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MAP GQ-157

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGY OF THE BARE MOUNTAIN QUADRANGLE NEVADA

By
H. R. Cornwall and F. J. Kleinhampl

INDEX MAP OF NEVADA

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GEOLOGY
OF THE
BARE MOUNTAIN QUADRANGLE, NEVADA

By
H. R. Cornwall and F. J. Kleinhampl

INTRODUCTION

The Bare Mountain quadrangle is located in Nye County, Nev., east of Death Valley, Calif., and about 100 miles northwest of Las Vegas. It was mapped in cooperation with the Nevada Bureau of Mines. Published studies on the Bare Mountain area consist of an areal reconnaissance by Ball (1907), and the abstract of a dissertation by Brown (1954). Thurston (1949) studied the Daisy fluorspar mine, and Bailey and Phoenix (1944, p. 143-144) investigated some cinnabar properties. The geologic mapping was started in the fall of 1956 and completed in the spring of 1958.

Members of the U. S. Geological Survey identified Paleozoic fossils collected by the authors during field work. Cambrian faunas were identified by A. R. Palmer; Ordovician faunas by J. M. Berdan, R. J. Ross, Jr., and E. L. Yochelson; Silurian and Devonian faunas, except the Devonian *Stringocephalus*?, by J. M. Berdan and C. W. Merriam, and Carboniferous faunas by W. H. Hass and L. G. Henbest.

SUMMARY OF GEOLOGY

Paleozoic rocks in the Bare Mountain quadrangle are typical of the eastern Nevada facies and consist dominantly of carbonate rocks with Lower Cambrian and Upper Mississippian clastic rocks. The Paleozoic rocks are intensely deformed, principally by flat thrust faults and right-lateral strike-slip faults. The thrust faults occur mainly in the weak shaly parts of the section. Tuffs and welded tuffs of Tertiary age are thrust over the Paleozoic rocks, but the deformation was less intense than in the earlier thrust plates in Paleozoic rocks. Basin and range normal faults developed in late Tertiary and Quaternary time.

PALEOZOIC ROCKS

JOHNNIE(?) FORMATION (Єj)

The Johnnie(?) formation of Early Cambrian age is the oldest and thickest (4,800 feet) formation exposed in the quadrangle. Its base is not exposed, and the contact with the overlying Stirling(?) quartzite appears to be conformable, unlike that between these two units at the type locality in the Spring Mountains (Nolan, 1929, p. 466-468) and in the Nopah Range (Hazzard, 1937, p. 305).

The Johnnie(?) formation consists of zones several hundred feet thick of interstratified sandstone, siltstone, micaceous shale, and less commonly, carbonate rock; in any one zone either one rock type is dominant or several occur in about equal proportions. Low-grade metamorphism commonly has produced phyllite, phyllitic shale, schistose siltstone, marble, and quartzite. The rocks of the formation are locally more intensely metamorphosed in the vicinity of Conejo and Dry Canyons near the west-central margin of the quadrangle.

In the Johnnie(?) formation at Bare Mountain the lower beds consist of 200 to 300 feet of dolomite and limestone that become increasingly sandy upwards and several hundred feet of quartzitic sandstone, silty sandstone, and siltstone. This sequence is similar to the basal part of the Johnnie(?) formation in the Nopah Range (Hazzard, 1937, p. 303). The remainder of the formation is predominantly shale and siltstone with subordinate intercalated sandstone and a few thin beds of dolomite and limestone; siltstone is most abundant in the upper part. Two prominent quartzite units, each about 300 feet thick, occur near the middle and top of the formation; the lower quartzite is conglomeratic and locally the upper has vertical tubular structures. An oolitic limestone unit associated with silty and sandy dolomite crops out locally about 800 feet below the top of the Johnnie(?). It may be extensive at this horizon but is not readily recognizable, probably because of metamorphism.

The shale and siltstone are light olive gray to brownish gray, the quartzite is gray to white, and the dolomite and limestone are yellowish brown. The shale has a wavy, parallel, laminated to very thin-bedded stratification, as does the siltstone except where the latter is locally cross-stratified. The sandstones are poorly sorted, locally contain abundant dark minerals and carbonate cement, and are laminated to thin-bedded with parallel to low-angle cross-stratification.

The topography of areas underlain by Johnnie(?) formation, with its easily eroded shale and siltstone, is relatively subdued, and the slopes are smooth except where broken by ledges and low cliffs of quartzite, dolomite, and limestone.

