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PLACER DEPOSITS OF THE ELK CITY REGION

by

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IDAHO BUREAU OF MINES AND GEOLOGY

MOSCOW, IDAHO

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FOREWORD

In a number of localities the sands and gravels of certain Idaho placer deposits contain, in addition to gold, potentially economic concentrations of minerals that contain thorium, uranium, titanium, zirconium, and other metals. As part of a program of research on these placer deposits initiated in 1957 by this Bureau, R. R. Reid has spent two field seasons in the Elk City district and has done much laboratory work on samples collected during those two seasons.

The principal valuable heavy minerals of the Elk City region and the metals they contain are:

Ilmenite	-	Titanium
Monazite	-	Thorium, Rare earth metals
Zircon	-	Zirconium
Brookite	-	Titanium
Rutile	-	Titanium
Sphene	-	Titanium
Allanite	-	Rare earths, thorium

Although Dr. Reid's results indicate that the stream placers of the Elk City region cannot now be mined profitably for their heavy mineral content, his figures on the higher, Tertiary sands and gravels show that they are much richer in several of these minerals than are the stream placers. A quick calculation, based on the assumption that his four Tertiary samples are representative of the entire deposit, reveals that the Tertiary sands and gravels may contain 60 million pounds of titanium oxide, 74 million pounds of zirconium, and 160 million pounds of monazite with an unknown thorium and rare earth content. The economic potential for heavy-mineral production in the Elk City region appears to be in the Tertiary deposits.

This pamphlet is companion to Pamphlet 120, previously published, which described the bed-rock geology of the Elk City region. The two should be read together for a complete picture of the placer deposits and their geologic environment.

E. F. COOK, Director
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ABSTRACT

Stream placer gravel in the Elk City region, Idaho, aggregates about 55 million cubic yards, about 25 million cubic yards of which has already been mined for its gold content. The average amounts in pounds per cubic yard of potentially valuable heavy minerals in 15 samples of stream placer gravel in the Elk City region are as follows: allanite - 0.2 pounds; monazite - 0.15 pounds; rutile - 0.07 pounds; brookite - 0.1 pounds; sphene - 0.1 pounds; zircon - 0.25 pounds; ilmenite - 6.9 pounds; and magnetite - 16.8 pounds; the average total of heavy minerals, 27 pounds per cubic yard. Brannerite, euxenite, and columbite are present in trace amounts. Judged by these figures, the deposits are non-commercial at present.

The volume of Tertiary basin gravels and sands is not accurately known, but is probably more than 100,000,000 cubic yards. The outcrop area of such beds in the Elk City region is about 18 square miles, with a probable average thickness of more than 60 feet. The average amounts in pounds per cubic yard of potentially valuable heavy minerals in four small grab samples of the Tertiary deposits are as follows: monazite - 1.6 pounds; rutile - 0.3 pounds; brookite - 0.3 pounds; zircon - 1.5 pounds. These relatively large amounts serve to indicate that further testing of the Tertiary gravels may be of value.

The Elk City region is underlain predominantly by biotite gneiss, from which all the data in hand indicate, the major part of the heavy mineral content of the placer deposits was derived.

INTRODUCTION

PURPOSE OF THE INVESTIGATION

A study of the placer deposits in the Elk City region was made by the Idaho Bureau of Mines and Geology in the summers of 1957 and 1958 to determine the mineral content of the deposits and to extend earlier studies made in this area by the Bureau and the U. S. Geological Survey. Following the discovery of uranium-bearing minerals in the placers in 1951 (Armstrong and Weis, 1957) there has arisen considerable interest in the uranium, thorium, zirconium, cerium, and rare earth content of the heavy sands in the placer deposits of central and north-central Idaho. In the Elk City region this interest resulted principally in extensive staking of placer claims (197 claims from 1952 to 1957); to the end of 1958, to my knowledge, no heavy sands produced had been sold. In the summer of 1958, three small-scale operators were mining the placer deposits for gold, but only one of them was stockpiling the black sands.

In this study most of the heavy minerals in the placer sands were identified and the approximate amount in pounds per cubic yard of each was determined. So far as available data would permit, the origin of the placer deposits and of the heavy minerals in the deposits was determined, though it proved practicable to identify only those minerals that were present in relatively large amounts. The rarer black radioactive minerals, which are difficult to identify without specialized mineralogic knowledge, specialized research equipment, and plenty of time, have been neglected in this work: present only in trace amounts, such minerals have no probable economic value. Of the radioactive blacks, only euxenite was present in sufficient amounts to be counted.

GEOGRAPHY

Location

The Elk City region is in the drainage of the upper South Fork of the Clearwater River, Idaho County, Idaho (Fig. 1). Field mapping on this project was confined almost entirely to the South Fork drainage, including lower Red River, Newsome Creek, American River, and Crooked River north of Orogrande. Approximately 330 square miles are included within the map boundaries (Fig. 2), although not all of this area was mapped.

Access

This region may be reached most conveniently from Kooskia or Grangeville along an all-weather, narrow, graveled highway leading eastward up the South Fork of the Clearwater. During the summer one may drive to Elk City from Selway Falls (on the Selway River to the north) over a single-track forest road or fly to a small airstrip maintained a short distance southwest of Elk City.

Except on the road leading beyond Elk City along Red River and the road up Crooked River to Orogrande, four-wheel drive vehicles are desirable for travel off the main highway. Most of the forest roads can be traversed in July and August by

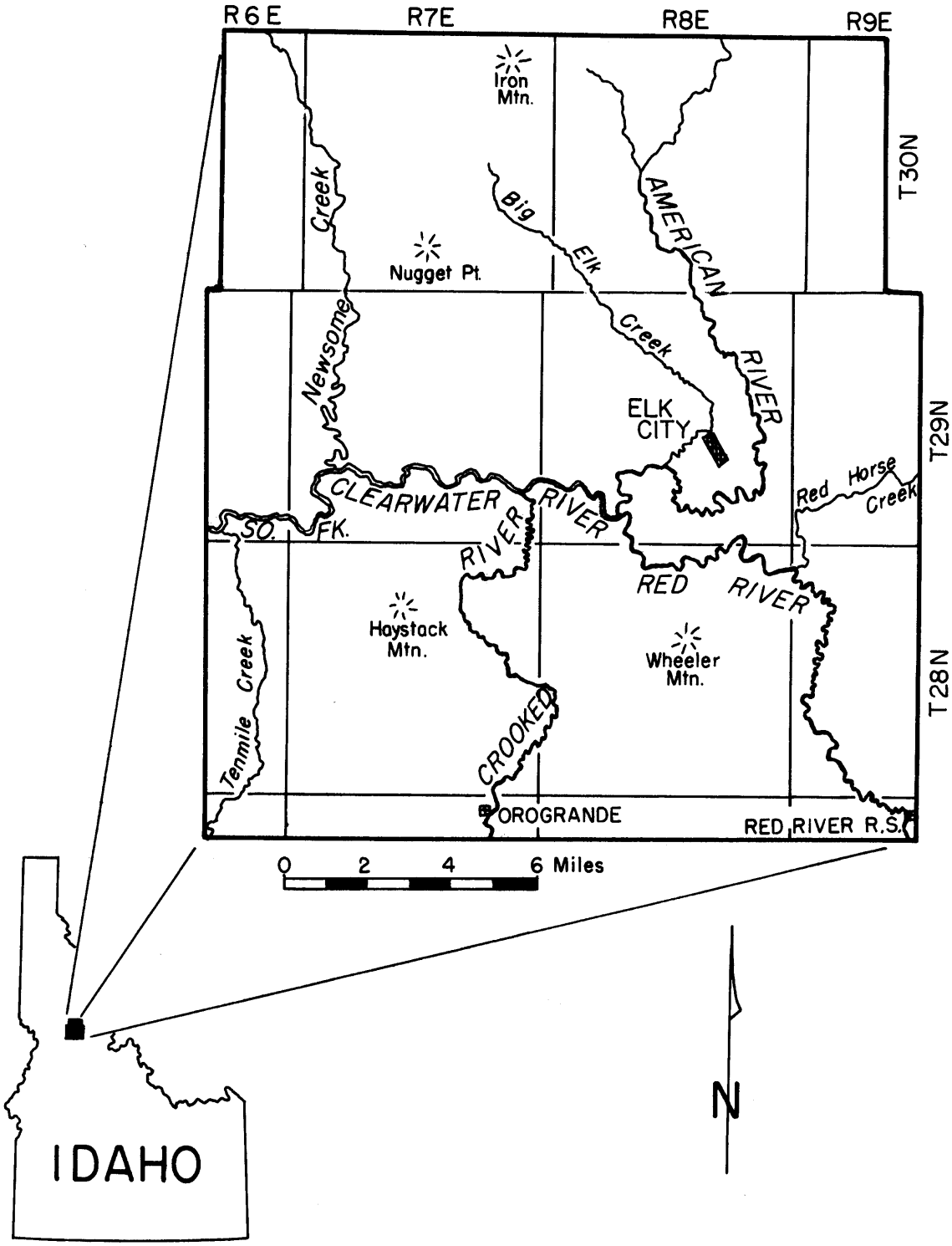


FIG. 1 — INDEX MAP OF THE ELK CITY REGION, IDAHO.

automobiles with good clearance. In most years, a heavy snow cover is present during the winter months.

Topography

As several authors have emphasized, the Elk City region lies within a rather high, dissected upland with broadly accordant ridge levels. The local relief is only a few hundred feet over most of the eastern part of the area, although along Newsome Creek and Crooked River, it may be a thousand feet or more. Most of the ridges are steep-sided, slopes of 20° to 30° being common. From high points within the area, such as Elk Summit, the area presents a broad, rolling aspect. Driving along the South Fork of the Clearwater River, one has the impression of steep, mountainous terrain because of the steep walls of the canyon.

SUMMARY OF PREVIOUS WORK

The earlier work done in the Elk City region on general geology and on the placer deposits has been largely in the nature of reconnaissance. Lindgren (1904) made a number of observations on the bedrock geology and on the placer deposits that have proved to be accurate and, for the placer deposits, very helpful in the present investigation. Thomson and Ballard (1924) made a few general observations on the bedrock geology during a study of the gold mines in north-central Idaho. Anderson (1930) prepared a geologic map that is overlapped on the north by the geologic map prepared in this investigation. Shenon and Reed (1934a, 1934b) made a relatively thorough geologic reconnaissance in an area that overlaps my mapped area. Their excellent geologic map has proved helpful for further mapping. Reed(1934) dealt with the geology of the placer deposits of the Elk City region in some detail. Lorain and Metzger (1938) discussed the economics and extent of the gold placers. Capps (1941) examined fault relations in part of the district in connection with a study of faulting in western Idaho. Anderson (1948) briefly described vein relations in the district.

A previously published report, companion to this paper, discussed the bedrock geology in the Elk City area (Reid, 1958).

FIELD AND LABORATORY PROCEDURES

Field data were mapped on air photographs (scale 1:20,000) obtained from the U. S. Soil Conservation Service. U. S. Forest Service planimetric maps served as a base for compilation of data, as well as for the geologic map (Fig. 2).

Sixty heavy sand specimens (Appendix No. 1), 15 sand samples (Table 1), 2 soil samples (Table 2), and 8 rock samples (Table 3) were investigated. Petrographic microscopy, binocular microscopy, hydrofluoric acid staining and scintillation counting were used in the heavy mineral identification and in grain counting. Use of the oil immersion lens (over a cover glass) in the study of very finely crushed minerals yielded many optical data not otherwise easily obtainable.

