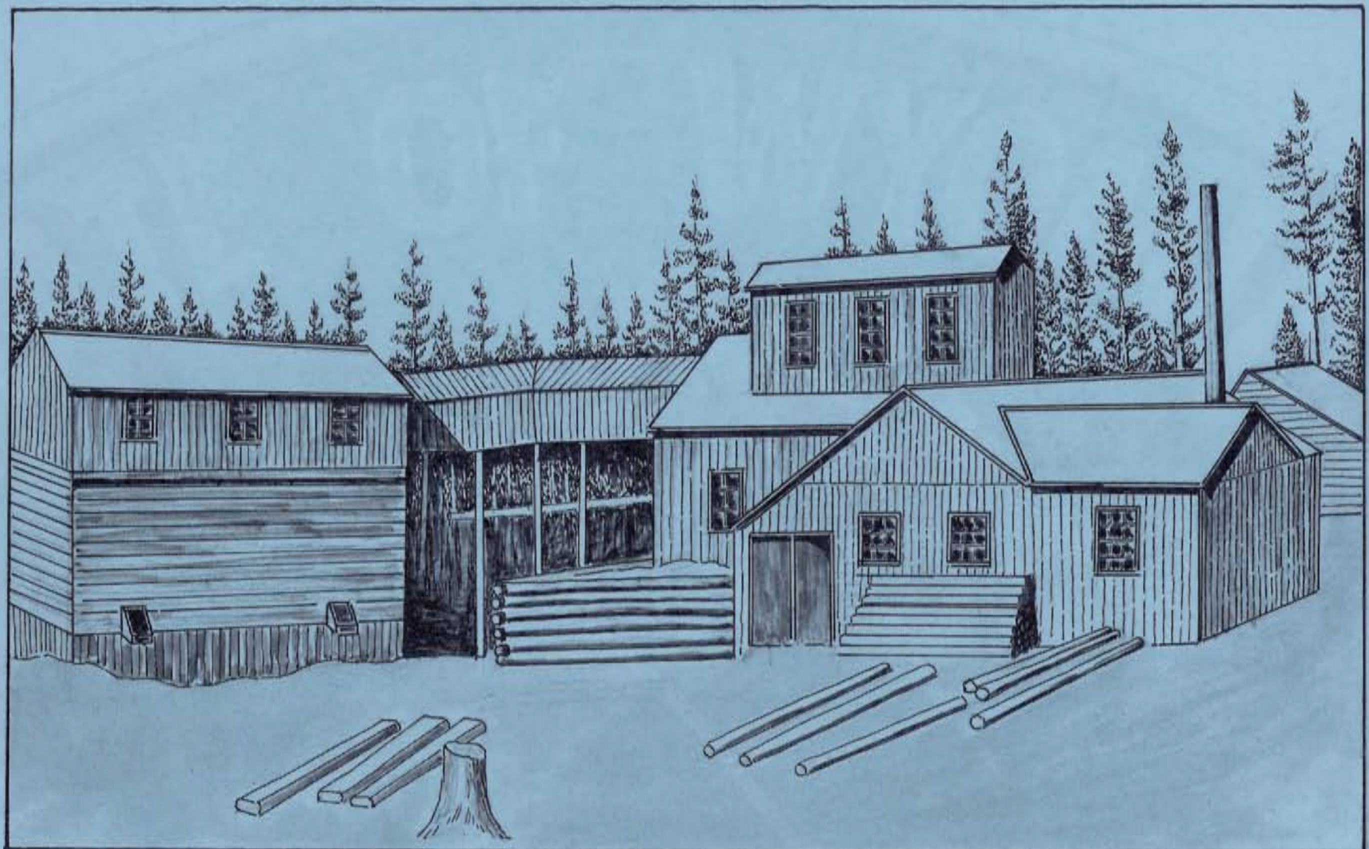
THE GEOLOGICAL SURVEY OF WYOMING

D. L. BLACKSTONE, JR., State Geologist



PRELIMINARY REPORT NO. 8

The New Rambler Copper-Gold-Platinum District, Albany and Carbon Counties, Wyoming

BY

M. E. McCALLUM and C. J. ORBACK

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Cover. Rambler Mine, 1905. Drawing by S.H. Knight

THE NEW RAMBLER COPPER-GOLD-PLATINUM DISTRICT, ALBANY AND CARBON COUNTIES, WYOMING.

by

M. E. McCallum* and C. J. Orback+

INTRODUCTION

The New Rambler district encompasses about 20 square miles in portions of T. 14 N., T. 15 N., R. 79 W. and R. 80 W. in the central part of the Medicine Bow Mountains of southeastern Wyoming (Fig. 1). The area includes the northern half of the old Holmes-Keystone mining district which has been prospected for gold and copper for nearly a century. In 1958, the southern half of this old district was mapped by D. R. Currey and later evaluated in Preliminary Report No. 3 of the Geological Survey of Wyoming (D. R. Currey, 1965).

A network of lumber roads and jeep trails within the New Rambler district and one good graded road between Keystone and Encampment provide access. However, these roads are not maintained during the winter and can be traveled only about six months of the year. The nearest railheads are about 12 miles from the district at the small towns of Albany and Foxpark (Fig. 1), which are served by the Coalmont Branch of the Union Pacific Railroad.

Geologic mapping was done during the fall of 1958 and the summer of 1960 on a 1:7,200 topographic base enlarged from the 1906, 1:125,000 U.S. Geological Survey Medicine Bow Quadrangle, and on enlarged aerial photographs having a scale of approximately 1,130 feet to the inch. Field data were transferred to a topographic base with a scale of 1,500 feet to the inch, enlarged from the 1:24,000 U.S. Geological Survey Albany and Keystone Quadrangles.

The study was supported by research grants from the Geological Survey of Wyoming and the Geological Society of America (Project Grant No. 843-60) and for this aid appreciation is here expressed. The writers also wish to thank Mr. Paul Theobald of the U.S. Geological Survey for valuable discussions regarding geochemical studies in the area, and Professor R. S. Houston, Department of Geology, University of Wyoming, and W. H. Wilson, Geological Survey of Wyoming, who kindly reviewed the manuscript.

TOPOGRAPHY

The New Rambler area is situated on a slightly dissected, sloping erosion surface with low to locally moderate relief. The average elevation is approximately 9,600 feet, with the surface sloping from a high of 10,200 feet along the northern edge of the area, to a low of 9,300 feet along Douglas Creek to the south. Although normal relief ranges from only 200 to 400 feet per square mile, in the northwest and northeast corners, stream dissection is more severe and relief is in the order of 600 to 800 feet where elevations rise from 9,400 to 10,000 feet and 8,900 to 9,700 feet respectively in less than one mile.

Most of the low relief surface and stream valley slopes are covered by dense stands of lodgepole pine with occasional other conifers. These forests have supported timbering operations for many years and at least one camp is still active in the area. The stream valleys generally contain abundant alder and/or aspen along with thick growths of willows and other bushy shrubs which also abound in bogs and marshy meadows. Grasses are also common in bog and stream bank meadow areas as well as covering gravel based open parklands (e. g. Cinnabar Park).

Rock exposures are sparse throughout most of the district. Geologic control, to a large extent, is based on float and rock debris removed from prospect pits and other exploratory workings. Outcrops are most abundant in the southeastern part of the district.

