the presence of numerous test pits indicates that non-placerred ground has been thoroughly explored. Placered ground on the bar, approximately 1,000 feet long and 400 feet wide, parallels Stanley Creek. Lodge-pole pine, 20 to 25 feet high, grow on the old workings. Ground sluicing was performed by channeling diverted stream water through long winding rows of hand-placed cobbles and small boulders. Many of these cobbled and boulder banks still criss-cross the bar. Bedrock beneath the bar is several feet above the present stream level; overburden averages 4 to 6 feet in depth. Coarse material in the old tailings is composed of quartz monzonite, granodiorite, aplite, pegmatite, and porphyritic dike rocks.

Buckley Bar placer operations, reportedly the second oldest in the Stanley mining district, probably commenced in the early 1870's. No written record of placer production exists. Jesse Lynch and John Weidman of Stanley state that $250,000 are reported to have been recovered from the bar—this production would have given the ground a value of approximately $5.60 per square yard of area or $3.40 per cubic yard of ground (Au at $20 per oz.) This value, per square yard of area, is the same as the value obtained for the Sturkey diggings on Kelley Creek.

Ham Fat

Ham Fat, a small "grass roots" placer in a shallow draw on the west side of Stanley Creek, is about three quarters of a mile south of Doran Gulch. This extremely rich placer was worked out in the early days prior to 1900 (A. McGowan, oral communication). The placer, about 200 feet long and 30 to 40 feet wide, probably formed by in-place weathering. The draw is only a few hundred feet long and overburden is generally less than 2 feet deep. Bedrock beneath placered ground is a quartz porphyry dike. Throughout the Stanley mining district, highly fractured acidic dikes were favorable hosts for emplacement of narrow, auriferous quartz veinlets. In-place weathering of such protore bodies can readily form rich in situ placers such as Ham Fat.

Early dredge operations

Several attempts to recover Stanley Creek placer gold by dredge were made between 1900 and 1914. These attempts were generally unsuccessful because of

1) the presence of a "false bedrock" clay stratum,
2) insufficient sampling, and
3) inadequate equipment.

Reports on early-day operations are conflicting. Glowing newspaper articles in 1900 state "...The Stanley dredge is now taking out daily from $600.00 to $800.00 in gold..." and "...Nearly 22 pounds avoirdupois weight of gold dust was cleaned up at the dredge..."
The actual working time would not exceed 5 1/2 days..." (September 4 and 25, respectively, Silver Messenger, Challis). However, it is locally reported that the dredge was abandoned after one year's operation because the gold could not be economically separated from the "robber" clay. The dredge, rebuilt about 1903, and improved several times subsequently, operated intermittently for short periods of time until 1914. The rebuilt dredge was known first as the "Wormack" dredge (after Mat Wormack) and then as the "Willis" dredge (after Henry C. Willis). In 1909, two dredges were operated. The second operation involved a track-mounted, dryland dredge using a drag scoop. The dryland dredge was a complete failure because large chunks of clay, dug up by the drag scoop and dumped into the sluice box, picked up most of the gold (Moore, 1910, p. 52).

A description of the dredge grounds as they existed in 1913 follows (Umpleby, 1920, p. 16):

The (dredge) channel is about 200 feet wide and possibly a mile long and but a small portion of it had been worked prior to 1913.

The gold-bearing gravel is made up of well-rounded boulders, varying in size but not over eight inches in diameter. About 50 percent of the material is sand and 20 percent boulders. The total depth of the ground is from 9 to 12 feet with from 1 to 5 feet of soil on top. The gold is about the size of wheat grains and is to some extent distributed through the gravel, but in the main is concentrated on the bedrock, and is worth about $13.00 per ounce (650 fine). The ground will run between 30 cents and $1.00 a yard. (Au at $20 per oz.)

Mercury is found in the fine gravels in the form of native amalgam, and also in the mineral cinnabar. The latter is becoming more abundant as the dredge is moved up stream, suggesting a cinnabar deposit at some point farther up the creek.

Willis, the last dredge operator, told Frank Preston of Stanley that the ground worked by the dredge contained $0.50 or more in gold per cubic yard; however, all attempts to recover the gold from the clay had been unsuccessful (F. Preston, oral communication).