Heavy sand specimens were taken from prospect pits, riffles, jigs, washer piles, dredge piles; from sample holes that could not be completed to bedrock for a variety of reasons; from shallow stream channel gravels; and from small rivulet concentrates along dirt roads. The specimens were washed and panned in the field to about one-third of original volume and then air dried. The resulting specimen weighed 5-10 pounds.

Placer samples were taken from hand-dug sample pits, old bulldozer sample pits, old dragline sample pits, an operating dredge, an operating dragline, and a small operating hydraulic placer mine. Soil samples were taken from road cuts. Rock samples were taken from selected outcrops, and Tertiary gravel samples were taken from the walls of the old hydraulic placer pits. The samples from hand-dug pits weighed 86 pounds each (two buckets of gravel at 43 pounds each). After plus 3-mesh material had been screened off in the field, the sample was air dried. In the collection of such pit samples, the sand and gravel from a pit 6 feet in diameter and 8-9 feet deep (bottom on bedrock) was piled in a rude cone. About a quarter of this cone was removed by shovel and repiled in a new, smaller cone. The new, smaller cone was similarly quartered, and from one of its quarters the 86-pound sample was taken. Only this admittedly rough method of sample collection was feasible under existing field conditions.

The gravel at many localities could not be sampled because of high influx rate of water into the pits or because the presence of boulders larger than 10-12 inches in diameter would have necessarily produced a sample size larger than could have been handled conveniently.

Samples collected from previously dug pits were air dried without screening off coarse material. Such samples weighed 40-125 pounds.

In preliminary laboratory treatment, soil samples and Tertiary gravel samples were weighed, washed free of clay, panned to about one-third of their original volumes, and dried. Rock samples were crushed to pass 8-mesh screen, in three stages. After each of the first two stages, minus 8-mesh material was screened off for recombining with the crushed rock after its third stage of crushing. The crushed rock was then weighed, washed free of water-suspended material, panned to about one-third of its original volume, and dried. Placer samples were weighed, washed free of clay, panned to about one-third of their original volume, and dried. Occasional pans were checked to see that no heavy minerals were being washed into the discarded light portion of the placer samples.

All specimens and samples were screened to plus 8-mesh; minus 8, plus 14-mesh; minus 14, plus 20-mesh; minus 20, plus 28-mesh; minus 28, plus 35-mesh; minus 35, plus 48-mesh; minus 48, plus 100-mesh; minus 100, plus 200-mesh; minus 200-mesh. The very small amount of minus 200-mesh material was discarded.

Plus 8-mesh heavy minerals (generally minor in amount) were examined megascopically and weighed. Finer sands in each grade size were concentrated with a small laboratory hydraulic classifier and dried. After initial checking showed

that the separation of heavy minerals was very good, the light fraction was discarded.

Magnetite was removed from all sample fractions with a hand magnet. Each of the heavy sand fractions was then separated into three sub-fractions on an electromagnetic separator (Carpco): one at zero amps, one at one-half amp, and one taken to be nonmagnetic. Necessary weights of sub-fractions were obtained. The nonmagnetic fraction was immersed in hydrofluoric acid so that any euxenite or brannerite present might be etched, in accordance with a technique recommended by Dwight Schmidt (oral communication).

Mineral proportions in each sample fraction were determined by counting 100-300 grains using a grid ocular on the binocular microscope. Percent by volume was computed and, as an approximation, assumed to be equal to percent by weight.

For samples, the weight in pounds per cubic yard of each heavy mineral identified was computed, as well as total weight, in pounds, of heavy sands per cubic yard. For specimens, only qualitative studies of the mineralogy were made.

Standard optical techniques were used in the identification of all but the opaque blacks. A large number of standard and specialized mineralogical references was consulted during the course of this investigation. There appears to be no necessity that detailed references be made.

ACKNOWLEDGMENTS

Several persons have contributed materially to this report. John Beeder and Richard Kopp each provided one month of high-quality field assistance. Bruce Brogoitti and Stuart Hill each did significant portions of the heavy mineral analyses under my supervision and checking.

The excellent geologic map prepared by Shenon and Reed (1934a) has been consulted freely during the course of this work. Many geologic contacts have been transferred directly from their map to the present map (Fig. 2) with a special line symbol to show which contacts are their work. Most of the contacts transferred lie in the south-west quarter of the present map. It follows that the present work does not supplant that of Shenon and Reed, but rather extends and elaborates upon it.

DESCRIPTION OF THE PLACER DEPOSITS

GENERAL DESCRIPTION

The placer deposits of the Elk City region, including those in the Elk City, Orogrande, Newsome, and Tenmile mining districts, occur partly as high-level gravels and partly as flood-plain gravels along the present streams (Reed, 1934, p. 2). Because the high-level gravels are those of Tertiary age that have been previously described in Pamphlet No. 120, they require only brief discussion here.

Though these high-level gravels have generally been called placer deposits and have been worked in a number of places for their gold content, these gravels, strictly speaking, are not placers, but rather old basin-fill deposits that now cap a few ridges and benches remaining after streams in the area had cut below the bottom(s) of the former basin(s) of accumulation. Torrential bedding, lack of sorting, and richness in quartz and quartzite detritus characterize these Tertiary gravels. Bedrock below them is strongly decayed to depths of 50 feet. The extent of the Tertiary gravels is shown on the geologic map (Fig. 2).

The base of the Tertiary gravels is at 4,000-4,200 feet elevation over the entire Elk City region. The basal part of the gravels, particularly in old stream channels, contained commercial quantities of gold, much of which was hydraulically mined in the latter part of the 19th and the early years of the 20th centuries. Where exposed in road cuts and in hydraulic placer pits, these gravels range from a few feet in thickness, as along parts of Erickson Ridge, to perhaps 200 feet, as on upper Newsome Creek. They range widely in composition, from bouldery silts through poorly sorted sands, gravels, bouldery gravels, to coarse conglomerates. Subordinate amounts of clay, lignite, carbonized wood, and peat are present, as along upper Little Elk Creek and in the American Hill placer. Along upper American River, these gravels are at their base 20-30 feet above the stream. Downstream, they rise progressively higher above the stream, as the valley becomes deeper. The gold content of these gravels is reportedly low, 6 to 10 cents a cubic yard (Lorain and Metzger, 1938, p. 36).

The flood-plain gravels under most of the streams are 8-10 feet thick, including 2-4 feet of silt that is partly of main-stream and partly of valley-side origin. In a few places, as in parts of Crooked River, the gravels in bedrock holes may be 22 feet in depth, according to Mr. Clair Finch, former operator of a dredge on Crooked River. Gravels along parts of American River and the South Fork of the Clearwater River are said to be considerably deeper than 20 feet. In the upper portions of the smaller tributary streams, the channel gravels are 2-3 feet deep and not generally amenable to placer mining.

In a sample pit 6 feet in diameter, which I dug entirely in channel gravel on Red River, bedrock was encountered at 8 feet. In another hole, on Seigel Creek, bedrock was encountered at 8 feet, below 4 feet of silt and 4 feet of channel gravel. A hole dug on the South Fork of Red River to a depth of 6 feet did not encounter bedrock and an andesite boulder not much smaller than the hole diameter prevented further digging. Another hole dug to a depth of 6 feet on Red River upstream from the Red River Ranger Station did not encounter bedrock, and ground water, which flowed into the hole too

fast to be bailed out, prevented further digging. A hole attempted on American River, just above the edge of the dredge ground, had a similar termination. Still other holes attempted on the West Fork of Newsome Creek and on Newsome Creek itself were abandoned, partly because boulders too large to be lifted from the hole were found at depths of 5-6 feet and partly because of rapid influx of ground water.

The size of the boulders in the flood-plain gravel is related partly to the gradient of the stream and partly to the nature of the bedrock. Along Red River where the gradient is 26-28 feet per mile, few boulders are larger than 10 inches in diameter. But where the channel is narrow and gradient steeper, boulders weighing many tons are present. Along the dredged portion of Newsome Creek (gradient 48 feet per mile), quartzite boulders 3-4 feet in diameter are not uncommon, and gneiss boulders up to 2 feet in diameter are abundant. The channel gravel is generally thicker in parts of the stream of more gentle gradient. Along Crooked River, for example, the average depth of gravel in dredged areas was about 12 feet. In a narrow, steeper part of the channel, however, one test pit sunk by Mr. Lester Strack encountered bedrock at a depth of 8 feet (2 feet of over burden and 6 feet of gravel).

The U. S. Bureau of Mines drilled a number of test holes in the placer gravels of Red River and Elk Creek in 1953. The classified report had not, by the spring of 1960, been released for public information. According to the owners of the ground on which the drilling was done, churn-drill holes in the Red River gravels, supposedly entirely in place gravel, ranged in depth from perhaps 15 feet to as deep as 50 feet. If these estimates are accurate, the holes must have been overdrilled. Mr. Clair Johnson, mining in the lower Red River meadows with a dragline-modified dredgeboat combination, reports bedrock at an average depth of 7 feet. In fact, I stood on augen gneiss bedrock in a pit 7 feet deep excavated in these gravels by Mr. Johnson's dragline, during the collection of a sample of the gravel. Drill holes in the Elk Creek meadows are said to have been drilled as deep as 80 feet in placer gravel. Mr. Johnson stated that bedrock is only 8-10 feet under these meadows. On the other hand, one hears local reports of test holes on Elk Creek hand-dug to depths of 30 feet and more in gravel. These holes were probably dug into the Tertiary gravels that are almost certainly present in places below the layer of Elk Creek floodplain gravel which is 8-10 feet thick.

LOCATION OF PAST DREDGING ACTIVITY

Dredging along the South Fork of the Clearwater River

Within the area covered by this report, the South Fork of the Clearwater River (Fig. 3 has been dredged in two places: (1) from the Santiam Creek bridge to Rabbit Creek; and (2) from the Crooked River bridge to the confluence of American River and Red River, which forms the head of the South Fork of the Clearwater. Below Santiam Creek to Golden and beyond, the valley bottom is the stream channel, which is full of rapids and very large boulders. There, its gradient is about 50 feet per mile, whereas in the dredged portion of the stream above Santiam Creek, the gradient is only 15 feet per mile and the valley floor averages 150 feet or more in width. From Rabbit Creek to the mouth of Crooked River the gradient is about 35 feet per mile along a narrow bouldery channel; and from the Crooked River to the head of the South Fork of the Clearwater, the gradient is about 21 feet per mile and the valley floor averages perhaps 200 feet in width.

Dredging along Newsome Creek

Newsome Creek has been dredged from the mouth of Nugget Creek almost to the mouth of Radcliff Creek (Fig. 4). Below Bear Creek, its gradient is about 63 feet per mile. Along parts of the stream, rather sharply incised or ingrown tight meanders are present; the bouldery stream channel occupies the full width of the valley bottom.

Above Nugget Creek the gradient is about 48 feet per mile, and the valley bottom averages perhaps 325 feet in width as far as Radcliff Creek, where the valley bottom narrows to the width of the stream channel.