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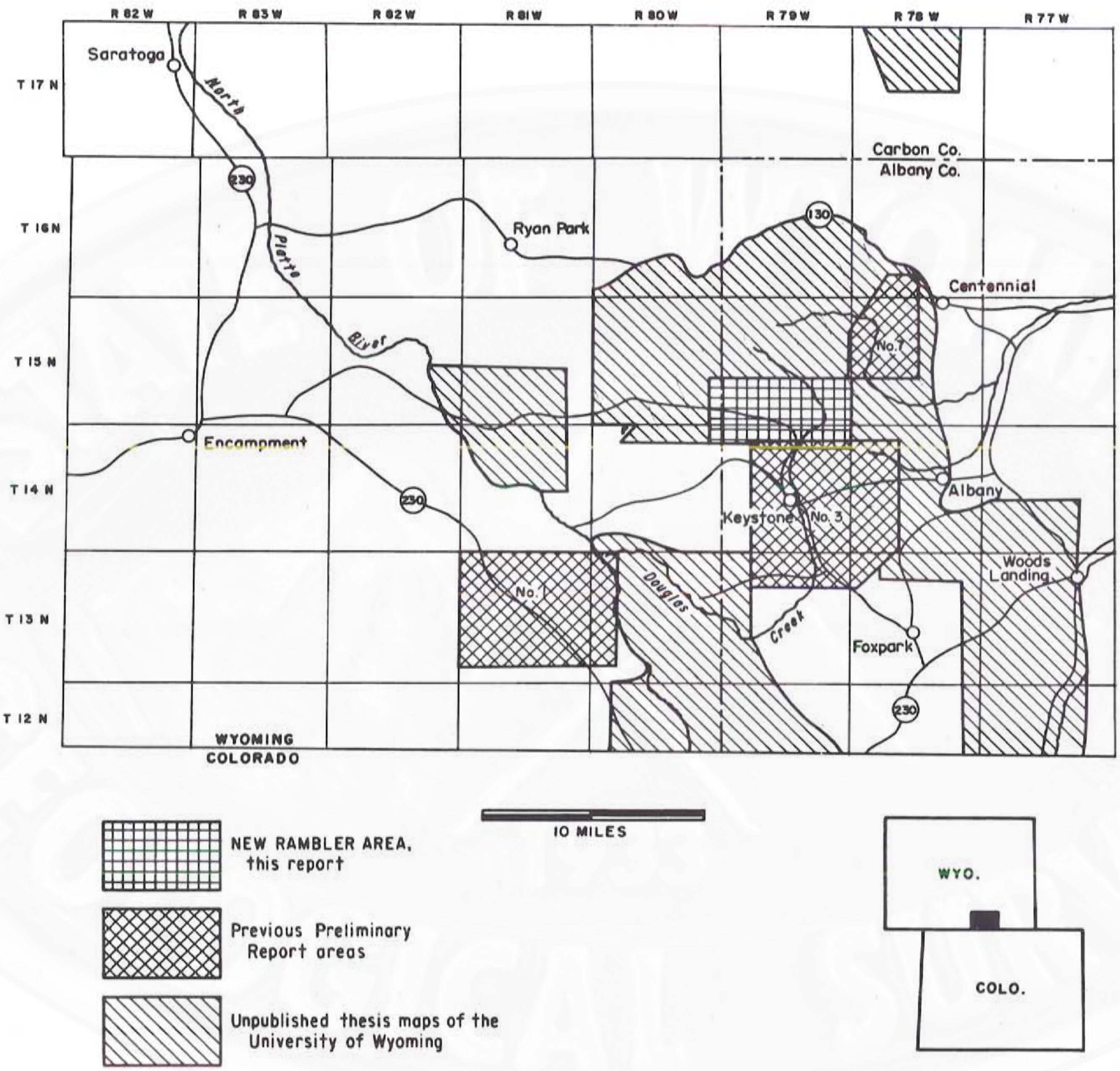

Fig. 1 - Index map showing the location of the New Rambler copper-gold-platinum district.

HISTORY AND DEVELOPMENT

Attention was first focused on the New Rambler district in 1868 with the discovery of placer gold by Iram M. Moore in Moore's Gulch (just south of mapped area, sections 10 and 11, T. 14 N., R. 79 W.), one of the tributaries of upper Douglas Creek. During the spring of 1869, about $8,000 worth of gold was taken from the gulch using only ordinary sluice box, rocker, long tom, and gold pan methods (Beeler, 1906, p. 14). Following Moore's discovery placer mining began on a large scale and continued for many years, with the production of considerable quantities of gold. All placer deposits in the New Rambler district were referred to as the Albany placers and were originally owned and developed by the Albany Development Company of Laramie. The Albany properties consisted of more than 1,200 acres of patented and located ground along Moore's Gulch, Elk Creek, Bear Creek, Dave Creek, and the upper part of Douglas Creek. Gold values of not less than 50 cents per cubic yard were claimed at most sites, and authenticated values of $1.60 per yard and greater than $2.00 per yard were reported from gravel worked along Dave Creek (sections 4, 9 and 10, T. 14 N., R. 79 W.) and Moore's Gulch respectively (Beeler, 1906, p. 29). Platinum was also reported from several placer localities as metallic platinum or associated with black sand, but apparently none of the metal was recovered. Total production figures of placer gold taken from the Albany properties are not available, but estimated values in the range of several tens of thousands of dollars appear reasonable.

In 1870, following the discovery of placer gold in Moore's Gulch, a lode gold claim (Douglas mine) was located to the south along Douglas Creek in the Keystone district (Beeler, 1906, p. 11; Currey, 1965, p. 8). During the next 30 years, lode deposit prospecting was very active in the general area.

Shortly before the turn of the century the New Rambler mine was opened as a gold prospect. In 1900, copper was found at a depth of 65 feet in the main shaft, and shipment of high grade copper ore began that same year. In the winter of 1901, the presence of platinum in the copper ore was discovered by H. R. Wood of Denver in the course of assaying samples being prepared for shipment to the Denver smelters (W. C. Knight, 1902). Subsequent testing by numerous individuals and agencies further confirmed the presence of platinum and gave evidence for the existence of other platinum group metals, particularly palladium. Before the platinum group discovery, nearly 4000 tons of 25 to 30 percent copper ore had been shipped from the mine for which no platinum metals payment was received (Anonymous, 1911, p. 75). Payments for shipments in 1902 included $6,000 for platinum (Osterwald, 1959, p. 134) and subsequent shipments also produced variable returns for metals of the platinum group. By 1906, more than $120,000 worth of copper and platinum ore had been mined from the New Rambler, and numerous adjacent properties were being worked with limited success (e. g. Blanche and Duchess mines west of the New Rambler).

The richer copper ores of the district were soon exhausted and efforts were directed toward methods of concentrating the low grade ores for commercial extraction of copper, gold, silver, and platinum group metals. In 1910, a concentrating mill was erected at the New Rambler mine and minor ore production continued intermittently in the district until 1918 when the Rambler mill and mine buildings were destroyed by fire. Periodic attempts at re-opening the workings have been made since that time, but no known ore production has resulted. The New Rambler properties are currently being geochemically studied by several parties in an effort to evaluate their potential as a low grade platinum metals deposit.

GENERAL GEOLOGY

Rocks in the New Rambler district may be conveniently subdivided into two major groups: Precambrian crystalline rocks and Cenozoic sediments (Pl. 1).

The Precambrian rocks consist of a complex metamorphic sequence of gneisses and schists into which both granitic and mafic magma was injected. Many of the igneous bodies have been partially to completely metamorphosed and all of the Precambrian rocks of the district have been subjected to varying intensities of cataclasis. Shear zone tectonites are quite prominent throughout the area, but are most highly concentrated in a belt extending from the southwest to northeast corners, a trend which parallels that of the gross planar fabric of most units in the west and central parts of the district. A strong north-south planar fabric is prominent in the south-central part of the district, whereas randomly trending foliations predominate in the southeastern corner. Dips of foliation and schistosity of all rocks tend to be quite steep, rarely being less than 60°.