STIRLING (?) QUARTZITE (Єs)

A quartzite, 1,150 feet in thickness, conformably overlies the Johnnie(?) formation and conformably underlies the Carrara formation. It is correlated with the 3,700-foot thick Stirling(?) quartzite of Early Cambrian age, whose type section is about 35 miles to the southeast in the Spring Mountains (Nolan, 1929, p. 463). In general, the Stirling(?) consists of light gray, orange, and brown quartzite, that appears pale red from a distance. The unit is slabby to massive, locally gritty and conglomeratic, unstratified to thinly laminated or thin bedded, and commonly low-angle cross stratified. Thin lenses of schistose siltstone and phyllitic shale, similar to those in the upper part of the underlying Johnnie(?) formation and the lower part of the overlying Carrara formation, are intercalated in the quartzite in the basal and upper parts of the formation. The lower contact of the formation is placed arbitrarily at the base of the quartzite overlying relatively continuous thick siltstone.

A white vitreous fine-grained quartzite, 10 to 40 feet thick, marks the top of the Stirling(?) and is overlain by alternating thin units of limestone, limy siltstone, sandstone, and shale of the Carrara formation. Fossils have not been found in the Stirling(?) quartzite at Bare Mountain.

CARRARA FORMATION (Єc)

The Carrara formation is here defined and named for Carrara, an abandoned mining camp 8 miles east-southeast of Beatty on Nevada Highway 95. The formation is well exposed in and near Carrara Canyon, 2 miles northeast of the camp. It consists of interstratified shale and limestone with minor amounts of quartzite, sandstone, and siltstone. A typical section 1,785 feet thick was measured in the canyon half a mile northwest of Carrara Canyon. Clastic rocks dominate the lower half of the formation, whereas limestone dominates the upper half. The lower half commonly has three major subdivisions and the upper half two. The lowest unit, a transition zone above the Stirling(?) quartzite, consists of alternating quartzite, sandstone, siltstone, phyllitic shale, and minor limestone. The next overlying unit consists mostly of limestone alternating with shale and siltstone. A conspicuous dark-gray cliff-forming algal limestone about 150 feet thick forms the top of this unit. It is overlain by fine-grained clastic rocks of the third unit. The two units in the upper half of the formation are a light-gray and orange limestone and, at the top, a darker gray thick-bedded clayey, silty, or dolomitized limestone that is marbleized at some places.

The lower half of the Carrara formation is greenish-, yellowish-, and brownish-gray shale with 1 or 2 bands of dark-gray limestone, which form ledges in the steep shaly slope. The upper half of the formation forms a striking series of broken cliffs, visible from a distance as a broad band of alternating white, orange, pink, and brown limestone overlain by dark-gray limestone.

The upper contact is not easily discernible and the Carrara formation appears to be transitional into the overlying Bonanza King formation through a zone of irregularly dolomitized limestone with dolomitization increasing upwards into the overlying formation.

A trilobite, identified only as an olenellid type, collected from a bed beneath the algal *(Girvanella)* limestone in the lower part of the formation indicates a late Early Cambrian age. The age of the Carrara formation is Early and Middle Cambrian and it correlates roughly both in lithology and in overall thickness with units of the same age overlying the Stirling(?) and Prospect Mountain quartzites in the Atomic Energy Commission Nevada Proving Grounds (Johnson and Hibbard, 1957, p. 336-342) and Groom district (Humphrey, 1945, p. 23-26) respectively.

BONANZA KING FORMATION (Єbk)

Alternating light- and dark-gray dolomite layers, forming a sequence 3,800 feet thick, are correlated on the basis of stratigraphic position and lithology with the Bonanza King formation of the type locality in the Providence Mountains, Calif. (Hazzard and Mason, 1936, p. 234-238), and with the Bonanza King formation in the Nopah Range, Calif., as revised by Palmer and Hazzard (1956, p. 2494-2499). The formation is mostly thin- to thick-bedded dolomite with a few zones as much as 150 feet thick that contain intercalated silty and sandy layers and partings, and locally thin cherty zones.