Dredging along Crooked River

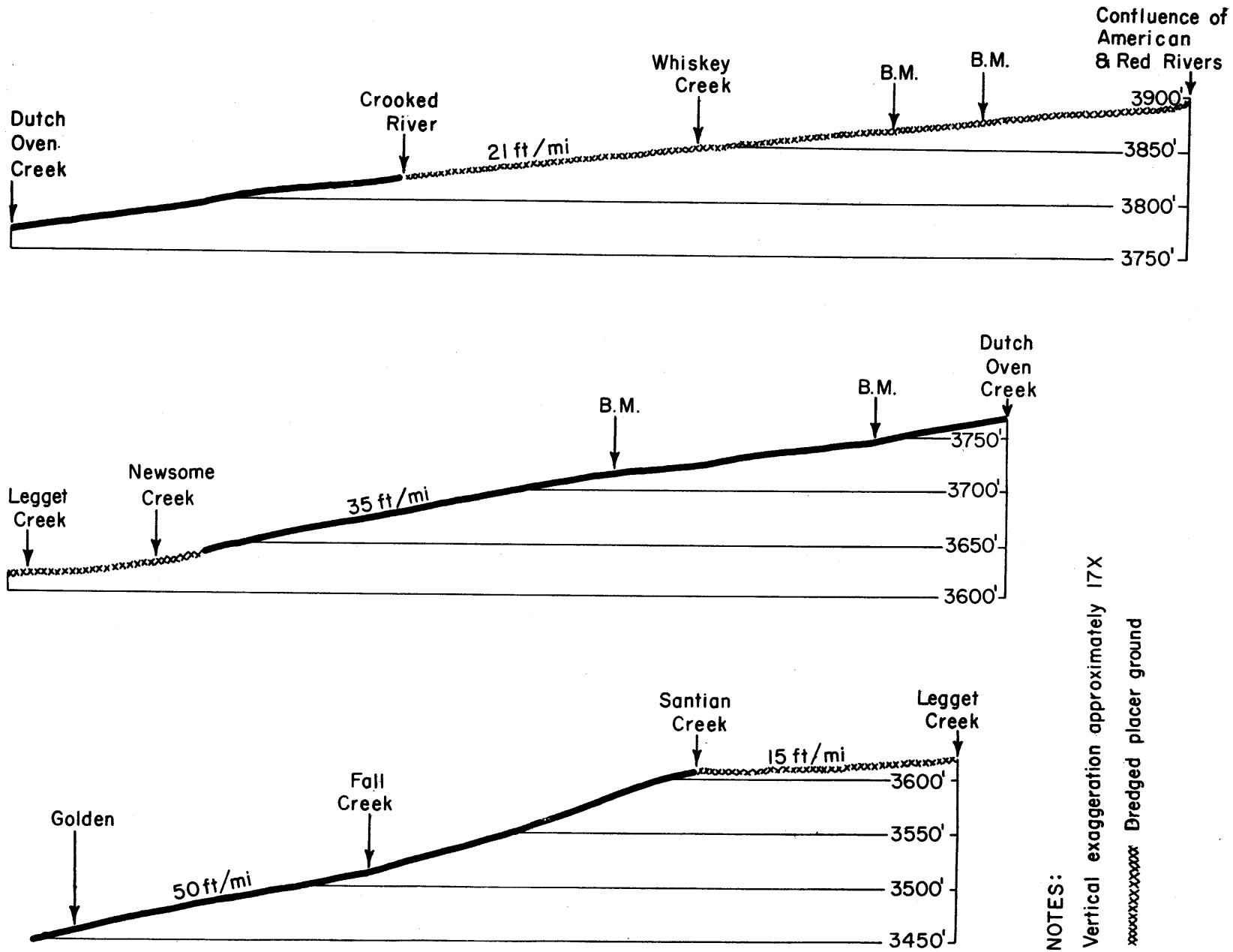
Crooked River (Fig. 5) has been dredged in two places: near its mouth and below Orogrande. Compared to other placer gravel areas in the Elk City region, the lower area of dredged stream channel has a rather high gradient of 96 feet per mile. The valley bottom averages perhaps 300 feet in width in this part. Above this area, the narrow, rocky stream channel has an average gradient of about 61 feet per mile. In the summer of 1958, Mr. Lester Strack was mining a part of this stream gravel for gold with a small dragline and washing plant. The upper area of dredged ground extends from about 1.5 miles below Relief Creek to Fivemile Creek. It has a gradient of 43 feet per mile in its lower part and a gradient of 86 feet per mile in its upper part. The valley bottom averages about 300 feet in width over this dredged ground.

Dredging along Red River

Red River (Fig. 6) has considerable unmined placer ground. Within the map area are two large meadows used for agricultural and grazing land. Red River below French Gulch has a meandering, bouldery channel almost as wide as the valley bottom, with a gradient of about 40 feet per mile. The lower meadow, with an average minable width of perhaps 1,500 feet, has a gradient of 25 feet per mile. The relatively narrow valley between the two meadows has been dredged; its gradient is about 30 feet per mile. The upper meadow, with an average minable width of perhaps 1,000 feet, has a gradient of 10 feet per mile. Where the stream channel narrows above the upper meadow, the gradient again becomes 30 feet per mile.

Dredging along American River

American River has been dredged almost entirely from its mouth to the Flint Creek trail, above Telephone Creek. Below Kirk's Fork, the average gradient of 26 feet per mile is somewhat steeper than that below Elk Creek. Most of this part of the valley is not much wider than the stream channel. For about a mile above Elk Creek, the channel gravel is several hundred feet wide. But from Kirk's Fork to Baboon Gulch, the valley bottom is very narrow and has a gradient of 54 feet per mile. Then from Baboon Gulch to the Flint Creek trail, the gravels average perhaps 500 feet in width and have a gradient of about 28 feet per mile (Fig. 7). Smaller streams in which extensive placer mining has been done (largely with dragline and washing plant) include Red Horse Creek, Seigel Creek, Little Elk Creek, Deadwood Gulch, Relief Creek, and lower Buffalo Gulch.



NOTES:
Vertical exaggeration approximately 17X
xxxxxxxxxx Dredged placer ground

FIG. 3— Profile along the South Fork of the Clearwater River.

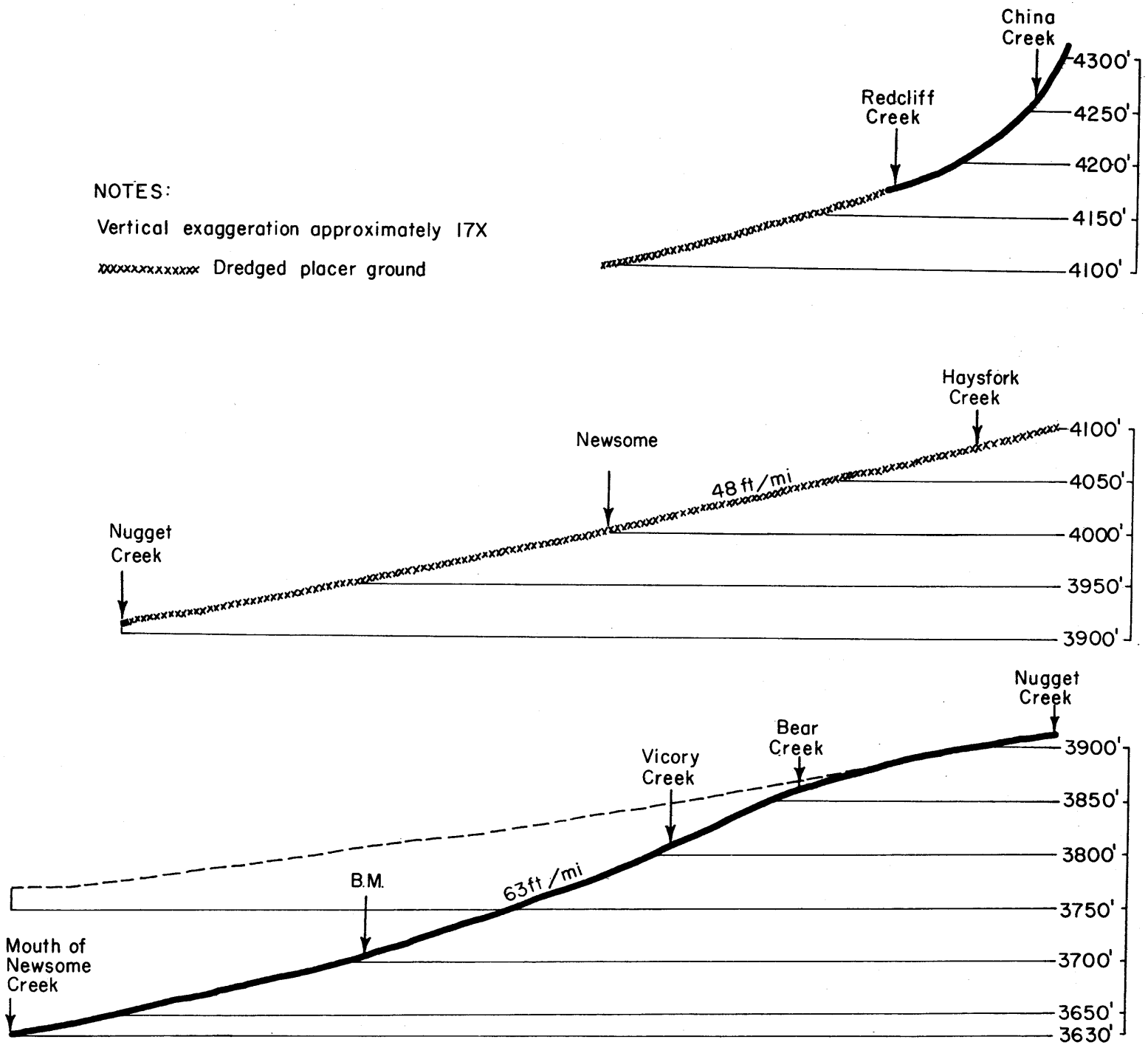


FIG. 4 — Profile along Newsome Creek.

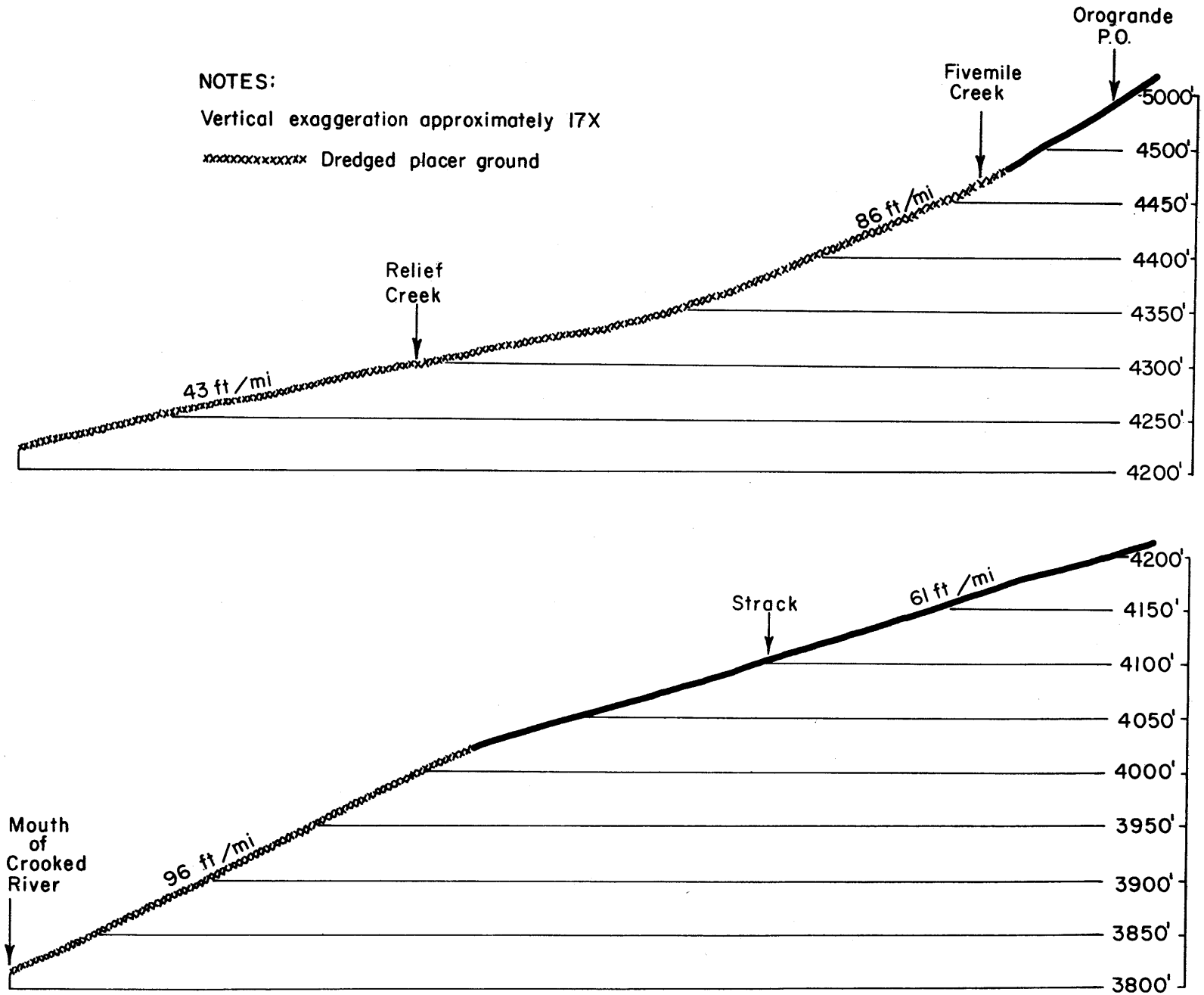


Fig. 5 — Profile along Crooked River.