The sedimentary materials range in age from Oligocene(?) to Recent, and consist predominantly of various types of gravel deposits along with alluvium, landslide debris and small outcrops of tuffaceous(?) siltstone of the White River Formation(?) (Oligocene). The White River(?) siltstone is exposed at the top of an old landslide scar in sec. 25, T. 15 N., R. 79 W. and represents the oldest sedimentary unit in the area.

The Cinnabar Park region of the eastern part of the district is covered with a veneer of cobble to boulder gravel composed chiefly of mafic rock materials. Similar mafic gravels have been described south of the area by Currey (1959, p. 29) and they are tentatively correlated with Miocene-Pliocene gravels mapped by Steven (1953,

1960) just south of the Wyoming-Colorado line in the Northgate fluorspar district. Locally overlying the mafic gravels and covering much of the northern part of the upland erosion surface is a thin veneer of quartzite boulder gravel derived from the massive quartzites of the Medicine Bow Peak area (north of State Highway 130) (Fig. 1). The boulders are almost all subrounded to well rounded, ranging up to nearly eight feet across, and were probably deposited during very late Pliocene and/or early Pleistocene time.

Terrace gravel deposits border many sections of Douglas Creek and its tributaries at elevations from about 5 to 15 feet above present flood plains. These deposits consist of heterogeneous mixtures of Precambrian crystalline rocks and were probably transported in large part by the melt waters of pre-Wisconsin glaciers. Landslide debris is largely confined to the eastern part of the area, particularly in sec. 25, T. 15 N., R. 79 W., where a combination of poorly consolidated to unconsolidated Tertiary sediments and high relief provide highly unstable surface conditions. Recent alluvial deposits may be observed along most of the streams and in poorly drained low areas, and include peat-rich bog deposits along with stream associated soils, clays, sands, and gravels.

PETROGRAPHY OF PRECAMBRIAN ROCKS

Precambrian rock units in the New Rambler district are predominantly quartzofeldspathic with a few interspersed pelitic and amphibolitic members. Mineralogy of the metamorphic assemblage reflects metamorphism at the almandine-amphibolite grade followed by local, tectonically controlled retrogressive activity at the greenschist level. The igneous rocks show varying degrees of metamorphism, but most appear to be younger than the retrogressive episode if at all. Age relationships of the Precambrian units are very poorly defined, thus the following rock descriptions are presented in an inferred order from oldest to youngest.

Mafic Series Sequence

Dark colored biotite-hornblende rich schists and gneisses occur within other foliate units of the area as isolated lenses and intercalated layers, and appear to be the oldest rocks in the region. Referred to as the Mafic Series sequence, this assemblage of rocks is similar to the same unit described to the northeast in the Centennial Ridge district (McCallum, 1968), but is somewhat less abundant and lithologically less diverse in the New Rambler area. Mappable exposures of Mafic Series rocks are chiefly confined to sections 24 and 35, T. 15 N., R. 79 W., and section 2, T. 14 N., R. 79 W.

Rocks of this sequence range in color from gray, to brown, dark green, and black; they are fine- to medium-grained, and generally have good to excellent foliation imparted by abundant biotite and/or chlorite. A micaceous sheen on foliation planes is prominent locally, and aligned amphibole prisms occasionally provide good lineation trends. The principal constituent minerals in these schists and gneisses are quartz, plagioclase, biotite, hornblende, and chlorite with lesser amounts of epidote, potash feldspar, garnet and various minor accessory minerals. Some phases are strongly porphyroblastic, containing large crystals or crystal aggregates (up to one centimeter across) of garnet, hornblende, or plagioclase.

Mafic Series rocks are commonly strongly gradational with juxtaposed felsic gneisses and amphibolitized units. These adjacent rocks appear to have crystallized much later, and may have resulted in part from local transformation of older mafic materials. Partially transformed inclusions (up to several feet in diameter) of Mafic Series rocks are a very common feature in the considerably younger Sherman-type granite immediately east of the district.

Quartz Monzonite Gneiss

Quartz monzonite gneiss underlies most of the northwestern third of the New Rambler district. This unit consists primarily of strikingly homogeneous, pale orange brown to buff, medium-grained rocks composed of quartz, plagioclase, and potash feldspar in nearly equal proportions, with subordinate amounts of muscovite, biotite, and chlorite. A relatively strong foliation is imparted to most of the gneiss by the parallel to subparallel alignment of micas and chlorite, and is greatly enhanced by numerous thin zones of cataclasis. Locally the gneiss grades into poorly foliated to nonfoliated more coarsely crystalline phases of quartz monzonite, granite, alaskite, and pegmatite which probably represent either less granulated remnants of earlier intrusives or later products of rheomorphism. The transition between essentially nonfoliate igneous-appearing phases and gneiss is completely gradational and apparently reflects differential shear stress during kinetometamorphism of the rock mass, although late synkinetic recrystallization could produce similar relationships.

The quartz monzonite gneiss, for the most part, is separated from other gneissic units by a series of northeast and east trending shear zones. Where bordering shear zones are absent (e.g., sec. 19, T. 15 N., R. 79 W.), contact relationships with adjacent units are extremely gradational and map boundaries are quite generalized. Changing rock competencies across these transitional zones may have controlled localization of the apparently later, more intense cataclasis that formed the sharply delimited shear zone tectonites.

Mylonitic Biotite-Epidote-Plagioclase Gneiss

The mylonitic biotite-epidote-plagioclase gneiss is the most widespread unit in the district, and includes a rather diverse assemblage of mineralogically and tectonically related rocks. Much of the southeastern half of the mapped area is underlain by rocks of this unit in association with various strongly cataclastic, igneous, and meta-igneous neighbors. The gneiss is characterized by a notably high biotite and epidote content (biotite often chloritized), abundant quartz and plagioclase (oligoclase-andesine, much untwinned), and moderate to severe cataclasis. Rocks of this unit are predominantly pink to gray in color, fine- to medium-grained, and poorly to moderately foliated. The planar fabric is the result of alignment of biotite and chlorite along planes of shearing, and of the presence of abundant narrow parallel zones of differential cataclasis. Some of the gneiss exhibits a prominent layering imparted by the segregation of light and dark colored mineral constituents. Individual layers range from less than one millimeter up to nearly a centimeter in thickness, and were probably formed by metamorphic differentiation associated with the shearing of interspersed felsic and mafic materials. Distributed throughout the mylonitic gneiss are thin, tabular units of pink to grayish black submylonite and mylonite. These units usually crop out as dense, blocky exposures with prominent rectangular jointing, and represent sites of extreme cataclasis.

The mylonitic biotite-epidote-plagioclase gneiss can be conveniently subdivided into three phases: 1) microcline-poor, 2) microcline-rich, and 3) mafic-rich. Although any phase may occur at any given locality, a general east to west phase trend from microcline-rich to microcline-poor to mafic-rich is evident, indicating increasing Ca, Fe, and Mg, and decreasing K and Na in that direction. Both microcline-rich and microcline-poor phases are described by Currey (1965, p. 4) in his discussion of the Keystone area quartz-feldspar gneiss (equivalent to or gradational with mylonitic biotite-epidote-plagioclase gneiss of New Rambler district).