A complete section measured north of the mouth of Tungsten Canyon contains roughly a dozen units that differ from one another chiefly in content of clastics, chert, and secondary dolomite and in the spacing of light- and dark-gray bands. In the bottom and top thirds of the formation the alternating gray bands are 20 to 200 feet thick, and rather indistinct except at the very top. The middle third of the formation, on the other hand, has very distinct light- and dark-gray bands that are only 1 to 20 feet thick. This prominently striped middle unit probably corresponds to striped unit no. 7G in the Cornfield Springs formation (Hazzard, 1937, p. 277, 319) in the Nopah Range, which according to a revision of nomenclature (Palmer and Hazzard, 1956, p. 2498-2499) forms the upper part of the Bonanza King formation.

Three distinct bands, each about 200 feet thick, that are from bottom to top, black, white, and gray, form the uppermost part of the Bonanza King formation at Bare Mountain. Similar thick bands also occur in the Nopah Range (Hazzard, 1937, p. 319-320) at the top of the formation as revised by Palmer and Hazzard (1956). At Bare Mountain, the formation shows many zones containing white to yellowish-gray very coarse dolomite in crystals and aggregates that form specks, large spots, and discrete and anastomosing seams, which are both parallel to and oblique to stratification.

Fossils are rare and none of those found have been identifiable. The formation at Bare Mountain is considered to be Middle and probably in part Late Cambrian in age; the formation lies above an Early Cambrian fauna and below a Late Cambrian one.

NOPAH FORMATION (Єn)

Two distinct units with a total thickness of about 1,900 feet constitute the Nopah formation of Late Cambrian age at Bare Mountain; these two units, a thin basal shale and a thick upper dolomite, are here designated as the lower shale member and the upper member, respectively. A third unit, a limestone up to 150 feet thick overlying the basal shale, occurs locally; it has a sharp lower contact and grades up into the upper member, with which it is included on the map.

Lower shale member.—The lower member consists of approximately 100 feet of brownish gray to black shale with a few thin, lenticular interbeds of gray, aphanitic to fine-grained limestone. The shale weathers to a light brown that contrasts strikingly with the adjacent gray carbonate beds. The lower shale member has slightly wavy thinly laminated layering and a shaly to papery parting, and overlies with a sharp contact the Bonanza King formation and passes abruptly up into the upper member of the Nopah formation.

Upper member.—A limestone, 100 to 200 feet thick, locally occurs at the base of the upper member, and when viewed from a distance appears generally as a sheer cliff that is darker in color than the rocks above and below. Very thin resistant lenses of chert, siltstone, and some dolomite are intercalated with the limestone. The unit is conspicuously laminated, platy to flaggy, and grades upward into the much thicker dolomitic part of the upper member.

The dolomitic part of the upper member is 1,600 to 1,800 feet thick and has thin and thick, faintly and sharply contrasting, parallel and subparallel gray-colored bands and 1 or 2 moderately thick, very pale orange or light gray bands. The dolomite commonly yields a fetid odor when struck, and is fine to coarse grained and obscurely to well stratified. Stratification is parallel, and locally wavy, laminated to thin bedded and locally thick bedded. Low-angle cross-stratification is prominent in a few zones. Brownish- to olive-gray silty and sandy layers occur commonly in the lower half and rarely in the upper half of the dolomitic part of the upper member. The upper member characteristically contains some chert in zones of blebs, nodules, and stubby thin lenses, and also many zones in which the dolomite has partly recrystallized as coarse-grained, white to yellowish-gray flecks and stringers subparallel to stratification and, in the upper part, as large irregular masses. Stylolites are locally well developed in the middle part of the member.

Pseudoagnostus, a distinct Upper Cambrian agnostid, as well as other poorly preserved agnostid and aphelaspid trilobite forms, have been identified from the lower shale member of the Nopah formation at Bare Mountain. These indicate the equivalence of the member with the basal Nopah formation at its type locality in the Nopah Range, California, and with the basal shaly part of the Cornfield Springs formation of Hazzard and Mason, 1937, in the Providence Mountains, California (Palmer and Hazzard, 1956). The lower shale member of the Nopah formation together with several hundred feet of limestone and dolomite above and below the shale also correlate closely lithologically with the Dunderberg shale and carbonate units adjacent to it in the AEC Nevada Proving Grounds (Johnson and Hibbard, 1957, p. 340-345).

POGONIP GROUP (Op)

A limestone sequence 1,375 feet thick measured at Bare Mountain has been correlated with the Pogonip group as defined in the revised section of the type locality near Eureka, Nevada (Nolan and others, 1956, p. 23-25; also see Hall and MacKevett, 1958, p. 6). Units within the group were not differentiated during mapping. The lower third of the group consists chiefly of silty, cherty limestone with cherty dolomite at the base; the upper two-thirds of the group consists of shaly limestone with interbeds of pure limestone, and about 100 feet of cherty limestone at the top.