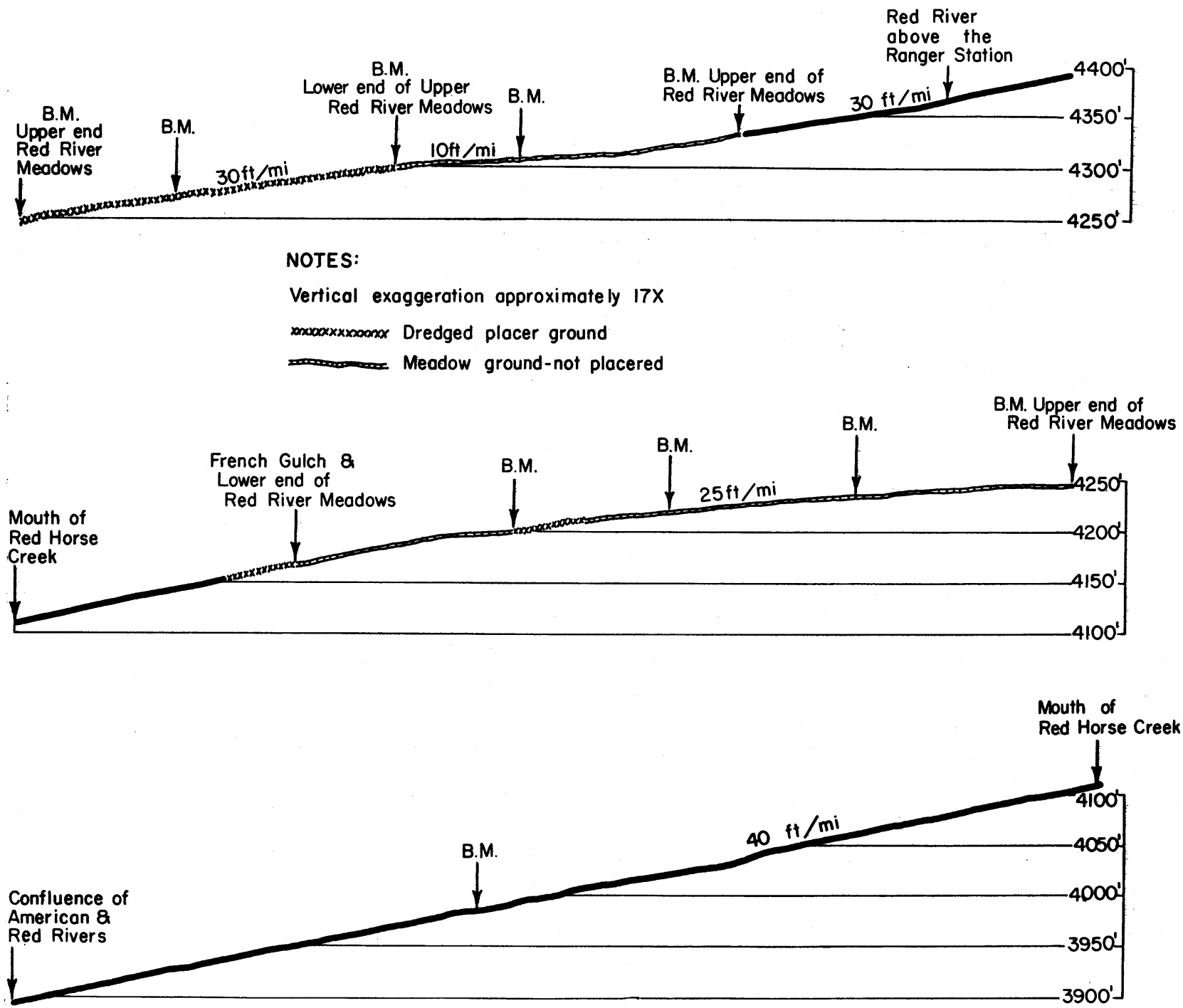


Fig. 6— Profile along Red River.

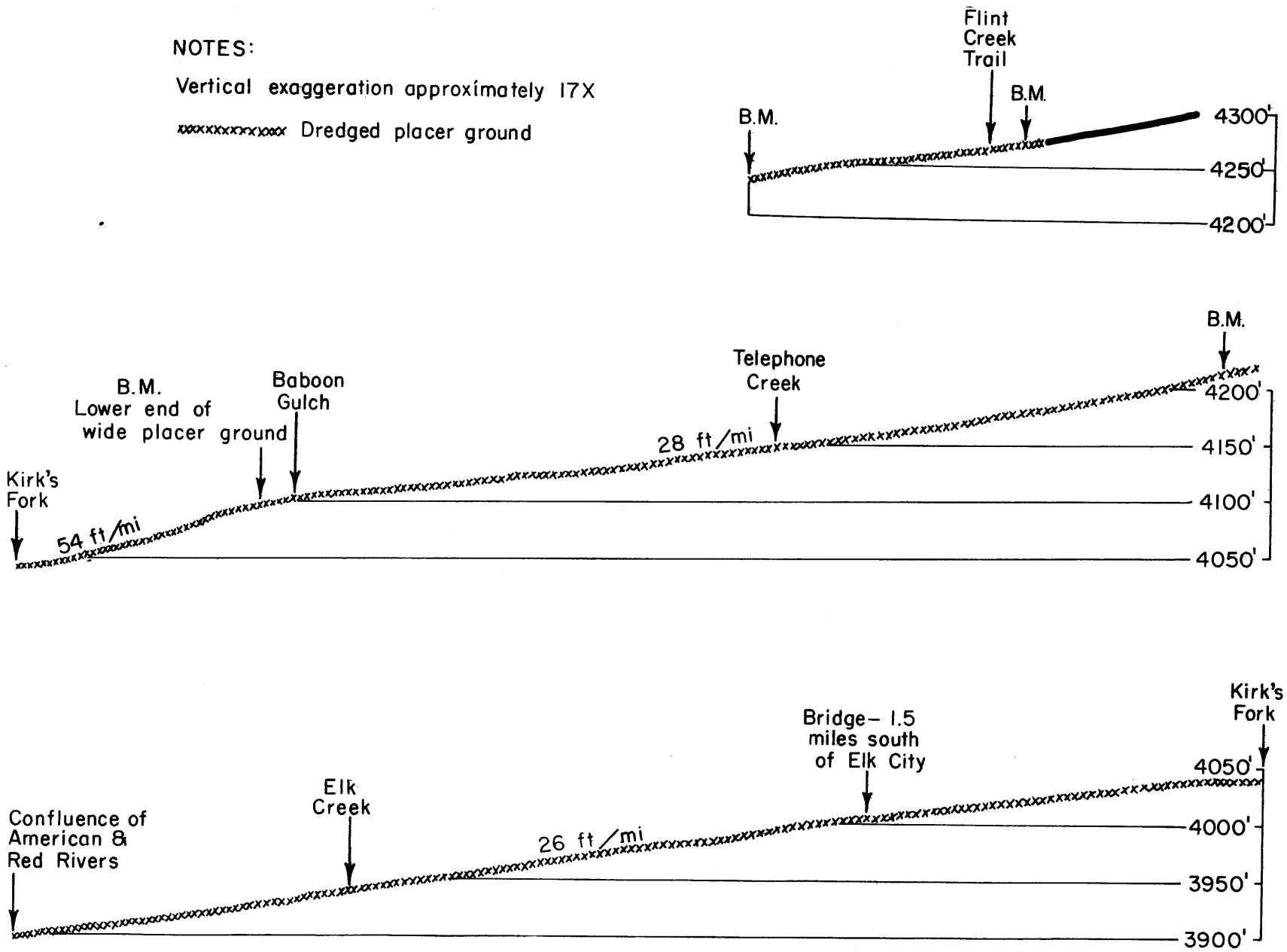


FIG. 7 — Profile along American River.

VOLUME AND OWNERSHIP OF PLACER GROUND

Placer ground mined for gold

Introductory remarks

The total volume of the dredged ground in the Elk City region is 24,263,000 cubic yards; the total volume of unmined placer ground is about 30,220,000 cubic yards; and the total volume of stream placer gravel in the Elk City region is 54,484,000 cubic yards. These figures include both overburden and channel gravel. The total overburden is about 25 percent of the total yardage present.

This section and the one to follow are based largely on previous work by Lorain and Metzger (1938), in which they give length, average width, and average depth for many of the stream placer deposits in the Elk City region. It has been necessary to compile only a few more data for some of the smaller creeks to permit completion of rather comprehensive volume computations. Although these volume data are approximations, they may be accurate within about 20 percent; many of the smaller creeks, even those with placer claims along them, have been omitted.

Many claims are not mentioned here, some because they are on small creeks; some because they were not observed during the work in the field; and some because of space limitations. Further, many claims have been allowed to lapse and have been restaked by new owners, and certain of the claims mentioned may have lapsed prior to this work or may have lapsed before this comes to print. For claims owned by several persons, the name of the first person listed is the only name mentioned herein.

American River and tributaries

Dredged ground on American River aggregates about 11,000,000 cubic yards. A portion of the gravel lies in the Congress group of patented claims in Section 24, T 29 N, R 8 E. About 1.5 miles of the gravel lies above the mouth of Whitaker Creek on patented meadow land owned by Mr. Fred Shawley. The ground below the Congress group to Kirk's Fork, and up Kirk's Fork, is held under location by Mr. V. C. Ross and includes the Ross and Ross No. 1 unpatented placer claims. American River ground above the Shawley land to the West Fork and up the West Fork is held under location by Mr. Clair Johnson and includes the Rare Find Wedge and the Rare Find Group No. 1 placer claims. Mr. Ray Paulson holds the unpatented Blue Jay claim north of the Rare Find claims on American River. The unpatented ground below the Ross claims to a point near the American River bridge is held by Mr. Clair Johnson (Rare Find No. 3), who holds also under location the ground between the Shawley land and the Congress patented ground. Baboon Creek, tributary to American River, contains about 200,000 cubic yards of gravel, a figure based on data provided by Lorain and Metzger (1938) for I did not traverse Baboon Gulch during my work. Mr. Ray Paulson holds the Blue Eagle unpatented placer claim on the north fork of Baboon Creek.