Doran Gulch

Doran Gulch is a short tributary of Stanley Creek that follows the same N65E fault zone that lower Kelley Creek follows. Much of the south slope of the gulch along its upper half was "boomed" in the early days—lower Doran Gulch is choked with this debris. Henry Middleton, who worked the gulch in the 20's or 30's, recovered in addition to gold, important amounts of cinnabar (J. Weidman, oral communication) Arthur McGowan states that about 1890 a test shaft was sunk from 15 to 20 feet to bedrock in the terrace gravels on the south side of the gulch about 300 feet from its mouth. Rich
gold was recovered from bedrock; however, the two miners who sunk the shaft had no way to work the ground (oral communication).

Willis diggings

The Willis diggings, extending along Stanley Creek from Doran Gulch to Buckley Bar, are covered by seven unpatented claims now held by Mary E. Martin. Placered ground is approximately 1,600 feet long and ranges in width from 200 to 500 feet. Most of this work was performed by C. H. Lord and associates between 1933 and 1938. During the 30's, Lord controlled 120 claims along the creek covering a strip of ground 1/4 to 1/2 mile wide and 4 miles long. Test holes in part of this strip at least, gave values of $0.25 per cubic yard (Campbell; 1937, p. 164). Lord is reported to have spent $350,000 in his operation but reportedly only recovered $23,000 in gold. Equipment used included a diesel-operated, 1-cubic yard dragline bucket; two bulldozers; a large trommel and washing plant; and an overhead cableway to dispose of tailings. Lord's major efforts were directed towards finding an economical way of breaking up the gumbo or "robber" clay so that gold could be saved in the washing plant. One technique employed was to direct jets of water under pressures of 90 to 110 pounds per square inch against the clay (Jason Vaught, Stanley, oral communication). All attempts to recover the placer gold economically were unsuccessful.

Joes Gulch

Joes Gulch, entering the Salmon 1 mile downstream from lower Stanley, contains a small intermittent stream about 2 miles long. The gulch has been intensely placered for almost its entire length. Most of the gold, once contained in the gulch, has been mined; a little, however, still remains in the very narrow terraces left by the miners along the sides of the gulch. The depth of undisturbed overburden ranges from 10 feet in the upper portion of the gulch to 30 feet in the lower portions. Some of the gold mined was found up to 4 feet above bedrock but most was in the lower 18 inches of the fill (Jesse Lynch, oral communication). The richest and coarsest gold was contained in natural riffles in the rough-surfaced granitic bedrock. These riffles were formed by stream plucking which was controlled by three sets of fractures; two sets have steep dips and the third has a shallow dip, all dip downstream (Fig. 1). Part of the placer gold in Joes Gulch was derived from the rhyolite dike at the Iron Crown mine; much of it, however, probably came from other mineralized dikes and quartz stringers along the gulch.

The gulch, named after Joe Garadina, one of its early successful miners, was first staked by Billy Casto in the 1870's (Otto Centauras and Bill Sullivan, Stanley, oral communication). The gulch was first mined by drifting along bedrock; later, pay dirt was exposed by hydraulically removing the overlying fill.

A description of the 1930 "booming" operations on lower Joes Gulch, as related by two of the miners, follows (M. Patterson and J. Lynch, oral communications). An
earth-fill dam, equipped with an automatic "Chinese gate", was constructed across the gulch just upstream from the ground to be placered. The gate would be "triggered" each time the reservoir filled—an overflow pipe would fill a 55-gallon drum, which in turn, lifted a large door at the base of the dam. The water, channeled between large logs, would "boom" down the placer ground, flushing the overburden downstream as it went. Holes punched in the drum permitted the drum to drain slowly and the gate to close. Most of the small-to medium-sized boulders washed from the overburden were pitchforked onto racks built along the valley sides. Some large boulders, left in the path of the water, acted as riffles to collect any gold in the upper fill. Pay dirt above bedrock was washed in a sluice box; all fractures in bedrock were carefully cleaned. One very rich "pocket" about 4 feet wide and 22 feet long was worth $2 per pan. The largest nugget found was worth $2.50.