The microcline-poor phase is most abundant in the south-central part of the district, and is typically a gray to pinkish gray and grayish white, commonly layered gneiss, consisting in order of decreasing abundance of plagioclase (oligoclase-andesine), quartz, microcline, biotite, epidote, chlorite, and minor accessory minerals. This phase has a consistently higher plagioclase, biotite, and epidote content than the nearby microcline-rich phase.

The microcline-rich phase underlies most of the extreme southeast corner of the district, and grades imperceptibly into zones of the microcline deficient phase. It is mainly pink to pinkish gray and in order of decreasing abundance consists of quartz, plagioclase (oligoclase-andesine), microcline, chlorite, epidote, biotite, and minor accessory minerals. Along the eastern edge of the district where this phase is in contact with intrusive Sherman-type granite, the microcline content is noticeably higher than the norm and the plagioclase is considerably more sodic (sodic oligoclase, An_{16-23}), indicating some K and Na metasomatism.

The mafic phase predominates west of the New Rambler mine where the gneiss is somewhat darker in color (dark pinkish gray to greenish gray), coarser grained, and noticeably enriched in hornblende, biotite, and chlorite. This phase contains numerous irregular masses and networks of coarse-grained amphibolitized gabbroic, dioritic, and pyroxenitic rocks which when not mapped as separate units are indicated on the geologic map (Pl. 1) by a superposed pattern of small crosses. Microlayering is locally more abundant than in the other phases, and the rock is commonly strongly contorted. Hornblende and chlorite typically occur together in the gneiss in roughly circular to eliptical clusters along with interstitial epidote and ilmenite. These mineral clusters may represent amphibolitized and chloritized remnants of younger mafic igneous rocks that were engulfed during rheomorphic mobilization of the felsic gneiss.

Cataclastic Biotite Augen Gneiss

Cataclastic biotite augen gneiss is exposed only in the extreme northwestern corner of the district(section 24 and 25, T. 15 N., R. 80 W.). This unit is gradational with the quartz monzonite gneiss, and is a gray black to grayish white biotite-quartz-plagioclase-microcline rock with pronounced crystals and aggregates of quartz, plagioclase, and/or microcline in a medium- to fine-grained cataclastic matrix. In less sheared phases, well-developed idioblastic to subrounded augen of quartz and feldspar ranging in size up to two inches long occur in a swirling foliated matrix of biotite, muscovite, and moderately granulated quartz and feldspar. Many of the feldspar augen crosscut foliation indicating some post-cataclastic crystallization. Where biotite is extremely abundant, the augen gneiss tends to be strongly schistose and is highly contorted.

Abundant darker colored, finer grained biotite rich phases occur throughout the augen gneiss complex. These phases consist primarily of intercalated biotite schists and gneisses composed of medium- to fine-grained biotite, quartz, and plagioclase (oligoclase-andesine) with occasional zones enriched in muscovite or garnet.

Amphibolitized Meta-igneous Rocks

Amphibolitized meta-igneous rocks comprise a general map unit that includes a wide range of amphibole-plagioclase rich rocks of presumably igneous origin. These rocks occur throughout the area but are most abundant in the south-central part of the district in the general vicinity of the New Rambler mine. The amphibolitized rocks show both conformable and discordant relationships with enclosing rocks and appear to be younger than most of the surrounding metamorphic units (with the exception of shear zone tectonites).

Rocks of this group are highly variable in overall composition, degree of metamorphism, and relative development of gneissic fabric. Most varieties are dark green to black in color, medium- to coarse-grained, and range from crystalloblastic to relict diabasic, ophitic, and gabbroic in texture. Metagabbros and metapyroxenites and crystalloblastic orthoamphibolites are also present. The various types of mafic rocks are quite gradational with one another, merging both laterally and horizontally. These transitions within short distances represent to some extent degree of recrystallization of parent rock to orthoamphibolite, and may also reflect differentiation by crystal fractionation in a crystallizing mafic magma. Owing to the strongly gradational character of the rocks, precise subdivision of amphibolitized varieties into separate map units was impractical; however, in areas where one phase is predominant over others the appropriate symbol is used on the geologic map (Pl. 1).

The metagabbros and metadiorites are very similar in most respects other than plagioclase composition (metagabbro characteristically more calcic: anorthite content greater than 50 per cent). They are composed essentially of amphibole (generally hornblende, commonly partially chloritized), variably saussuritized plagioclase (oligoclase to labradorite), and chlorite, but often contain significant quantities of uralitized pyroxene. Common accessory minerals include magnetite, ilmenite, epidote, and biotite with lesser amounts of sphene, allanite, apatite, pyrite, muscovite, and garnet. The metapyroxenites consist chiefly of hornblende, uralitized orthopyroxene and clinopyroxene, chlorite, and iron ores. Minor amounts of epidote, sphene, and apatite are also usually present, and olivine occurs locally. The orthoamphibolites typically contain a range of mineral constituents comparable to those comprising related mafic phases, but are characterized by strongly crystalloblastic textures. All of the amphibolitized rocks contain varying amounts of secondary quartz and potash feldspar filling fractures and veinlets and occupying enrichment aureoles in zones adjacent to later felsic intrusives. The more strongly mafic phases are commonly enriched in sulphides which may be in part a product of early magmatic segregation, but were principally derived by later hydrothermal enrichment.

Many of the amphibolitized rocks have a moderate to strong foliation which apparently was developed by cataclasis. These rocks are typically more chloritic than less foliate to nonfoliate phases. Where mafic rocks are included within or are crosscut by shear zones, the amphibolitized materials are generally intensely granulated and chloritized and some are completely converted to chloritic submylonites and mylonites.

Diabase Dikes and Sills

A few small diabasic dikes and sills were mapped in the area immediately surrounding the New Rambler mine. These rocks are dark green to black, fine- to medium-grained, and consist of nearly equal amounts of only slightly altered calcic plagioclase and pyroxene. Most of the dikes and sills are less than five feet in width and emplacement was probably controlled by joints or shear planes. These diabases are considerably less altered than their amphibolitized neighbors and are apparently related to a slightly younger episode of mafic intrusion.

Granitic Intrusive Rocks

Several types of silicic igneous rocks intrude the dominantly metamorphic units of the district. They occur in numerous small sills and dikes and in two considerably larger irregular intrusive bodies. These rocks can be readily subdivided into four separate units: 1) Rambler granite; 2) small felsic intrusives; 3) luxullianite; and 4) Sherman-type granite.

Rambler granite. A relatively small highly irregular stock of granitic rock is exposed immediately northeast of the New Rambler mine. Although the granite is not exposed at the mine site surface, it was encountered in the underground workings and may have been the source of mineralizing fluids. The granite covers about 1½ square miles and has both crosscutting and conformably contacts with surrounding rocks. Contacts with amphibolitized host rocks are commonly quite sharp, whereas contacts with mylonitic gneiss tend to be gradational. Inclusions of gneiss are fairly abundant and one large gneissic mass within the southeastern part of the stock may be a roof pendant.

Medium-grained pink granite comprises the bulk of the rock mass although quartz monzonitic, aplitic, and pegmatitic phases are also present. Some border zones exhibit rather fine-grained fractions, whereas dump samples of the granite presumably found at depth in the New Rambler mine workings is quite coarse-grained and strongly epidotized. In order of decreasing abundance the principal mineral constituents in the Rambler granite are quartz, potash feldspar (commonly perthitic), sodic plagioclase (albite-oligoclase), biotite, and chlorite with minor amounts of epidote, hornblende, muscovite, magnetite, and allanite.

Several shear zones crosscut the granite and a strong cataclastic fabric has been imparted upon much of the rock. Where the granite has been subjected to shearing, it ranges from weakly foliated to strongly fractured and brecciated, to submylonitic and mylonitic. Zones of maximum cataclasis are typically enriched in both quartz and epidote.