Red River and tributaries

Red River has been dredged between the upper and lower meadows within the map area; because its channel is narrow, the total yardage of gravel is small and has not been computed. This ground is held under location (Patrin placer claims) by Mr. Floyd Patrin. Placer mining by Mr. Clair Johnson was getting well under way in the lower Red River meadow in the summer of 1958.

Red Horse Creek, tributary to Red River, contains about 650,000 cubic yards of gravel, and nearby Seigel Creek has about 310,000 cubic yards. The most recently posted claims in Red Horse Creek are the Red Horse No. 1 and No. 2, held under location by Mr. V. E. Anderson. Lower Seigel Creek lies on patented agricultural land, but most of the upper part is covered by patented claims of the American Eagle group. A short portion of Seigel Creek below the American Eagle claims was being mined under lease in the summer of 1958 by Mr. Donald Behrens. The most recent location on this ground (J. and M. placer claim) has been made by Mr. J. W. Hart.

Newsome Creek and tributaries

Newsome Creek has about 5,000,000 cubic yards of gravel above its junction with Nugget Creek. Virtually all of this ground is held under location by Mr. McKibben. The volume of gravel that has been worked in Pilot Creek is too small to compute for present purposes.

Crooked River

Crooked River contains about 3,870,000 cubic yards of gravel. The lower placer ground on Crooked River is held under location by Mr. W. G. Rape (Ramona No. 1 and No. 2 placer claims). South of these claims are the Alma No. 1 and No. 2 placer claims (owner not noted). South of this, along the lower narrow portion of the river, are the Crooked River placers and the Blue Moon group, all held under location by Mr. Lester Strack. The Lux placer claims (owner not noted) lie south of the Blue Moon claims, where the valley widens, and north of the Riverside and Mt. Carmel patented claims. Still south of the Riverside and the Mt. Carmel are the Lux No. 2, the Hi-Lo, Vista, Black Sand, Gold Point, and Crooked River placer claims.

South Fork of the Clearwater River

The two dredged areas along the South Fork of the Clearwater contain approximately 2,100,000 cubic yards of gravel. The ground above the Santiam Creek bridge is held under location by Mr. C. E. Weston in the Friendly Association and Party Line placer claims. The ground above the Crooked River bridge, also held under location by Mr. Weston, includes the Great Northern Association and Western Association claims.

Other streams

Lower Buffalo Creek has about 53,000 cubic yards of gravel, which is not now held under claim. The upper part of Little Elk Creek has been dredged. About 590,000 cubic yards of gravel are present. This ground lies partly on patented agricultural land

and partly on U. S. Land. Deadwood Gulch has about 390,000 cubic yards of gravel.

Placer ground not mined for gold

On the East Fork of American River are approximately 200,000 cubic yards of unmined gravel, above the lower narrow portion of the creek. No road yet leads up this creek, though Mr. John Oberhaufer holds a claim on this creek by location. The upper part of Buffalo Creek, which lies partly on patented agricultural land and partly on state and federal land, has about 26,000 cubic yards of gravel. If its entire meadows are underlain by placer gravel, Elk Creek has about 11,000,000 cubic yards. Virtually all of this ground lies on patented agricultural land or on school land, except for the patented Thomas Placer Mining Co. claim in Section 15, T 29 N, R 28 E. Little Elk Creek has about 2,400,000 cubic yards of unmined gravel, all on patented agricultural land. The West Fork of American River has about 450,000 cubic yards of gravel, held under location by Mr. Clair Johnson in the Little Rare Find group of placer claims.

Lick Creek has 100,000 cubic yards and Limber Luke Creek has 500,000 cubic yards. A steep narrow road reaches these creeks, and the land, partly patented agricultural land, is being used largely for grazing. If all of its meadow ground is underlain by placer gravels, Red River has about 13,300,000 cubic yards of unmined gravel. All of the land in both the upper and lower meadows is patented agricultural land, owned by a number of persons. In the summer of 1958, Mr. Clair Johnson was mining under lease from Mr. Floyd Johnson in the lower Red River meadows. French Gulch has about 45,000 cubic yards of gravel, held by the Gold Point Mining Co. in the Myke, Peace J., and Quail placer claims. Seigel Creek has about 350,000 cubic yards of unmined gravel; Pilot Creek has about 200,000 cubic yards; and Baldy Creek has 240,000 cubic yards. Most of Baldy Creek is held under location by Mr. McKibben. Haysfork Creek has 870,000 cubic yards, held under location by Mr. Pell. China Creek has about 90,000 cubic yards of gravel. Leggett Creek has 275,000 cubic yards of gravel, held under location by Mr. Maryland. The West Fork of Newsome Creek has about 175,000 cubic yards of gravel, partly on patented mining claims, and, above the bridge on the West Fork, partly in the Joker and Black Jack placers, held under location by Mr. G. G. Waddell.

POSSIBLE ECONOMIC PLACER DEPOSITS

Any of the yet undredged areas previously mentioned could contain commercial quantities of gold, although most of them have been tested, and the presence or absence of gold is known to prospectors or other persons previously or now engaged in placer mining in the Elk City region. The meadows of Red River and Elk Creek are all underlain by gravels that would be in part commercial according to local report, but gold content was not checked systematically in the present investigation. Further, virtually all this meadow land is under agricultural use (patented land) and will, according to its present owners, remain so.

The principal question then, is whether or not the previously dredged gravels contain enough valuable heavy minerals to make their second mining profitable. To determine the answer to this question was one of the major aims in this investigation. In general, the answer is negative.

Reference to Table I will show that the gravels in the Elk City region contain about 27 pounds per cubic yard of heavy minerals. Fig. 8 shows the locations of samples studied. Of those minerals that may conceivably be valuable at a future time (but which in their present location have no value now), the gravels contain: allanite - 0.2 pounds, monazite - 0.15 pounds, rutile - 0.07 pounds, brookite - 0.1 pounds, sphene - 0.1 pounds, zircon - 0.25 pounds, ilmenite - 6.9 pounds, and magnetite - 16.8 pounds. Brannerite, euxenite, and columbite (known from earlier work to be present, these minerals formed the major impetus for this study) occur generally only in trace amounts.

The Newsome Creek area may have some columbite deposits: relatively large amounts of columbite (but not necessarily commercial concentrations) were found in the West Fork of Newsome Creek, Sing Lee Creek, and Haysfork Creek.

Similarly, the Red Horse Creek area has some euxenite and brannerite, because the highest concentration of euxenite found (0.003 pounds per cubic yard) was in a sample of Red Horse Creek gravel.

Because one sample from Seigel Creek contained 0.2 pounds per cubic yard of allanite, a lode deposit of allanite may exist in upper Seigel Creek (see Appendix No. I, specimen E-10a).

American River gravel may be relatively high in monazite; one sample contained 0.37 pounds per cubic yard. For the relatively small yardage of gravel in American River, this would perhaps not constitute a commercial concentration even under favorable market conditions. For lack of samples, the heavy sand potentials of Elk Creek and Newsome Creek are not known from this study. They are probably not significantly different from those of the streams sampled.

Surprisingly, four samples of the Tertiary deposits (Table 2) contain an average of 1.6 pounds per cubic yard of monazite, 0.3 pounds per cubic yard each of rutile and brookite, and 1.5 pounds per cubic yard of zircon. Though not nearly so high

as monazite content reported for gravels elsewhere in Idaho, these values are all much higher than values for the same minerals in the stream placer gravels. Should further investigation and sampling reveal that the Tertiary gravels are uniformly high in these minerals, then, the very large amounts of Tertiary gravels present in the area (estimated area 18 square miles, average thickness more than 60 feet), and in surrounding areas, would make available large reserves of these minerals. The Elk City region probably contains more than 100,000,000 cubic yards of Tertiary sands and gravels.

The information derived from studies of these samples must be used with caution, for it is well known that placer gravels are highly lenticular in their internal structure. Recent studies by Carl Savage of the Idaho Bureau of Mines and Geology (oral communication) further support this fact. The few samples studied in this work probably suffice to show, therefore, only the order of magnitude of heavy mineral content in the placer gravels, but have no greater significance. Furthermore, detailed study of the sample and specimen data in the Appendices will show that--as was probably to be expected--even specimens and samples from different parts of the same stream do not necessarily contain precisely the same mineral suites.

TABLE I

Sample No.	Al	Co	Ep	Ga	Li	Mo	Ru	Sp	Zi	Bro	Cb	Eu	Il	Ma	Py	Au	To	Rock Types	Total
P-1			0.2	0.2	2.1	0.1	tr		0.12	0.19			2.2	3.6	tr	1 color		Crooked River Gravel	8.7
P-2	0.3	tr	0.3	0.1	2.0	0.2	tr	0.32	0.36	0.13			6.9	26.0	tr	1 color		Red River Gravel	36.3
P-12	0.2		0.5	1.1	0.2	0.2	tr	0.2	0.3	tr	tr		3.2	10.1	tr		tr	Red River Gravel	16.0
P-20	0.5	tr	0.55	0.2	0.7	0.1	0.04	0.16	0.2	0.1		0.003	4.8	23.6	tr		tr	Red Horse Cr. Gravel	30.6
P-21	0.01		0.1	0.2	2.0	0.2	0.07	tr	0.1	tr			8.2	12.2	tr			Little Moose Cr. Gravel	23.2
P-22			1.9	1.0	1.3	0.37	0.52		0.47	tr		tr	15.2	15.3	tr			Amer. River Gravel	36.3
P-23			0.1	1.1		0.05		0.03		0.5			10.9	1.4	tr		0.03	E. Fork Amer. River Gravel	13.7
P-24	0.2		1.9	0.47	1.1	0.01	tr	0.16	0.76		tr		9.8	60.4	tr			Seigel Creek Gravel	74.9
P-25	0.8		0.8	1.6	0.3	0.1	0.05	0.3	0.26	0.1	tr		3.2	10.1	tr		tr	Red River Gravel	16.8
P-26	tr		0.7	0.4	1.7	0.15	tr		0.04	0.01	tr		4.3	6.0	tr			Crooked River Gravel	13.3
P-35*				75.9	0.3	10.2	7.8		0.6	2.2	0.6		70.8	10.4	tr	0.141 (1.69 Oz.)		Haysfork Cr. 1/4 mi. above Pell's	178.8
Averages	0.2	tr	0.7	0.6	1.1	0.15	0.07	0.1	0.25	0.1	tr	tr	6.9	16.8	tr	tr	tr		27.0

Pounds per cubic yard of various heavy minerals in several samples of placer gravel. Gravel computed at 3,000 lb/cu.yd. Locations shown on Figure 8.**

* This one sample is anomalously high, probably because it lies in the headwater of the stream and is more nearly a reworked soil than a representative placer sample. It is not computed in the averages.

**Significance of mineral abbreviations -Appendix No. I.

TABLE 2

Sample No.	Al	Co	Ep	Ga	Li	Mo	Ru	Sp	Zi	Bro	Cb	Eu	Il	Ma	Au	To	Rock Type	Total
P-30				tr	0.7	2.3	tr		0.7	tr		tr	2.7	6.9			Tertiary Gravel	13.3
P-32				0.12	0.6	1.6	0.04		0.1	0.06	0.1		5.6	3.9			Tertiary Gravel	12.1
P-33				tr	0.1	1.2	0.04		0.06	0.06	0.02		2.9	7.4		0.6	Tertiary Gravel	12.4
P-39			6.9	2.3	0.1	1.23	1.14		5.1	1.05	tr		17.4	8.1	tr		Tertiary Gravel	43.3
Averages			1.7	0.6	0.4	1.6	0.3		1.5	0.3	0.03	tr	7.1	6.5	tr	0.1		20.2

Pounds per cubic yard of various heavy minerals in several samples of Tertiary gravel. Gravel computed at 3,000 lb/cu. yd. Locations shown on Figure 8.