Within these broad units several distinctive zones, ranging between 90 and 400 feet in thickness, can be recognized. Silt and shale commonly occur as partings and as thin, rather persistent lenses interbedded with limestone. Chert occurs both as nodules and as long thin lenses. Relatively pure limestone is in shades of gray, whereas shaly parts are olive gray to olive brown; silty and cherty parts appear yellowish gray to brownish gray. Most of the limestone is aphanitic to medium grained, but a 300-foot zone near the top is commonly medium to very coarse grained and locally recrystallized and dolomitized. In a thin zone 200 feet above the base of the measured section the limestone is locally conglomeratic.

The lower contact of the Pogonip group is placed arbitrarily at the base of a silty dolomite that is approximately 100 feet thick. The upper contact grades by intertonguing through a thin sandy zone into the overlying quartzite.

Diagnostic fossils found in the Pogonip are forms reported from the Antelope Valley limestone (Nolan and others, 1956, p. 28, 29). The fossils, of Early and Middle Ordovician age, include the spongelike form *Receptaculites elongatus* Walcott, the brachiopod *Orthidiella* cf. *O. costellata* Cooper, and the gastropod *Palliseria robusta* Wilson. Trilobite fragments also suggest species common to the upper part of the Pogonip group from other localities. The *Palliseria* zone is locally conspicuous, occurring in part in relatively massive, locally dolomitized limestone. *Palliseria* first appears about 750 feet above the base of the formation in the measured section, but is commonest at about 1,000 feet above the base and extends to about 1,050 feet above the base.

EUREKA QUARTZITE (Oe)

A cliff-forming quartzite about 360 feet thick overlying the Pogonip group is correlated with the Eureka quartzite of Middle and Upper(?) Ordovician age on the basis of stratigraphic position and lithology. The quartzite characteristically crops out as a light-colored cliff with a thin sandstone unit at bottom and top. The quartzite is chiefly white and grayish orange, with some brown staining; it is vitreous, fine grained, with well-rounded and well-sorted grains, indistinctly and distinctly very thin- to thick-bedded, with local, faint, low-angle cross-stratification. In the measured section at Meiklejohn Peak, the lower contact of the formation is placed at the base of a limy sandstone about three feet thick, which forms a thin transition zone into the underlying limestone. A limy quartzitic sandstone, about 30 feet thick, forms the uppermost unit of the Eureka and grades upward into dolomite. Fossils have not been found but by correlation with the Eureka quartzite of other areas, a Middle and Upper(?) Ordovician age is presumed. Worm trails indicate a subaqueous, if not marine, origin.

ELY SPRINGS DOLOMITE (Oes)

Cherty dolomite, about 300 feet thick, overlies the Eureka quartzite, and on the basis of stratigraphic position and lithology, it is correlated with the Ely Springs dolomite of the northern Panamint Range, California (McAllister, 1952, p. 13-15; 1956), and of the Nopah Range (Hazzard, 1937, p. 325-326).

At Bare Mountain most of the sequence is dark-gray, aphanitic to very fine-grained, laminated to very thin-bedded and blocky dolomite. Chert as anastomosing irregular lenses comprises about 10 percent of the rock, and in some zones is even more abundant. The base of the formation is a sandy dolomite or limestone, which within a few tens of feet grades upward into the cherty dolomite. Extensive patches of dark gray limestone occur at a few places. The uppermost beds have less chert than those below, and contain some limy dolomite, which appears as lighter gray bands in contrast to the prevalent dark gray bands of dolomite. Direct paleontologic evidence for the age of the Ely Springs dolomite at Bare Mountain has not been found, but elsewhere the Ely Springs is of Late Ordovician age.

ROBERTS MOUNTAINS FORMATION (Srm)

A sequence of limestone and dolomite beds, ranging from 650 to 850 feet in thickness, is correlated with the Roberts Mountains formation, which has its type section at Roberts Creek Mountain in central Nevada (Merriam, 1940, p. 11-12; Nolan and others, 1956, p. 36-37). The formation at Bare Mountain has lithologic affinities with two somewhat different lithologic sections, one at the type locality and one at Lone Mountain (Merriam, 1940, p. 11-12). A thin lower unit, about 150 feet thick, contains interstratified light- and dark-gray limy dolomite that locally contains sparse sand, small chert nodules, and intercalated chert layers; this is overlain by a thick middle unit about 400 feet thick, consisting chiefly of medium- to dark-gray limestone and limy dolomite. The upper unit, about 200 feet thick, consists of medium-gray limy dolomite that grades upward into light-gray partly recrystallized dolomite that commonly weathers to a pitted surface.