Small felsic intrusives. A few small felsic intrusives occur in the mylonitic gneiss and amphibolitic units near the New Rambler mine and within the prominent shear zone crossing the northwest corner of the district These intrusives are essentially sill-like in form but do exhibit some discordant contact relationships. Pink to gray and white, muscovite-biotite granite and alaskitic granite predominate but gradations into aplitic and pegmatitic phases are common locally. A few pale pink to gray, medium-grained quartz monzonitic phases are also present. A weak gneissic foliation has been developed where portions of the sills were subjected to moderate cataclasis.

Luxullianite. Several lensoid to pod-like bodies of luxullianite occur northeast of the New Rambler mine along the northern margin of the Rambler granite stock. These bodies are chiefly concordant and appear to have been intruded into mylonitic gneiss and amphibolitized meta-igneous rocks. The luxullianite may represent a late phase crystallate of the Rambler granite magma, and may be related in age to tourmaline pegmatites described in other parts of the Range (Houston, 1961, p. 9; McCallum, 1964, p. 122; McCallum, 1968).

The luxullianite is a pink to pinkish white, medium-grained, tourmaline rich rock, which contains some fine-grained to pegmatitic phases that range in color from bluish to yellowish gray and buff. The tourmaline (the black variety, schorlite), which locally constitutes up to 30 per cent of the rock, occurs as microscopic needles in quartz and as small euhedral crystals (several millimeters long) in finer grained phases, and as large conspicuous crystals (up to several inches long) in pegmatitic phases. Numerous spherulitic aggregates or "tourmaline suns" are also present. Representative samples of the luxullianite consist of the following mineral constituents in order of decreasing abundance: plagioclase (albite), quartz, microcline, tourmaline, muscovite, sericite, garnet, and iron ore "dust".

Sherman-type granite. Sherman-type granite as named by Darton, Blackwelder, and Siebenthal (1910) in the Laramie Range and described by McCallum (1964, p. 116) in the Medicine Bow Mountains, is exposed along part of the eastern margin of the mapped area. These exposures mark the northwestern limit of a large, irregular stock-like body of granite that underlies much of the region around the general vicinity of the town of Albany. This granite is part of the same intrusive mapped by Currey (1965, p. 6) in the Keystone area and is probably correlative with the Pikes Peak type granite described by Houston (1961, p. 11) a few miles southwest of the New Rambler district.

The unit consists of pink to pinkish-gray, medium- to coarse-grained granite with quartz monzonitic phases. The principal mineral constituents, potash feldspar, plagioclase and quartz, occur in variable proportions along with considerable accessory biotite and hornblende, and minor amounts of magnetite, ilmenite, sphene, apatite, allanite, epidote, chlorite, pyrite, and zircon. Strongly porphyritic phases of the granite contain phenocrysts (predominantly microcline) that range up to $1\frac{1}{2}$ inches long. The large microcline crystals commonly are twinned according to the Carlsbad law and a few show weak zoning. Fine-grained border phases occur locally and probably represent chill zones. The granite typically weathers to hummocky and knobby surfaces characterized by the presence of numerous rounded to mushroom or pedestal shaped, joint controlled, projecting outcrop forms.

Shear Zone Tectonites

Shear zone tectonites comprise a unit of compositionally diverse rocks which are all products of variable degrees of cataclasis. Although similar rocks are locally included within other units in the district, the tectonite map unit delineates the larger more prominent shear zones. The tectonites consist predominantly of cataclasites (products of crushing and granulation without reconstitution) and submylonites (somewhat recrystallized), but include some mylonites, ultramylonites, and phyllonites, all of which have been chemically reconstituted to variable extents (see McCallum, 1964, p. 19 and 103 for more complete discussion). Limited zones of fault breccia and gouge are also present, and probably reflect renewed movement (Laramide ?) along older structural trends (Precambrian).

Zones of tectonite concentration are roughly tabular to lenticular in shape and range from a few feet to nearly one half mile in width and up to several miles in length. Shear zones are most abundant in a northeast trending belt that crosses the district from the northeast corner southwestward through the area immediately surrounding the New Rambler mine site. Another northeast trending shear zone parallels the upper reaches of Douglas Creek and extends under the gravel cover of Cinnabar Park (sections 35 and 36, T. 15 N., R. 79 W.) toward the southern end of Centennial Ridge. The most prominent tectonites in the district occur in an east trending shear zone that extends west of the New Rambler mine site, and merges with a major regional shear system (Mullen Creek-Nash Fork shear zone; Houston and McCallum, 1961) about six miles west of the district. The tectonites all have very high angle to vertical dips, and most are strongly discordant to surrounding units.

Compositions of the tectonites vary widely as a function of parent rock composition; however, owing ~~to a~~ high concentration of gabbroic and amphibolitized rocks in the district, most tectonites are rich in mafic constituents and consequently dark in color. Some of the shear zones contain strongly layered submylonites and mylonites which were probably formed by the mechanical intermixing of mafic and felsic minerals during cataclasis. The more mafic tectonites typically contain abundant granulated amphibole, chlorite and epidote with lesser amounts of plagioclase (albite to labradorite), quartz, potash feldspar and minor accessory minerals. These in turn grade into more felsic varieties in which quartzofeldspathic constituents predominate over mafic minerals.

Many of the shear zones are appreciable mineralized and have been repeatedly explored. Fe and Cu sulphides were noted at several localities, and Pb, Zn, Au, Ag, Ni, and Pt group elements have all been reported. Most heavily mineralized are the tectonites at the site of and immediately west of the New Rambler mine workings. Here, Fe and Cu mineralization was dominant, but the presence of Pt group elements, Au,and Ag will more than likely determine the mining future of the district.

STRUCTURE

Structural features in the New Rambler district indicate that the region has been subjected to multiple episodes of deformation. Similar evidence has been reported from nearby areas (Houston, 1961, p. 10; McCallum, 1968), and at least three deforming periods have been postulated. The following observed features are indicative of several unrelated tectonic events: multiple superposed lineations, refolded folds, sheared and faulted folds, multiple generation shear zones, folded shear zone tectonites, shattered and brecciated tectonites, and multi-generation joint systems.

Most of the Precambrian rocks in the area are moderately well foliated but linear features are quite scarce and poorly developed. Foliation is principally produced by the alignment of biotite, chlorite, muscovite, and hornblende, or by the segregation of these and other minerals into layers. Many foliation planes are accentuated by or are the result of differential cataclastic granulation of mineral constituents. The only definitive lineations recorded in the area were mineral tracts of biotite, chlorite, and muscovite, and axes of minor folds and crenulations. A few outcrops contain up to three different lineations in superpositional order from mineral tract to crenulation to minor fold.

Folds are predominantly of the minor variety, although rocks of the mylonitic gneiss in the southeast part of the district appear to define a large antiform slightly overturned to the south. Amphibolitized rocks near the New Rambler mine may also be rather complexly folded into a tight, roughly isoclinal pattern with adjacent felsic units. The apparent "pinchouts" of the mafic units may actually reflect the effect of plunge; however, this same pattern could result from the intrusion of mafic rocks into already folded gneissic units. Although subsequent shearing has obscured many of the fold relationships, a detailed petrofabric study of the area might prove to be quite valuable in the deciphering of fold mechanics. Rocks adjacent to shear zones and small faults locally show considerable small scale folding and distortion.