TABLE 3

Sample No.	Al	Co	Ep	Ga	Li	Mo	Ru	Sp	Zi	Bro	Eu	Il	Ma	Py	Au	To	Rock Type	Total
P-18				0.38	0.03							0.18	0.23				Pegmatite	0.83
P-19	tr				0.2	0.07		0.07	tr			12.6	0.04				Biotite Gneiss	13.0
P-31				0.15	0.8	6.2			0.15	0.17		0.02	2.1		tr		Weathered(?) Biotite Gneiss Under Tertiary	9.6
P-34			34.0	0.02	4.1				0.4			0.1	0.2				Weathered(?) Biotite Gneiss Under Tertiary	38.8
P-36				0.02		0.2			0.001			0.08	4.8				Biotite Gneiss	5.1
P-37			0.5	0.1		0.05	0.02		9.8			0.5	112.6	1.1			Augen Gneiss	124.7
E-103				0.02		0.04						0.03	20.2	9.5			Granodiorite	29.8
E-113				0.5		0.15	0.2		0.03	7.6		0.3	1.5	0.06			Biotite Gneiss	10.3

Pounds per cubic yard of various heavy minerals in several samples of country rock. Rock computed at 4,400 lb/cu. yd. Locations shown on Figure 8.

TABLE 4

Sample No.	Al	Co	Ep	Ga	Li	Mo	Ru	Sp	Zi	Bro	Eu	Il	Ma	Py	Au	To	Rock Type	Total
P-13			1.0	tr	1.7			0.7	0.05	tr		0.6	17.2				Soil over Amphibolite	21.2
P-38			tr	0.01	1.1	3.7	0.001		0.56	0.01		125.2	159.				Soil over biotite gneiss	289.4

Pounds per cubic yard of various heavy minerals in two soil samples. Soil computed at 4,000 lb/cu. yd. Locations shown on Figure 8.

ORIGIN OF THE PLACER DEPOSITS

STREAM PLACERS

The stream placers have been formed by concentration of heavy minerals at the base of flood-plain gravels in the stream valleys of the region. The heavy minerals were released from the bedrock by weathering processes and carried to the valley bottoms by soil creep and rill wash. Part of the heavy mineral content has been contributed by the Tertiary gravels. Virtually all of the gold and other potentially valuable heavy minerals are in the bottom few feet of gravel under the present valley floors. These gravels are generally 8-10 feet in depth; only exceptionally along constricted portions of the larger streams, are greater depths of gravel present. Where the valley bottoms are relatively wide, the heavy minerals have been concentrated in relatively large amounts.

As mentioned earlier, the steep portions of the streams have relatively large boulders, and the less steep portions have relatively small boulders. This contrast implies that the stream "makes boulders to size" in a given part of its course, or, alternatively, that the size of the boulders contributed by the bedrock controls the gradient of the stream. At any rate the streams seem not to transport large boulders across areas of gentle gradient, which further implies that the rate of boulder reduction may be somewhat greater than generally supposed.

A large number of pebble and boulder measurements would be necessary to begin to confirm the conjectures of the previous paragraph. Because the streams are in youth, lately rejuvenated, and have non-equilibrium profiles, such conjectures are more difficult to confirm than those that might be made in the study of a graded stream. A corollary problem lies in the presence of relatively wide valley floors in areas of lower gradient. Perhaps the hypothesis of a series of small rejuvenations with the "backward retreat" of each change in gradient still visible in the profile would best solve these problems.

TERTIARY GRAVELS

The Tertiary gravels, which were deposited in a past basin or basins, have very small amounts of gold and other heavy minerals disseminated through them. In a few places, rich accumulations of gold were found in buried stream channels at the base of the Tertiary gravels (Lindgren, 1904, p. 94).

When considered in conjunction with the highly quartzitic nature of the gravels, the relatively high concentrations of such minerals as monazite and zircon in the Tertiary gravels, seems to imply rather intensive weathering upon the erosion surface from which these gravels were derived. Much more study of the Tertiary gravels and their related problems needs to be done.

ORIGIN OF THE HEAVY MINERALS IN THE PLACER DEPOSITS

DISTRIBUTION OF PLACER MINERALS

To try to find significant heavy mineral distribution patterns, heavy sand specimens were taken from 60 locations in the area. It was thought that the results obtained from their study might help to delineate preferred areas for further exploration either in the placers or in the bedrock. The sand specimens were processed in the same way as the sand samples had been, except that it was not possible to compute pounds per cubic yard of heavies. After processing, mineral identification, and the plotting of various minerals on a mineral distribution map, I concluded from the resulting pattern that all of the placer minerals are virtually ubiquitous, spread evenly over the whole area. For this reason, it was not necessary to publish any plots. But for such value as it may contain (probably very little) locations of the minerals found in the specimens are shown in Appendix No. I.

One small exception to the foregoing is that euxenite and brannerite were not found in sands from the Newsome Creek area. These two minerals were found, however, in trace amounts in specimens studied from virtually every other stream in the area and thus occur over the entire area outside of Newsome Creek.

SOURCE ROCKS

Two lines of direct evidence bear on the problem of the origin of the heavy minerals in the Elk City region: (1) evidence from petrographic study of rock thin sections, and (2) heavy minerals separated from crushed samples of country rock.

In studies of 67 thin sections the presence of the following minor (heavy) minerals was observed: thorite, zircon, magnetite(?), ilmenite(?), monazite, sphene, allanite, tourmaline, garnet, epidote, rutile, brookite(?), and pyrite. None of these occurs preferentially in any rock, except that amphibolite contains as accessories allanite, epidote, sphene, and opaque blacks.

Eight samples of country rock were crushed approximately to grain size and their heavy minerals were extracted. Rock types include pegmatite, biotite gneiss, augen gneiss, and granodiorite, which are the major rock types in the Elk City region (see Table 3). Amphibolite, relatively rare in the district, was not tested. Accessories identified include allanite, epidote, garnet, limonite, monazite, rutile, sphene, zircon, brookite, ilmenite, magnetite, and a trace of gold. Although it is unlikely, the few colors of gold observed may have been introduced into the samples accidentally.

It is clear from this study that most of the heavy placer minerals in the Elk City region were derived from the metamorphic country rocks, that subordinate amounts came from the granodiorite, and that still lesser amounts came from pegmatite, which is rare in the district.

The only minerals of possible economic interest for which the origin is not clear are columbite, euxenite, and brannerite. None of these minerals was found in any of the heavy mineral fractions separated from crushed country rock samples or in thin section (where they would not normally be detected anyway). Therefore, discussion of the origin of these heavy minerals in the placer deposits must depend on two lines of indirect evidence: (1) distribution of the minerals in the placer deposits, and (2) intergrowths of the minerals with other minerals for which the origin is more certainly known. Mackin and Schmidt (1955, p. 376) found that "The euxenite occurs as an accessory mineral in the granitic rock and in associated pegmatite dikes."

As shown previously, the three minerals columbite, euxenite, and brannerite are widespread in the Elk City region. Because of their virtually ubiquitous distribution, subject only to the one limitation previously described, the conclusion is hard to avoid that the metamorphics, particularly the biotite gneisses, which are predominant, constitute a major source of these minerals.

Intergrowths of columbite and brookite were observed in specimen E-137. One grain of intergrown euxenite and rutile and another grain of intergrown euxenite and monazite were observed in specimen E-146. Monazite, rutile, and brookite are all derived largely from biotite gneiss. Therefore, observed intergrowths of columbite and euxenite with one or another of the three tend to support the inference advanced in the paragraph above: that columbite, euxenite, and, perhaps by association, brannerite are in large part derived from the biotite gneiss.

The euxenite and brannerite occur in rather large grains, mostly plus-14 mesh, as Dwight Schmidt (oral communication) earlier observed. Failure to find any of these grains in the crushed country rock samples may mean that the samples collected were not sufficiently large, and, therefore, that each single grain is surrounded by a relatively large volume of rock.

Although the data are not reproduced in this report, it was noted early in this study that the concentration of radioactive blacks was significantly higher in certain jig concentrates than might have been expected in view of the relatively low content of such radioactive blacks in virgin placer gravel. Perhaps this inconsistency is best explained on the hypothesis that the relatively large, heavy grains of radioactive blacks are preferentially concentrated in jig beds (and in sluice boxes).

Certain features of special significance in Table 3 merit emphasis: (1) 7.6 pounds per cubic yard of brookite in the biotite gneiss of sample E-113; (2) 9.8 pounds per cubic yard of zircon in the augen gneiss of sample P-37; (3) 112.6 pounds per cubic yard of magnetite in the augen gneiss of sample P-37; and (4) variation in magnetite-to-ilmenite ratio among all the rocks sampled. Such data, apart from possible economic significance, permit the suggestion of interesting and, though time-consuming, potentially very fruitful lines of research into the detailed origin of these metamorphic rocks. Scanty soil sample data (Table 4) similarly suggest such research.

Pan-sampling of soil at various places might, in time, lead to the discovery of eluvial or "soil" placers, rich in one or another of the potentially valuable heavy minerals. Further, bedrock zones rich in such minerals might also be discovered in this fashion.

In a few places, cross-cutting white quartz veins that contain either magnetite or ilmenite were observed. Such veins also contribute ilmenite and magnetite to the placer deposits.

No work has been done on the problem of the origin of the heavy minerals within the metamorphic rocks. It is not known in general or in particular whether the minerals are early or late in the paragenesis. One exception to this is thorite, which, at the deposit known on Iron Mountain, is clearly later than the other silicates, having replaced them along shears that lie parallel to the pre-existing schistosity.

GENERALIZED GEOLOGY

The rocks found in the Elk City region are primarily of metamorphic origin, although some are igneous. The metamorphic rocks include quartzite, biotite gneiss, augen gneiss, and amphibolite. The quartzite and biotite gneiss were formed from ancient sedimentary rocks under high pressures and temperatures. The augen gneiss may have been formed from sedimentary rocks under special conditions, or from igneous rocks. The amphibolite probably was formed from thick igneous sills.

Quartzite is generally rather massive if pure, or slabby if impure. Some varieties of quartzite are rich in biotite and very much resemble biotite gneiss. Biotite gneiss is coarsely foliated and has a high feldspar content, although this is not very easily seen in the hand specimen. The coarse foliation, with strong alternation of light and dark layers, is the best feature for recognition of biotite gneiss, the most abundant rock in the region, which may be seen at many places along the South Fork of the Clearwater. Augen gneiss looks much like biotite gneiss except that it is speckled with large white oval feldspar grains. Amphibolite is black and heavy, fine grained, and notably foliated or lineated.

All of these rocks have been subjected to intense and complex squeezing under high pressures and temperatures so that the original layers or sedimentary beds have been folded and twice refolded. After the latest folding, the igneous rocks of the Idaho batholith were emplaced in two or more intrusive episodes. After emplacement, much faulting took place, ore deposits were formed, and then more faulting occurred.

In one of the later episodes of faulting, depressions were formed at the earth's surface, which had become rather flat in Idaho owing to a long period of erosion. Mud, sand, and gravel were carried into these depressions from neighboring mountains (created by the faulting) by streams, forming lake beds. In this manner rather extensive gravel deposits were formed. Some gold was deposited with these sediments. After the depressions were filled to overflowing, the streams again flowed out toward the sea and cut down the rims of the depressions so that removal of the soft sedimentary rocks therein could begin. In this process, gold and other heavy minerals in the bedrock and gold from the sedimentary rocks were concentrated and reconcentrated to form the placer deposits in the stream gravels.