Most of the formation is faintly to distinctly laminated or thin bedded, platy, and slabby. Although the lower part of the formation is cherty, the conspicuous chert unit which marks the base of the formation in central Nevada is not present everywhere at Bare Mountain. Therefore, the lower contact is placed at the base of a relatively persistent cherty medium-gray dolomite that weathers light gray in contrast to the darker grays of the underlying more cherty Ely Springs dolomite.

A limestone conglomerate, about 3 feet thick, is present locally near the base of the limy part of the formation. Fossils occur sporadically throughout this limy part, but the best collections were made from a few dolomite layers near its top, about 500 feet above the base of the formation. Collections yielded pentameroid brachiopods and corals, like faunas described from the type section (Merriam and Anderson, 1942, p. 1687), which date the formation as Middle Silurian in age.

LONE MOUNTAIN DOLOMITE (Slm)

A relatively homogeneous dolomite about 1,600 feet thick, and overlying, gradationally, similar dolomite at the top of the Roberts Mountains formation, is correlated with the Lone Mountain dolomite as restricted by Merriam (1940, p. 10, 13-14; Nolan and others, 1956, p. 37-40) at Lone Mountain in central Nevada. Lithologically the Lone Mountain dolomite at Bare Mountain is similar to that described in the type section. From a distance the dolomite appears as a thick very light gray unit with a thick, poorly defined darker gray zone in the lower part.

A section measured between Chuckwalla and Tarantula Canyons was divided into three units. The lowest unit, 200 to 300 feet thick, consists of pitted light-gray dolomite that is fine to medium grained and becomes coarser grained upward. It is indistinctly stratified, massive, and contains fragments of crinoid stems. The middle unit, about 500 feet thick, is blotched light- and dark-gray dolomite, chiefly fine to medium grained with a few sandy layers near its top, and with aphanitic to coarse-grained sequences in the upper hundred feet. Stratification and splitting are like that in the lower unit. The upper unit is 800 feet thick and consists chiefly of light-gray, medium-grained, massive dolomite. Stratification of the dolomite is absent or faint, and it is thin to thick bedded.

The contact of the Lone Mountain dolomite with the overlying Fluorspar Canyon formation seems to be conformable and was placed above a brecciated indistinctly stratified medium-gray dolomite and below thin- to thick-bedded medium- to dark-gray dolomite. The overlying dolomite commonly has zones of chert and quartzose sandstone lenses.

Diagnostic fossils were not found at Bare Mountain, but based on lithology and on a stratigraphic position above the Roberts Mountains formation of Middle Silurian age, the Lone Mountain dolomite is correlated with similar strata considered to be Silurian and possibly in part Early Devonian in age in central Nevada (Nolan and others, 1956, p. 39, 41).

FLUORSPAR CANYON FORMATION (Dfc)

An incomplete section of Devonian rocks, exposed in several fault plates, is here named the Fluorspar Canyon formation for the most extensive exposure and designated type section on the north end of Razorback Ridge at the head of Fluorspar Canyon. Three separated partial sections were measured with a total thickness of about 1,700 feet.

The basal part of the formation crops out on the south side of Tarantula Canyon and conformably overlies the Lone Mountain dolomite. The Fluorspar Canyon formation exposed here is 300 feet thick and is dark-gray cherty dolomite with sandstone lenses and a little limestone. Fossils collected near the top of this unit were identified by C. W. Merriam as: *Favosites* sp., *Cladopora* sp., *Alveolites* sp., *Schizophoria* sp., *Cyrtina* sp., and *Crurithyris* sp. These fossils indicate a Devonian age, probably late Middle Devonian, for this basal part of the formation.