Shear zones are the most prominent structures in the district and are apparently causally related to most of the associated subsidiary structures (minor folds, small faults, and joints). Major trends were probably established soon after Precambrian regional metamorphism, and periodic reactiviation occurred along some of these zones at least through early Laramide time (McCallum, 1968). The shear zones show little to no evident displacement and are interpreted as zones of intense granulation and pulverization caused by an infinite number of local readjustments to strongly directed shear stresses. Evidence of reactivation along these structural trends consists of resheared and recrystallized tectonites, neomineralization, shattering, brecciation, and formation of fault gouge. The latter three features are believed to be primarily products of Laramide stress and in places accompanied by sulphide mineralization.

Several small, moderate to high angle faults were observed (or inferred) but only the most prominent are included on the geologic map (Pl. 1). One of these is located east of the New Rambler mine (in sections 3 and 35, T.14 N., T.15 N., R.79 W.) and is marked by a slightly mineralized (Fe-oxides) breccia cutting the host mylonitic gneiss and dipping 80 degrees to the northeast. Four small northwest trending faults are present at the New Rambler mine crosscutting shear zone tectonites, amphibolitized rocks, and granite at depth. The faults dip to the northeast at about 40 degrees and considerable fault gouge and copper mineralization was encountered along these planes in the mine workings (Orback, 1958, p. 9). Another fault is situated at the eastern edge of the area in section 1, T.14 N., R.79 W. (extends into section 6, T.14 N., R.78 W.) and involves Sherman-type granite and the bordering mylonitic gneiss. The trace of this fault is marked by a narrow breccia zone containing abundant irregular masses of white to pale bluish gray opaline chalcedony. Ages of these minor faults are very difficult to determine, but a Laramide age is postulated.

ECONOMIC GEOLOGY

Mineral properties of possible economic importance in the New Rambler district include both lode and placer deposits. Although copper and gold have accounted for most of the ore production from the area, current activity is chiefly directed toward potential low grade ores containing platinum group metals.

Lode Deposits

Lode deposits in the district are of both primary and secondary origin, and for the most part mineralization is not well understood. Most of the ores consist of sulphides of copper or copper and gold; however, ores in the vicinity of the New Rambler properties show significant quantities of platinum and palladium. In the primary deposits, sulphides and/or gold are associated with quartz veins, as fracture fillings, along fissures, and in brecciated and shattered portions of shear zone tectonites. These deposits are characterized by prominent surface oxidation of Fe and Cu sulphides but weathering has had little overall effect on the ore minerals which include chalcopyrite, bornite, tetrahedrite, and native gold. Important secondary ores have been reported only from the New Rambler mine workings. Solution of primary sulphides within the zone of oxidation, followed by redeposition near the water table produced a rich supergene ore zone. These deposits consist chiefly of copper sulphides and are characterized by an overlying gossan rich in porous iron oxides, quartz, chalcedony, and various oxide-zone copper minerals. Ore from the supergene zone is typically quite rich (often assaying greater than 35 percent copper) and consists largely of covellite and chalcocite. Within the oxidized zone, the lower part is commonly richest and includes azurite, malachite, chrysocolla, cuprite, tenorite, malaconite, native copper, hematite, and limonite.

Platinum group metals were first recognized associated with covellite and pyrite and the mode of occurrence was determined by Wells and Penfield (1902, p. 95) to be sperrylite ($PtAs_2$). Palladium and other platinum group metals probably also occur as arsenides, and along with platinum may occur as sulpharsenides finely disseminated through both iron and copper sulphide minerals. Kohanowski (1953, report on Independence Gold Mining Company claims, E. K. Burhans, personal files) tentatively identified platiniridium from the Independence mine to the northeast in the Centennial Ridge district (McCallum, 1968) but none has been reported from the New Rambler area.

None of the mines of the New Rambler district are accessible today, and there is very little information on these mines in the geologic literature. Nearly all of the old mine buildings have been destroyed as also were many mine maps, reports, and records. Brief discussion of a few mines on which information is available is given below.

New Rambler Mine. SW$\frac{1}{4}$, sec. 33, T. 15 N., R. 79 W. The New Rambler mine was developed in the only known important lode deposit in the district. The mine operated intermittently from about 1900 to 1918 and has produced more than 6000 tons of ore for which payment was received for copper, gold, silver, platinum, and palladium (U. S. Bureau of Mines, 1942). In August of 1918, the mine buildings were destroyed by fire and active mining has never resumed.

The New Rambler shafts are sunk in hydrothermally altered metapyroxenite and metagabbro in shear zone tectonites and mylonitic gneiss. Coarsely crystalline, sheared, epidotized granite (Rambler granite) was encountered at a relatively shallow depth, and Taft (1918) reported the presence of both "diorite" and "peridotite" in the main shaft. By 1906 nearly 3000 feet of development workings had been opened (shafts, drifts, and raises) (Beeler, 1906, p. 42) and shortly thereafter several small stopes were mined. The first copper ore was found at a depth of 65 feet in the main shaft and occurred as fissure fillings of copper minerals, "jaspilite" (silica), limonite, and hematite in granite. Attitude and extent of these fissures is quite variable but most trend northwest and dip approximately 40 degrees northeast. Additional ore was encountered as lenses, stringers, streaks, irregular masses, and particles disseminated through altered (clayey) host materials. Veins containing quartz, pyrite, copper minerals, gold and silver were also reported.

The New Rambler ore body has been described as a typical oxidized and supergene enriched deposit with an overlying porous, spongy limonite, hematite, "jaspilite" gossan. Oxidation zone minerals were common above the 75 foot level whereas supergene zone minerals predominated from 75 to 100 feet below the surface. Less mineralized rock containing quartz-pyrite-chalcopyrite veins was present below the 100 foot level (zone of primary mineralization). Mine drilling records and Bureau of Mines core drilling conducted during 1942 and 1943 (Kasteler and Frey, 1949) indicate that the richest ore was rather rigidly confined to the limits of the stoped areas. One nearly spherical deposit of oxidized ore was stoped out from an area 40 to 70 feet below the surface and several similarly shaped deposits of enriched sulphide ore were present between the 75 and 100 foot levels. The altered material around stoped areas was reported to consist of porous, vuggy masses of clay and opaline silica with minor calcite. Most of the clay exhibited no inherited textures, but in some areas relict gabbroic and pyroxenitic textures were noted.

The principal supergene ore minerals were covellite and chalcocite. Covellite was most abundant in stoped areas and contained up to 1.4 ounces of platinum per ton of ore, in addition to lesser amounts of palladium (Beeler, 1906, p. 42). According to Emmons (1903, p. 95-96), the platinum occurs as well-defined crystals of sperrylite ($PtAs_2$) in covellite and pyrite, the covellite replacing pyrite. W. C. Knight (1902, p. 696) reported platinum and palladium present in nearly equal amounts and also noted the associated presence of traces of iridium and osmium. The chalcocite apparently contains only trace amounts of platinum metals, but does carry abundant very fine grains of chalcopyrite. The orpiment, realgar, and deep red crystals of lorandite ($Ti_2SAs_2S_3$) reported by Rogers (1912) may also have been products of supergene enrichment.

An extremely diverse assemblage of ore minerals has been described from the zone of oxidation and many of these minerals can still be found in the dumps. Dendrites and small nuggets of native copper were noted whereas the copper carbonates, azurite and malachite, and the silicate chrysocolla occur in abundance. The copper oxides cuprite, tenorite, and chalcotrychite were reported along with chalcopyrite and lesser amounts of atacamite, chalcanthite, tetrahedrite, and bornite. Also present in the oxidized zone are pyrite and pyrrhotite, and Emmons (1903, p. 97) noted the occurrence in a gossan of a trace of gold and up to nine ounces of silver per ton.