Umpleby and Livingston reported that Joes Gulch paid about $3.60 per square yard and that the gold was about 717 fine (1920, p. 14). They estimated that up to 1913, about $70,000 to $75,000 had been produced, although $100,000 had been claimed for the gulch (Au at $20 per oz.). Annual production for the gulch, up to the first World War, probably ranged from $2,000 to $5,000 (Umpleby and Livingston, 1920, p. 14; U. S. Geological Survey, 1905–1914, Mineral resources of the U. S.).

Rough Creek

**Introductory statement**

Rough Creek is a perennial stream that flows northward 6 1/2 miles from Rough Lake to Salmon River. Development of much of the creek path is fault controlled. Bedrock is coarse-grained, porphyritic quartz monzonite-granodiorite; phenocrysts are mostly microcline. Numerous pegmatite and some quartz latite dikes crop out on the ridges bordering the creek.

Placers on Rough Creek start 1 1/4 miles from the mouth. Total length of placered ground is 1,630 feet and maximum width is about 300 feet. Placered ground is centered on a sharp bend formed by two straight sections of the creek. The lower section occupies a fault zone that strikes N55E and dips steeply northwest; the upper section follows a fault that strikes N15W (Fig. 1).

The two main placerers on Rough Creek were the Rough Creek Placer and the Grubstake.

**Rough Creek Placer**

The first placerering on Rough Creek was performed on the Rough Creek Placer group of 12 unpatented claims by John W. Friend. Because gold was recovered by relatively inefficient hand excavation and ground sluicing during Friend's early efforts, much of the gold was lost (John Seagraves, Stanley, oral communication).

In 1932-34, Friend formed the Rough Creek Mining Company and installed a rather extensive plant to hydraulically mine the placer (Campbell, 1932, p. 129). Mining commenced in 1934, was sporadic and only continued for a few years. In 1934, $1,526 in gold was produced from 8,500 cubic yards of gravel (U. S. Bur. Mines, 1935, p. 87). No record exists of the total production.

Grubstake

The Grubstake group of nine unpatented claims covers virgin ground along Rough Creek upstream from Friend's old workings, and a small flat or meadow that borders the creek on the west. The group, held by Jack Seagraves and Elbert Bowen, was worked by them from 1940 to 1942. In 1960, a one-man exploratory operation carried on for about 6 weeks, recovered about 2 ounces of gold by hand excavation.

The Grubstake is an unusual placer; the gold-bearing stream gravels have been overridden by a Pleistocene glacier. The stream gravels, however, seem to have been little disturbed. Large, subrounded glacial erratics abound in the till that composes the upper third of the overburden. These boulders occur in clusters in the upper till to form a "glomeroboulderitic veneer" over the gold-bearing stream gravels. One large erratic embedded in till at the upstream face of the workings, is 12 feet long, 10 feet wide, and 5 feet high. These large erratics seriously hampered past placer operations.

Ground worked by Seagraves and Bowen is 525 feet long and has an average width of 47 feet. The average depth of the overburden was 20 feet. In three 5-month seasons, $8,500 in gold was mined; the value of the ground (in recovered gold) was $3.07 per square yard of area ($0.46 per cubic yard of ground mined). Fineness ranged from 880 to 895. Much of the gold was coarse. About $1,000 of the gold mined was sold to tourists. The largest nugget recovered was worth $7.08 (Jack Seagraves, oral communication). A sample of undisturbed pay dirt collected from just above bedrock in 1960, contained 0.5 troy ounces of gold per cubic yard. The sample contained no flour gold; gold particle size ranged from 0.4 to 3.0 millimeters.

In addition to gold, heavy concentrates contain abundant magnetite, ilmenite, biotite, sphene, and zircon; some epidote; and minor monazite and brannerite(?).

Seagraves stated that because they did not work the placer correctly, much of the gold was lost. A large sluice box—70 feet long, 3 feet wide, and 1 1/2 feet deep—was built on bedrock in the present stream channel. Riffles for the sluice consisted of flattened screens salvaged from an old trommel. The large boulders in the till upstream from the sluice were winched to the side (onto virgin ground); the largest boulders had to be blasted. Giants were used to wash all overburden, up to small boulders in size, down
the stream along the outside of the sluice. Bedrock gravel was directed through the sluice box. A locally low-stream-gradient made it difficult to dispose of the overburden—waste gravel would pile up and overflow into the sluice. Rich pay dirt containing $1 in gold per pan at the lower end of the placer was not worked because there was no way to flush waste material downstream. According to Seagraves, the richest and coarsest gold was not in the stream channel, but was on bedrock west of the channel, towards the flat. It is possible that high gold values are contained in bedrock gravels beneath much of the flat. Fifty colors per pan can be obtained from surface gravels in the creek that drains into the flat from the west.