A second incomplete section of the Fluorspar Canyon formation exposed on the north end of Razorback Ridge has 3 characteristic units. The lowest 550 feet consists of very fine- to medium-grained dolomite with a few quartz and dolomite sand zones several feet thick near the base. Intense fracturing is common. The rock is light to dark gray in faintly to sharply defined bands 1 to 40 feet thick; each band in turn commonly has alternating bands of nearly the same shade. Locally, the rock is irregularly mottled light to dark gray. Stratification ranges in thickness from laminated to thick bedded and is obscured locally. Fossils, although poorly preserved and scattered throughout much of the dolomite are especially conspicuous and abundant in the darker dolomite, where they consist chiefly of tiny rod-shaped stromatoporoids that commonly occur in zones 1 to 15 feet thick.

The middle unit is about 75 feet thick, and consists of sandy and limy dolomite with a little limestone, quartzose sandstone, and quartzite. The carbonate rock is mostly light to dark gray, and the clastic rock is brown and locally gray.

The upper unit, about 215 feet thick, consists of aphanitic to fine-grained limestone with intercalated quartzose sandstone laminae and quartzite lenses up to 5 feet thick in the lower half, and with dolomitic limestone in the upper half. The limestone is predominantly medium gray with slightly different shades in faint bands, thick bedded and massive at the base, and laminated to thin bedded and massive at the top. The quartzose rocks are white to pink and weather pinkish brown. They are fine to medium grained and laminated to thin bedded.

Stringocephalus(?), a large and poorly preserved calcitized brachiopod, is present in the uppermost few feet of the section. The tiny rod-like forms in the lower part of the section are the stromatoporoid, *Amphipora*, which locally are associated with a gastropod questionably identified as *Orecopia* sp.

A third incomplete section, 580 feet thick, was measured 1½ miles northeast of Meiklejohn Peak. There, the dolomite contains chert and a fauna similar to that at the type locality, but lacks well-developed quartz sand and limestone zones. Some of the fossiliferous dolomites yield either a hydrogen sulfide or a petroliferous odor when struck with a hammer.

The basal part of the Fluorspar Canyon formation according to Merriam contains fossils of probable late Middle Devonian age. This and other faunas and the general lithology of the rocks suggest correlation of the Fluorspar Canyon formation with the middle part of the Nevada formation as restricted and redefined by Merriam (1940, p. 14-16, 22-25; see also Nolan and others, 1956, p. 42-48) near Eureka, Nev.

MEIKLEJOHN FORMATION (Mm)

A thick sequence of rocks of diverse lithology overlying the Fluorspar Canyon formation is here named the Meiklejohn formation for exposures north of Tarantula Canyon on the southeast flank of Meiklejohn Peak where the type section was measured. The measured section, bounded top and bottom by thrust faults, is 3,200 feet thick, and consists chiefly of silty claystone with intercalated zones of chert, shale, coarser clastics, and carbonate rocks. Two other fragmentary sections of the Meiklejohn formation, likewise bounded by thrust faults, crop out west and northeast of Meiklejohn Peak. The section west of Meiklejohn Peak is predominantly shale, whereas the section northeast of the peak consists of shale, quartzite, chert, and limestone.

The rocks in the measured section, southeast of Meiklejohn Peak, can be divided into lower, middle, and upper units, 1,000, 800, and 1,400 feet thick, respectively. The lower part of the lower unit consists of very thin bedded, platy to flaggy, tuffaceous silty claystone that is light gray with brown laminae, except for 50 feet of pinkish gray claystone at the base. Within this lowest 50 feet are several lenses of shale and dark gray fossiliferous dolomite. The middle part of the lower unit is silty claystone that includes thin to thick layers of black chert; the upper part of the lower unit includes several sandstone and conglomerate layers that weather brownish gray and contain prominent pebbles and grains of black chert.

The middle unit of the measured section, roughly 800 feet thick, consist of light gray to brown silty claystone similar to that in the lower part, but with numerous interbeds up to 5 feet in thickness of brown-weathering sandstone, grit, chert-pebble conglomerate, black chert, and fine- to coarse-grained gray to black limestone. These interbeds form regularly spaced sequences which grade successively upward from conglomerate to sandstone, siltstone, and limestone, indicating cyclic deposition.

The upper 1,400 feet of the measured section is predominantly varicolored pink, olive, brown, and dark gray silty claystone and siltstone, with interbeds of conglomerate, sandstone, chert, and limestone, similar to those in the middle unit of the section, and in part cyclically arranged.