Numerous assays have been run on ores from the New Rambler mine, but few of these figures are readily available. The earliest tests by H. E. Wood for platinum metals showed that various copper minerals from the mine carried from 0.10 to 0.70 ounces of platinum per ton, and several carloads of covellite ore contained from 0.40 to 1.40 ounces of platinum per ton (W. C. Knight, 1902). A series of comprehensive assays run in about 1910 on various grades of ore samples by Fitzgerald and Bennie (electrometallurgists, Niagara Falls, New York) gave the following results: precious metals, 0.60 to 5.80 ounces per ton; and copper, 0.50 to 31.07 percent (Anonymous, 1911, p. 76). Composite samples of dump materials collected by Hess in 1924, and assayed by E. T. Erickson gave values of 0.06 oz. of platinum, 0.04 oz. of iridum, 0.04 oz. of palladium, 0.10 oz. of silver, and a trace of gold per ton (Hess, 1926, p. 135). Erickson's platinum value agrees reasonably well with average platinum values of approximately 0.032 oz. per ton recently obtained from dump material by Paul Theobald (1967, personal communication) of the U. S. Geological Survey.

Blanche Mine. SE$\frac{1}{4}$ sec. 32, T. 15 N., R. 79 W. The Blanche mine properties are situated immediately west of the New Rambler workings. Shafts were sunk in sheared felsic gneiss, metagabbro, and metadiorite in an effort to locate an extension of the New Rambler ore body. The main shaft (near the old steam plant site) was sunk to a depth of 160 feet, and at 120 feet penetrated a zone containing copper carbonates, chalcocite, and chalcopyrite (Beeler, 1906, p. 45). The copper minerals occur primarily in quartz veins along with pyrite, hematite, and limonite and in quartz associated with gouge and shear zones (Osterwald, 1959, p. 36). No assay values or production figures are available.

Duchess Mine. SW$\frac{1}{4}$ sec. 32, T. 15 N., R. 79 W. A steam plant was erected in the early 1900's on the Duchess mine properties west of the Blanche mine, and several exploratory shafts were sunk in shear zone tectonites and strongly sheared metagabbro and metadiorite. Traces of minor copper mineralization associated with pyrite, hematite, and limonite in quartz are evident in many of the workings, but apparently no ore production was realized.

Placer Deposits

Quaternary alluvial deposits in and along upper Douglas Creek and its tributaries have been periodically placered for gold since 1868 when Iram M. Moore made the first discovery of placer gold in the Range along what is now called Moore's Gulch (just south of mapped area). Placers in the New Rambler district belong to the Albany placer group that was originally established by the Albany Development Company of Laramie and included more than 1,200 acres of patented and located ground along main Douglas Creek, Moore's Gulch, Elk Creek, Bear Creek, Dave Creek and other minor tributaries (Beeler, 1906, p. 29). Most of the earliest recovery work was done by ordinary sluice box, rocker, long tom, and gold pan methods, but elaborate systems of hydraulic ditches were later constructed along many of the creeks. No placer operations are currently active in the area.

Alluvial fills along upper Douglas Creek and its tributaries range from about 50 to 1,000 feet wide and up to 15 feet thick (average depth about six feet). The general stream fall varies from approximately 40 feet to nearly 120 feet per mile and water flow, although also quite variable, is sufficient in most years to operate placers during the spring and summer months. Most of the alluvium is relatively free of clay or cementing material and easily washed, and large boulders are rare. The greatest gold concentrations are found deposited on the bed rock, which is dominantly highly weathered felsic gneiss and granite. The majority of the gold occurs as fine flakes or flour (.900 to .950 fine) and is generally bright and easy to amalgamate (Beeler, 1906, p. 32). About 25 percent of the gold is coarse, commonly ragged with considerable quartz attached, and many flat nuggets up to an eighth of an inch long have been recovered (Beeler, 1906, p. 17). Both platinum and palladium associated with black sand and gold particles have been reported from several placers.

Mr. M.N. Grant[1] as quoted by Beeler (1906, p.29) estimated that over 3,000,000 cu. yards of gravel with an expected average of $0.50 per cu. yd. in gold, were available in the Albany placers at that time. Estimates of 60,000 cu. yds. of gravel in Moore's Gulch averaging better than $1.00 per cu. yds. in gold, and 70,000 cu. yds. of gravel along Dave Creek (at $1.60 per cu. yd. in gold with additional platinum values) were reported. According to Grant (Beeler, 1906, p.32) Bear and Elk Creeks (sections 3, 4, 5, and 6, T.14 N., R.79 W.; and sections 31, 32, 33, and 34, T.15 N., R.79 W., respectively) contain about 250,000 cu. yds. of potentially gold-bearing gravel. Little information is available regarding values in these gravels, but alluvium particularly along Bear Creek which drains the terrane of the New Rambler deposits, may well be enriched in both platinum and palladium.

SUGGESTIONS FOR PROSPECTING

Primary copper-platinum and gold mineralization in the New Rambler district is chiefly confined to shear zones, faults, and quartz vein associations. Enrichment in platinum metals appears to be a function of altered mafic rock sources and all authenticated occurrences have been reported from sulphides in intensely sheared amphibolitized meta-igneous rocks. All shear zones and fault trends should be explored for possible mineralization, but especial emphasis should be directed toward zones of shearing in mafic rocks. Further investigation of properties in the New Rambler mine vicinity, particularly for platinum metals, seems warranted and feasibility studies on the recovery of such metals from very low grade ores should be initiated.

Considering the nature of most of the primary deposits in this area (sulphides associated with mafic rocks) electrical and magnetic methods of prospecting might prove effective in locating new deposits. A general geochemical sampling program is also recommended, with emphasis placed on potential mineralized areas within shear zones. The prominent shear zone which extends westward from the Blanche and Duchess properties and continues into the Mullen Creek district, should be evaluated with considerable care. Also of special interest are shear zones in the northeast corner of the district which extend into the mineralized Centennial Ridge district (McCallum, 1968) and may be part of a potential narrow low grade ore belt extending between the New Rambler mine area and the northern end of Centennial Ridge.

Alluvial material in the area has been sampled and re-sampled for placer gold but only a few moderately extensive operations were ever conducted. Large quantities of unworked gravel with shallow average depths to bedrock (where most gold seems to be concentrated) offer some encouragement for future low grade gold production; however, of more significance may be the association of platinum metals at some localities. A sampling program on near bedrock gravel for platinum metals and gold should be conducted, and if significant values are present, large scale development might be practical.

No placer deposits are known from the gravels of probable Tertiary age that cover large portions of the upland erosion surface. However, in view of general mafic rock-ore mineralization affinities throughout much of the region, investigation of the mafic gravels in the vicinity of Cinnabar Park (see Pl.1) might be considered. Thicknesses of these gravels are not known, but testing efforts should probably be directed at material immediately overlying bedrock.

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[1] President and general manager of the Douglas Consolidated Mining and Milling Company, of record 1906.