The downcutting of the streams, caused largely by further rising of the mountains, has been rapid, and has produced steep-sided, narrow canyons in much of the area. The areas underlain by the old lake beds are relatively flat--upper Newsome Creek and the Elk Creek basin. Certain parts of the stream valleys in these areas are wide where the streams have been eroding relatively soft rocks.

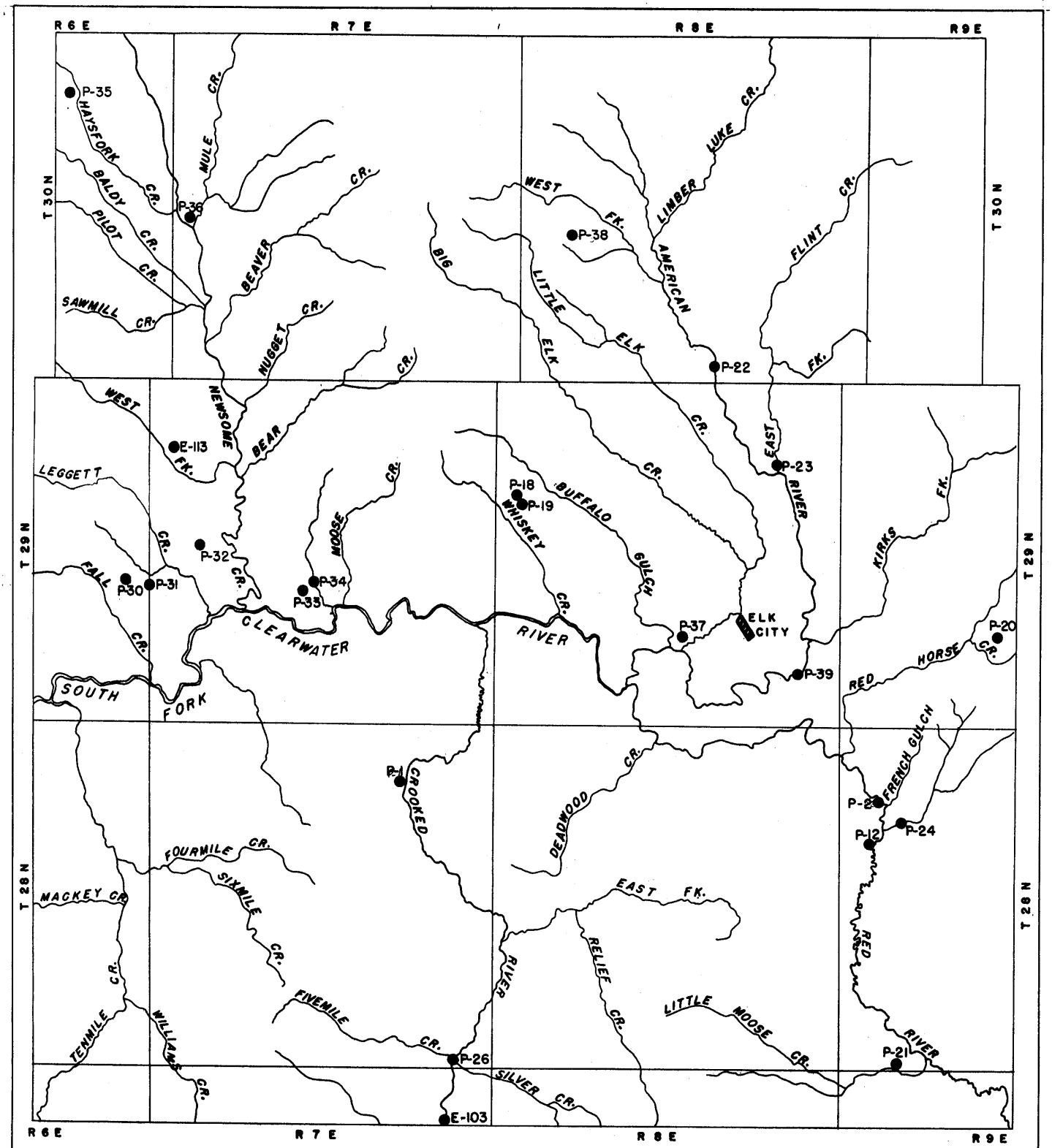


FIG. 8 - PLACER SAMPLE LOCATION MAP
ELK CITY REGION, IDAHO.

1 ½ 0 1 2 3 4 5 Miles

TRUE NORTH
MAG. NORTH

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APPENDIX NO. I

PLACER SPECIMENS, LOCATIONS, TYPES, AND HEAVY MINERALS RECOGNIZED. *

E-2. Crooked River at Fivemile Creek. Jig concentrate from Finch dredge. ma, il, ga, sp, ep, cb, py, eu, mo, zi, bro.

E-3. Red River below mouth of French Gulch. Sluice box concentrate from Behrens washing plant. ma, il, al, py, ga, eu, mo, ru, ep, zi, bro, cb.

E-8. Upper Red Horse Creek. Panned concentrate from a washer pile. ma, il, ga, ep, al, to, sp, eu, zi, bro.

E-9. Seigel Creek, lower end of upper placer-mined ground. Panned concentrate from a washer pile. ma, il, ga, sp, ep, al, zi, eu.

E-10a. Seigel Creek about two miles above mouth, at old prospect shown on map (Fig. 2). A small creek enters valley from south. In gravels here occur pebbles of allanite up to two inches in diameter. Prospecting the valley of this small creek may disclose a deposit of allanite.

E-11. Seigel Creek, upper placer ground. Panned concentrate from a washer pile. ma, il, ep, sp, al, ga, bro, zi.

E-34. Little Moose Creek, upper end of placer ground. Panned concentrate from a washer pile. ma, il, bro, mo, ep, ga, ru, py, cb, to, zi, al.

E-38. Crooked River, Strack claims. Sluice box concentrate from Strack washing plant. ma, il, mo, eu, zi, ga, ep, bro, py, cb, ru, to.

E-39. Moose Creek (trib. to Red River), upper end of meadows. Panned concentrate from a sample hole four feet deep that failed because of large boulders. ma, il, ga, ep, zi, mo, ru, cb (trace), bro, to.

E-40. French Gulch. Fines from an old sluice box. ma, il, ga, cb, mo, sp. ru, ep, bro, zi.

*Mineral abbreviations: ma-magnetite, il-ilmenite, ga-garnet, sp-sphene, ep-epidote, cb-columbite, py-pyrite, eu-euxenite, mo-monazite, zi-zircon, bro-brookite, al-allanite, to-tourmaline, ru-rutile, br-brannerite, li-limonite (not everywhere recorded), ci-cinnabar, au-gold, co-corundum, pl-pleonaste, pyr-pyroxene (not everywhere recorded). Many rare opaque radioactive black minerals have been recorded for the Elk City district by a number of earlier workers. Because of considerations mentioned previously, these minerals were not looked for in this research.

E-44. American River, upper end of placered ground. Panned concentrate from jig tailings pile. ma, il, ep, eu, sp, al, bro, zi.

E-47. Newsome Creek just above Pilot Creek. Panned concentrate from jig tailings pile. ma, il, ru, bro, cb, ga, ep, mo, zi, to.

E-52. American River east of Elk City. Jig concentrates from Johnson operation. ma, il, ru, zi, ga, mo, ep, bro, eu, br, sp, al.

E-71. Lower Flint Creek, tributary to American River. Panned concentrate from the waste pile of an old prospect hole. ma, il, ga, ep, mo.

E-76a. Lower Seigel Creek. Panned concentrate from an eight-foot sample hole dug to bedrock. ma, il, ep, sp, ga, bro, zi.

E-77. Red River, just below the upper meadows (Patrin claims). Panned concentrate from an eight-foot sample hole dug to bedrock. ma, il., ga, ep, al, sp, ru, bro, zi.

E-78. South Fork of Red River, one-half mile above the Ranger Station. Panned concentrate from a sample hole five feet deep that failed because of large boulders, and rapid influx of water. ma, il, ga, ep, al, bro, sp, mo, ru, zi.

E-79. Red River, a short distance east of the Ranger Station. Panned concentrate from a six-foot sample hole that failed because of rapid influx of water. ma, il, ga, ep, sp, al, mo, zi.

E-89. American River just below Kirk's Fork. Panned concentrate from jig tailings pile. ma, il, ep, sp, ga, py, zi, to, ru, al, bro, mo, eu.

E-91. Little Elk Creek, upper end of dredge ground. Panned concentrate from sluice box tailings. ma, il, bro, ga, mo, ru, cb, ep, zi.

E-93. Dawson Creek, panned concentrate from lower part of stream gravels. ma, il, mo, ep, bro, zi, to, ga, cb, ru.

E-95. Seigel Creek, lower. From sluice box on Behrens washing plant. ma, il, li, ga, bro, mo, sp, ep, al, zi.

E-96. South end of lower Crooked River placer ground. Panned specimen from jig tailings. ma, il, li, mo, ga, ru, ep, al.

E-97. Crooked River, just above East Fork. Panned specimen from jig tailings. ma, il, li, ga, mo, ep, ru, bro, sp.

E-98. Mouth of Fincher Creek, tributary to Crooked River, panned from stream gravel. ma, il, ru, eu.

E-99. East Fork of Crooked River, near mouth. Panned from old prospect pit gravel pile. ma, il, mo, ep, li.

E-100. Rainbow Creek, tributary to Crooked River. Panned from stream gravel. ma, il, li, ru, zi, mo, ga, ep, al, sp, bro.

E-101. Toby placer, lower Baker Gulch, tributary to Crooked River. Panned from a prospect gravel pile. ma, il, mo, ru, bro, ga, sp, ci, li, zi, au.

E-104. Mouth of Fivemile Creek, tributary to Crooked River. Panned from gravel in a pile at a prospect pit. ma, il, bro, ga, ep, zi, li.

E-105. Lower East Fork of Crooked River. Panned from riffle concentrates. ma, il, cb, mo, ga, bro, ru, li, ep, zi.

E-106. Upper Deadwood Gulch. Panned from riffle concentrates. ma, il, li, bro, ru, mo, zi, ga.

E-109. South Fork of Clearwater, 0.3 mile east of Rabbit Creek. Panned specimen from jig tailings pile. ma, il, ga, mo, bro, zi, ep, ru, sp, pyr.

E-110. Moose Creek, tributary to South Fork of Clearwater. Panned specimen from stream gravel. ma, il, ga, al, mo, sp, ep, bro (trace).

E-111. South Fork of Clearwater one mile up from Crooked River. Panned specimen from jig tailings pile. ma, il, ga, al, mo, sp, ru, zi, bro, ep.

E-112. Lower Buffalo Gulch. Panned specimen from stream gravel. ma, il, ru, ep, ga, co, mo, zi, bro, ru, sp (trace).

E-114. Mouth of Bear Creek, tributary to Newsome Creek. Panned from gravel pile by old dragline test pit. ma, il, al, ga, ru, bro, mo, zi.

E-115. Newsome Creek just above mouth of the West Fork. Riffle concentrate. ma, il, ga, bro, ru, co, mo, zi, ep, cb (trace).

E-116. Mouth of Nugget Creek, tributary to Newsome Creek. Panned specimen from stream gravel. ma, il, ga, li, mo, bro, ep, cb (trace).

E-117. Mouth of Sing Lee Creek, tributary to Newsome Creek. Panned specimen from stream gravel. ma, il, ga, bro, ru, mo, zi, cb (high).