The faulted section of Meiklejohn formation exposed west of Meiklejohn Peak consists of black siliceous shale in its lower part, and predominantly brown-weathering carbonaceous shale that contains scattered interbeds of black chert and limestone, and conglomerate with prominent black chert pebbles in its upper part. Fossils collected from the limestone beds indicate a Late Mississippian age. One bed contains the conodonts *Cavusgnathus* sp., *Gnathodus bilineatus*, *Ligonodina* sp., and fragments of other bladelike and barlike conodonts. Another bed contains the foraminifera *Monotaxis* sp., *Endothyra* sp., and a fusulinid genus with affinities to *Pseudoendothyra* sp.

The Meiklejohn formation is similar in part to the Chainman shale and the Diamond Peak formation near Eureka, Nevada, which are considered to be Late Mississippian in age (Nolan and others, 1956, p. 56-61). Similar rocks also crop out in Yucca Flat, 30 miles northeast of Bare Mountain, where they have been named the Eleana formation by Johnson and Hibbard (1957, p. 357-360) and have been correlated in part with the Chainman shale and Diamond Peak formation.

CENOZOIC ROCKS

TUFF AND WELDED TUFF

The northern and eastern parts of the Bare Mountain quadrangle are underlain by tuff and welded tuff of rhyolitic composition. The tuff and welded tuff have a combined thickness of as much as 6,000 feet, although accurate determination of the thickness is impossible because of inadequate exposures and disruption by faults. The probable range in age of the tuff and welded tuff is from Miocene to Pleistocene. The oldest welded tuff lies at the west-central edge of the quadrangle and can be correlated with similar rocks in the Bullfrog quadrangle to the west, which are younger than early Oligocene and are probably Miocene in age (Stock and Bode, 1935). The youngest tuff and welded tuff in the Bare Mountain quadrangle are horizontal and unconformably overlie the older tuff and welded tuff, as for example on the north side of Tates Wash.

Tuff.—Most of the tuff is moderately to well lithified, but parts of the youngest tuff are loosely consolidated. The tuff contains angular fragments, commonly less than 2 inches in diameter, of pumice, stony rhyolite, and rhyolitic glass, as well as glass shards. It also contains scarce to rather abundant broken crystals, commonly less than 2 mm in the longest dimension, of quartz, sanidine, albite or oligoclase, and biotite. The groundmass is porous and consists largely of glass, minute glass shards, and local aggregates of tridymite. Tiny tridymite crystals also line minute vugs in some of the tuff. The glass, both in the groundmass and in the fragments, is partly devitrified, and devitrified areas are spherulitic.

The tuff is white, gray, or yellowish brown, and locally orange or pink. The pink tuff occurs just below some of the welded tuffs and is as much as 30 feet thick. The pink deepens upward toward the welded tuff and probably was caused by heat from the welded tuff.

The tuff is mostly massive, but locally it is bedded with alternating beds of fine- and coarse-grained tuffaceous material up to 10 feet thick.

Welded tuff.—The welded rhyolitic tuff is predominantly stony. Individual beds range from 20 to 700 feet in thickness. Part of the welded tuff is glassy, and the stony welded tuff units commonly have a 10- to 30-foot glass zone at the base. Some glass zones are locally several hundred feet thick, however, these thick glasses commonly intertongue with stony welded tuff along the strike and presumably also down the dip.

The welded tuff glass is brown, dark gray, or black, in part perlitic, and contains abundant glass shards and scattered fragments, mostly less than 1 inch in diameter, of stony and glassy rhyolite. The glass fragments and shards are also commonly perlitic. In some glass the shards tend to be oriented with their long axes either parallel to the plane of the glass zone, or molded around crystal and rock fragments. Broken crystals, up to 2 mm across, of quartz, sanidine, biotite, and albite or oligoclase, are scattered through the glass.

The stony welded tuff has the same overall texture and included fragments and crystals as the welded tuff glass, but the glass is partly to almost completely devitrified. In addition, the stony rock contains scattered to abundant pumice fragments flattened parallel to the bedding planes of the welded tuff.

The stony welded tuff is gray to reddish brown and commonly contains conspicuous white feldspar crystals and transparent quartz crystals. Some stony welded tuff is mottled or banded light and dark reddish brown. The light brown is, in part at least, an alteration of an originally darker reddish brown. The color banding is a planar structure oriented parallel to the plane of bedding of the welded tuff except for local contortions. Crystals of biotite and feldspar, as well as platy pumice fragments, also tend to be oriented parallel to the plane of the welded tuff.