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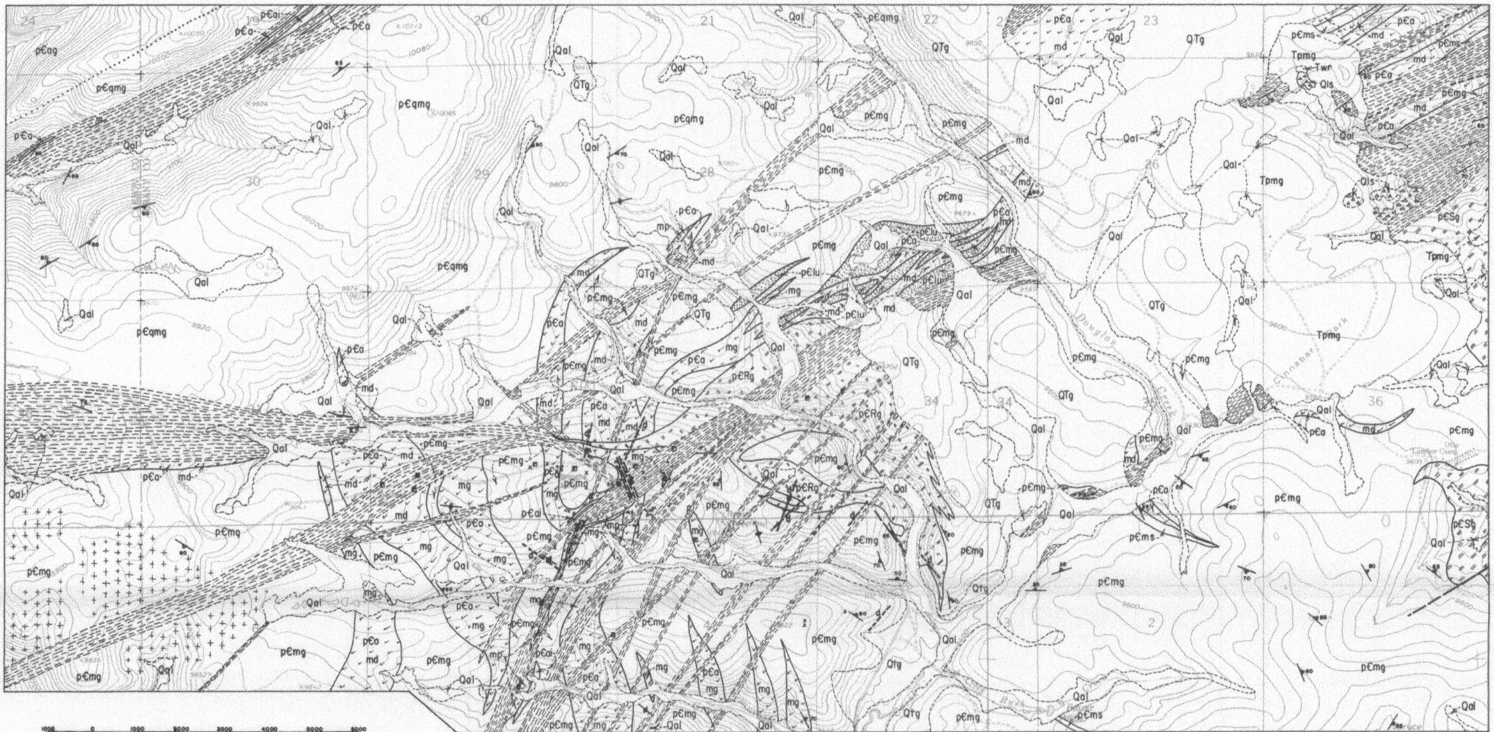
GEOLOGIC MAP OF THE NEW RAMBLER DISTRICT
ALBANY AND CARBON COUNTIES, WYOMING



FEET

Topography by U. S. Geological Survey, 1961

Geology by M. E. McCallum and C. J. Orback, 1958 and 1960

Contour Interval
20 feet in western sector, 40 feet in eastern sector
Datum mean sea level

LITHOLOGIC UNITS

QUATERNARY

Qal — ALLUVIUM
Stream associated soils, clays, sands, and gravels. Includes peat rich bog deposits.

Qls — LAND SLIDE DEBRIS
Chaotic masses of colluvium, alluvium, and minor bedrock that have moved down slope as discreet units under the influence of gravity.

Qtg — TERRACE GRAVEL
Heterogeneous mixtures of crystalline rock gravel forming terraces about 5 to 15 feet above present flood plains.

QTg — PLEISTOCENE-PLIOCENE(?) GRAVEL
Thin veneer of quartzite boulder gravel covering much of upland surface, and local pockets of boulder beds. Individual boulders range up to several feet in diameter.

TERTIARY

Tpmg — PLIOCENE(?)-MIOCENE(?) MAFIC GRAVEL
Dark colored, cobble to boulder gravel composed chiefly of mafic rock materials.

Twr — WHITE RIVER FORMATION(?)
White to buff, arenaceous, tuffaceous siltstones. Locally calcareous.

PRECAMBRIAN (Age Relationships Uncertain)

pЄSg — SHERMAN-TYPE GRANITE
Pink to salmon red, coarse-grained granite with quartz monzonite phases. Commonly porphyritic.

SHEAR ZONE TECTONITES
Varicolored ultramylonite, mylonite, submylonite, cataclasite, phyllonite, fault breccia, and fault gouge.

d — DIABASE DIKES
Dark green to black, fine- to medium-grained diabase consisting of nearly equal amounts of calcic plagioclase and pyroxene. Most dikes less than five feet in width.

pЄlu — LUXULLIANITE
Pink to red, medium- to coarse-grained, quartz-feldspar rich rock with abundant black tourmaline and muscovite.

pЄai — SMALL FELSIC INTRUSIVES
Small sills and lenses of pink to white, fine- to coarse-grained granitic and quartz monzonitic rocks.

pЄRg — RAMBLER GRANITE
Pink to red, medium- to coarse-grained, microcline-rich granite. Commonly epidotized along zones of shearing.

PRECAMBRIAN (Age Relationships Uncertain)

pЄa — AMPHIBOLITIZED META-IGNEOUS ROCKS
Green to black, fine- to coarse-grained rocks composed chiefly of amphibole and plagioclase. Many are termed orthoamphibolites but where recrystallization is incomplete, rock units are designated as follows:
md; metadiorite
mg; metagabbro
mp; metapyroxenite

pЄag — CATACLASTIC BIOTITE AUGEN GNEISS
Gray black to grayish white, coarse-grained, strongly foliated and granulated biotite-rich gneiss containing abundant large augen of quartz and feldspar.

pЄmg — MYLONITIC BIOTITE-EPIDOTE-PLAGIOCLASE GNEISS
Diverse sequence of mylonitic quartzo-feldspathic rocks. Chiefly pink to gray, fine- to medium-grained mylonitic gneisses rich in biotite, epidote, plagioclase, and quartz. Consists of both microcline-rich and microcline-poor phases.
Cross pattern designates areas rich in included gabbroic materials.

pЄqmg — QUARTZ MONZONITE GNEISS
Pink, buff, to gray, medium- to coarse-grained gneiss composed of nearly equal proportions of quartz, microcline, and plagioclase. Locally contains irregular zones of non-foliated granite, alaskite, quartz monzonite, and pegmatite.

pЄms — MAFIC SERIES
Diverse sequence of dark colored, fine- to coarse-grained, moderately to strongly foliated, amphibole-biotite rich schists and gneisses.

MAP SYMBOLS

CONTACT
Most contacts shown as solid lines since they are predominantly only approximately located, gradational, or inferred. Dashed between Precambrian and post-Precambrian units. Dotted where strongly gradational.

SHEAR ZONE

FAULT
Dashed where inferred.

Inclined — Vertical
STRIKE AND DIP OF FOLIATION

Inclined — Vertical
STRIKE AND DIP OF STRONGLY CATACLASTIC FOLIATION IN SHEAR ZONES

VERTICAL SHAFT

PORTAL OF TUNNEL OR ADIT

SMALL PROSPECT PIT

$14\frac{1}{2}°$

Approximate Mean Declination, 1961