E-119. Middle West Fork of Newsome Creek. Panned concentrate from a five-foot sample hole that failed because of heavy water influx and large boulders. ma, il, ru, cb (high), bro, mo, ga, li, to, co, zi.

E-120. Mouth of Vicory Creek, tributary to Newsome Creek. Panned concentrate from stream gravel. ma, il, ga, ep, bro, mo, zi, sp (trace).

E-121. First small creek north of Nugget Creek, tributary to Newsome Creek. Panned concentrate from stream gravel. ma, il, ep, bro, mo, ru, co, ga, al (trace), zi.

E-122. Mouth of Beaver Creek, tributary to Newsome Creek. Panned concentrate from stream gravel. ma, il, ga, ep, bro, cb, to, ru, al, mo, zi, pl.

E-124. Upper Bear Creek. Panned concentrate from an old prospect pit. ma, li, ga, co, ep, sp, mo.

E-125. Newsome Creek, above mouth of Baldy Creek. Panned specimen from riffle tailings pile. ma, il, ru, ga, mo, cb, bro, ep, to, zi, co (trace), pl.

E-126. Lower Mule Creek, tributary to Newsome Creek. Panned specimen from old prospect pit. ma, il, ru, bro, sp, ga, cb (trace), mo.

E-127. Newsome Creek, above mouth of Haysfork Creek. Panned concentrate from riffle tailings pile. ma, il, ru, cb, bro, ep, ga, mo, sp, al, to, zi.

E-128. Lower Radcliff Creek. Panned concentrate from stream gravel. il, ga, ru, ep, bro, sp, mo, to, al (trace).

E-129. Newsome Creek, between China Creek and Radcliff Creek. Panned concentrate from stream gravel. ma, il, ga, ep, bro.

E-130. Pilot Creek, just above mouth of Sawmill Creek. Panned concentrate from old jig tailings. ma, il, ga, ep, bro, ru, mo, li, to.

E-131. Lower Sawmill Creek. Panned concentrate from old prospect pit. ma, il, ep, ga, ru, bro, co, zi, cb, to, mo, au.

E-132. Soil specimen off quartzite along road north of Pilot Creek. ma, il, bro.

E-137. Upper Relief Creek. Concentrate from old riffle tailings pile. ma, il, co, ru, bro, ga, ep, zi, mo.

E-138. Little Leggett Creek. Panned concentrate from stream gravel. ma, il, bro, mo, ru, zi.

E-139. Mouth of Fall Creek. Panned concentrate from stream gravel. ma, il, bro, mo.

E-141. Soil specimen off Tertiary gravels, between Leggett and West Fork of Newsome Creeks. ma, il, bro, ru, ga, zi, to.

E-142. West Fork of Newsome Creek. Panned concentrate from a prospect pit. ma, il, ga, ru, bro, sp, mo, zi, ep, al.

E-143. Leggett Creek. Panned concentrate from old prospect pit. ma, il, bro, mo, zi, ga, ru, ep.

E-144. Haysfork Creek. Panned concentrate from stream gravel. ma, il, ep, ga, bro, al, zi, sp, co, cb, pl.

E-145. Haysfork Creek, one-quarter mile above Pell cabin. Specimen from operating placer mine. il, ru, mo, cb, bro, al, ga.

APPENDIX NO. 2

TYPES OF SAMPLES. DESCRIPTION OF MANNER IN WHICH EACH SAMPLE WAS TAKEN

P-1. 123-pound sample of a dump pile from a caisson test hole in Crooked River gravel made by Mr. Lester Strack.

P-2. 43-pound sample of 3 feet of gravel above bedrock from location stripped by dragline by Behrens mining operation in Red River.

P-12. 101 pound channel sample of 5 feet of Red River gravel above augen gneiss bedrock in pit dug by dragline at Clair Johnson mining operation.

P-13. 21-pound hand-auger sample of 5 feet of soil on the Blackhawk Road, east of Seigel Creek, off the map.

P-18. 49-pound channel sample of a weathered, decayed pegmatite.

P-19. 15-pound sample of a weathered biotite gneiss.

P-20. 86-pound sample of the dump pile of a discovery pit.

P-21. 86-pound sample of the dump pile of a discovery pit.

P-22. 86-pound sample of the dump pile of a discovery pit.

P-23. 86-pound sample of the dump pile of a discovery pit.

P-24. 86-pound sample taken from a hole six feet in diameter dug 8 feet to biotite gneiss bedrock.

P-25. 86-pound sample taken from a hole six feet in diameter dug 8 feet to biotite gneiss bedrock.

P-26. 29-pound grab sample taken from dredge buckets during continuous operation. Clair Finch property, Crooked River.

P-30. 15-pound grab sample near base of Tertiary gravels.

P-31. 14-pound grab sample of bedrock immediately below Tertiary gravels.

P-32. 9-pound grab sample of gravel higher in Tertiary gravels.

P-33. 14-pound grab sample near base of Tertiary gravels.

P-34. 11-pound grab sample of bedrock immediately below Tertiary gravels.

P-35. 67-pound channel sample of 3 feet of gravel.

P-36. 33-pound grab sample of country rock.

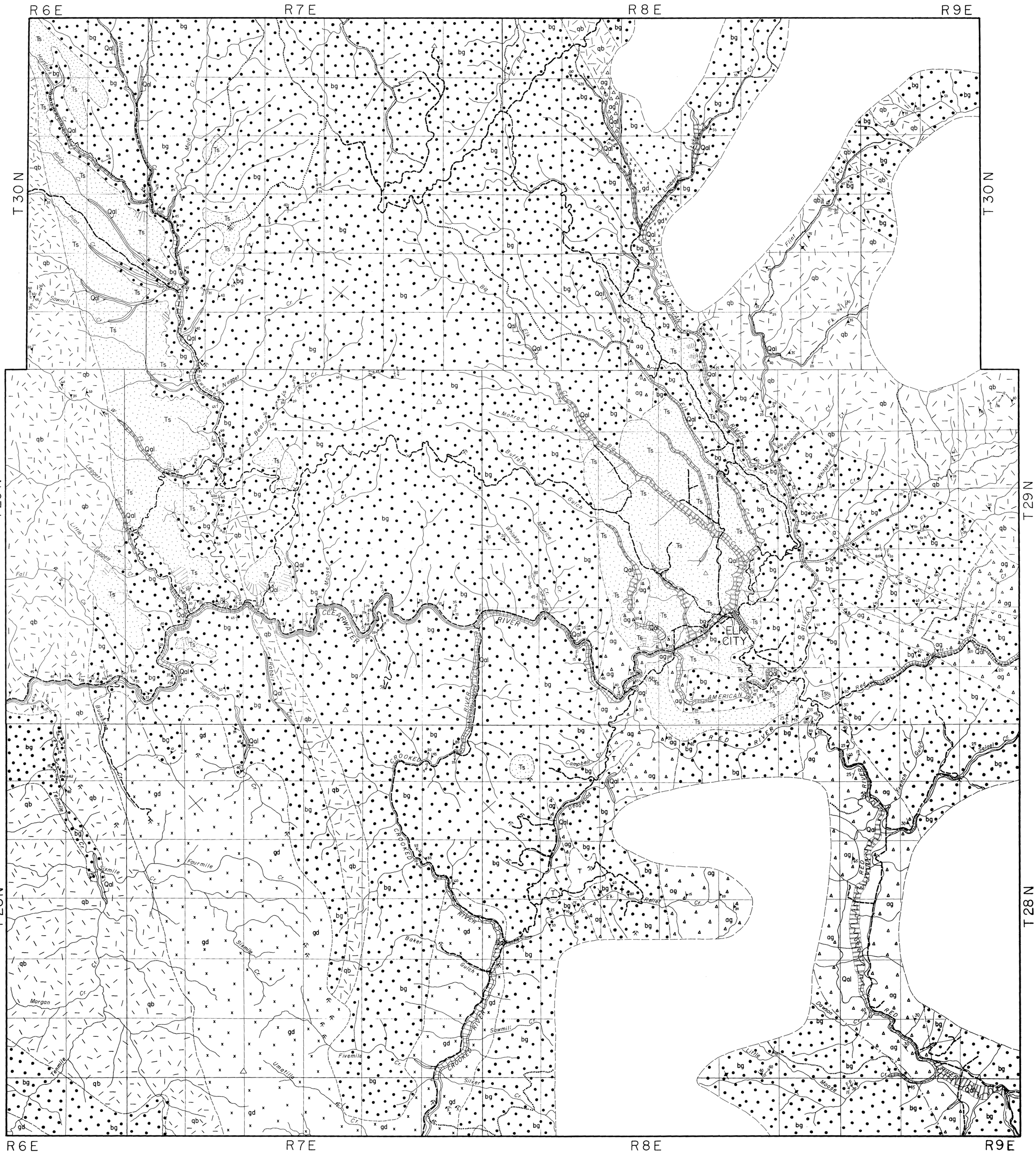
P-37. 30-pound grab sample of country rock.

P-38. 30-pound channel sample of 3 feet of soil.

P-39. 17-pound grab sample of Tertiary gravels.

E-103. 23-pound grab sample of country rock (hydrothermally altered).

E-113. 10-pound grab sample of country rock.



Based on U.S. Forest Service planimetric map sheets.

Geology by R. R. Reid

FIG. 2 - GEOLOGIC MAP OF THE ELK CITY REGION, IDAHO.

SCALE: 1 ½ 0 1 2 Miles

EXPLANATION

Bearing & plunge of lineation (fold axes)

- 30 Mineral grain orientation: axes of uncertain affinity.
- 30 No. 1
- 30 No. 2
- 30 No. 3

Bearing of horizontal lineation (fold axes)

- Uncertain affinity
- No. 1
- No. 2
- No. 3

Vertical lineation

- No. 2

Vertical strike

- Foliation
- No. 2 axial plane

Strike & dip

- 20 No. 2 axial plane
- 40 No. 3 axial plane
- 60 Foliation (S_2)
- 80 Joint

- Benchmark
- Triangulation point
- Mine or prospect
- Stream
- Trail
- Road
- Line of contact.
- Line of contact approximately located, or interpolated on aerial photographs.
- Line of contact adapted from Shenon and Reed (1934a).
- ? Line of contact extrapolated.
- Surrounds unmapped areas.

TRUE NORTH
19½°
MAG. NORTH
APPROXIMATE MEAN DECLINATION, 1959

- Qal — Quaternary alluvium.
- Qal — Quaternary alluvium, placer mined.
- Qal — Quaternary alluvium, unmined, possibly favorable for placer mining.
- Ts — Sedimentary rocks of possible Miocene age. Clay, silt, sand, gravel, quartz and quartzite boulder conglomerate, minor lignite, peat, carbonized wood.
- Ts — Placer pit in Tertiary sedimentary rocks.

- a — Amphibolite, rather homogeneous. Locally contains thin isoclinally folded granitic stringers.
- ag — Biotite augen gneiss, coarsely banded feldspar porphyroblast gneiss. Locally much contorted in small intense drag folds.
- bg — Rather homogeneous biotite gneiss, finely foliated, with some muscovite. Includes thin interlayers of quartzite and mica schist, large amounts of granodiorite in sills, dikes and small irregular stringers. Locally much contorted in small intense drag folds, ptygmatic folds.
- qb — Quartzite, biotite quartzite & muscovite quartzite; includes thin interlayers of augen gneiss and biotite gneiss; sills, dikes and small irregular stringers of granodiorite. Locally much contorted in small intense drag folds, ptygmatic folds.
- gd — Granodiorite and other granitic rocks (only larger masses are shown)