**American Creek**

American Creek is a small stream with a very steep gradient that flows southward into the Salmon 2 miles west of Yankee Fork. Most of the placering, probably performed in the 1870's, was confined to a gravel terrace that covers the low ridge west of the creek; the upper surface of the terrace has a gentle 6° slope towards the creek. The coarse material in the gravel is mostly subangular to subrounded cobbles and small boulders of dense, dark-blue Wood River quartzite and of quartz monzonite. A few large boulders are present. Gold in the terrace was recovered by ground sluicing with water delivered by a 2-mile ditch from Lower Harden Creek. Though the terrace gravel probably contained substantial amounts of gold, overburden along the creek seems to have contained very little. S. S. Stokes of Stanley held this ground for 15 years but was only able to find one pocket—the pocket was 3-feet wide and yielded 34 ounces of gold. Recently, H. L. Haralson worked for three summers exposing a stretch of bedrock along the creek 100 feet long and 15 feet wide; only $1.50 in gold was recovered. Overburden along the creek is only 4 or 5 feet thick; however, it contains numerous large boulders, several feet in diameter. According to his son, Otto, Herman Centauras stated that some of the old placers along the creek contained very rich pockets but that they were scattered and difficult to find.

On creek bottom in one old working is a winze that was sunk, reportedly, on a Pb-Ag vein that strikes parallel to the creek (N17W).

**Casino creeks area**

About 1 mile from its mouth, Big Casino Creek has been placered for several hundred feet. After visiting the claim in 1913, Umpleby stated, "The gold is about the size of rice grains and is found on the irregular granite bedrock in depressions and cracks... the overburden...is about 17 feet deep in the present pit". John Benzer of Stanley states that pay dirt is confined to a pay streak, 12 feet wide, down the center of the valley floor; bedrock on either side of the pay streak contained very little gold (oral communication).

About $8,000 was mined by rocker box from a short, dry gulch, located on the nose of the ridge east of Big Casino Creek. Mining was confined to the spring months when snow melt-water could be utilized. This gold was derived from the auriferous quartz veins crossing the Gold Chance claims.
Much of the gravel terrace on the point of Mormon Bend was placered by two early-day Mormons; the amount of gold recovered is unknown. Water for the operation was delivered by a 1 1/4-mile ditch from Big Casino Creek.

Little Casino Creek has been placered at its mouth and for a very short distance upstream. The production is unknown. John Benzer sank a 4-foot-square test pit to bedrock a short distance upstream from the placered ground; 1 ounce of gold was recovered from bedrock (oral communication).

West Fork of Yankee Fork

Possibly the best virgin placer grounds remaining in the area are along the West Fork of Yankee Fork and one of its tributaries, Cabin Creek. The wide valley floor along the West Fork southwest of Cabin Creek was held for a number of years by owners of the Yankee Fork dredge. The dredge, however, was too large to traverse the narrows in the lower portion of the valley west of Bonanza (Fig. 1). The ground was tested and reportedly contained high gold values. Much of the gold in the streams was probably contributed by the mineralized zone that crosses Hindman Ridge and Red Mountain. A small amount of hand placering has been performed at the nose of Hindman Ridge. A drag-line similar to the one used on Jordan Creek should be able to operate successfully on much of the ground.

Miscellaneous

Among several small inactive placers are those on Nip and Tuck Creek, the west side of Pinyon Lake, and the west fork of Upper Harden Creek. Little gold has come from these placers.

Platinum has been reported from a number of placers in the Stanley and nearby areas but has never been confirmed. Included are Stanley Creek, Jordan Creek, Loon Creek, and the Salmon River downstream near Torreys Cabins. Ultrabasic rocks, the normal source of platinum, are not known to occur in the area.
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