In several of the welded tuffs in the Bare Mountain quadrangle the upper 10 feet or so of the stony zone is spheroidal. A striking example of tuff showing this structure, noted first by Emmons (Ransome, and others, 1910, p. 39), crops out near the middle of sec. 8, T. 12 S., R. 47 E., and another spheroidal welded tuff occurs in the eastern part of NW¼ sec. 14, T. 12 S., R. 47 E.

The spheroids, prominent on weathered surfaces, range in size from one-tenth of an inch or less to several feet in diameter. They are composed of stony welded tuff that has been silicified and opalized. Agate, opal, and quartz crystals line vugs in the rock.

Alteration.—The tuff, and to a lesser extent the welded tuff, is locally intensely silicified and opalized, and moderately argillized. The two most extensive areas of such alteration occur at Hot Springs in the northwest corner of the quadrangle and in a zone extending from the Thompson to the Silicon mines at the west end of Yucca Mountain. The alteration was probably caused by solutions from thermal springs, which are still active at Hot Springs.

EXTRUSIVE BASALT

Basalt flows and cinder cones crop out in the southeastern and northwestern parts of the Bare Mountain quadrangle. The flows in the northwestern part of the quadrangle are interbedded with tuff and have been tilted and faulted with the tuff and welded tuff. These basalt flows are of probable late Tertiary or early Quaternary age. The basaltic cinder cones and associated flows in the southeastern part of the quadrangle are of Recent age and have not been appreciably modified by erosion since their formation.

The basalt in the flows and in some of the fragments from the cones is dark gray to black, aphanitic to fine grained, and commonly trachytic, with phenocrysts up to 2 mm long of labradorite, olivine, and a little hypersthene and augite. The groundmass consists of labradorite microlites and minute grains of pigeonite, augite, hypersthene, ilmenite, magnetite, and small to moderate amounts of biotite and interstitial glass. The tops of the flows and most of the bombs, lapilli, and cinders in the cinder cones, are vesicular, and brown or red due to a relatively high proportion of ferric iron in the rocks.

INTRUSIVE ROCKS

Intrusive rocks in the Bare Mountain quadrangle range in composition from basalt and dacite to rhyodacite and rhyolite. The basalt, dacite, and rhyodacite occur only in steep-dipping dikes less than 50 feet thick, whereas the rhyolite occurs both in dikes and in larger stocklike bodies up to 4,000 feet wide and 2 miles long. The dikes occur both in the Paleozoic rocks and in Cenozoic volcanic rocks. The larger stocks occur only in volcanic rocks, and one of the large intrusives cuts some of the young poorly consolidated tuff of probable Pleistocene age.

The basalt dikes are similar to the dark-gray to black extrusive basalt described above. The dacite and rhyodacite are gray to dark gray and porphyritic with prominent white andesine or oligoclase phenocrysts, commonly about 5 mm long, and black biotite plates about 1 mm across. A few dikes contain green hornblende phenocrysts up to 1 mm long. The andesine or oligoclase is partly altered to calcite, quartz, sericite, and chlorite. The groundmass consists of grains, mostly less than 0.1 mm in longest dimension, of quartz, sanidine, biotite, sericite, calcite, and a little zircon.

The intrusive rhyolite is porphyritic with phenocrysts up to about 2 mm in their longest dimension. Phenocrysts, in order of decreasing abundance, are sanidine, quartz, oligoclase, and biotite. Sanidine phenocrysts occur in all the rocks, but phenocrysts of the other minerals may be scarce or absent in any individual body. The groundmass of the rhyolite is commonly uniform with intergrown anhedral to subhedral crystals about 0.05 mm across of quartz and sanidine, and scattered hematite grains.

Some intrusive rhyolite is partly glassy, particularly along margins. Glassy rhyolite has a groundmass of clear perlitic glass. The groundmass of the stony facies, however, is locally finely spherulitic due to devitrification. The rhyolites range in color from white to gray and reddish brown; feldspar and quartz phenocrysts may be either prominent or inconspicuous. The spherulitic rhyolites commonly have a planar structure due to alternations of layers up to 1 mm thick of spherulitic rock and quartz, rimmed by minute sanidine laths.

OLDER GRAVELS

Older gravels, probably for the most part Pleistocene in age and characterized by the variable sorting of the detritus occur in the central and northern parts of the Bare Mountain quadrangle. These gravels are old dissected fans. The lower ends of the fans consist of relatively fine detritus and cobbles, whereas the upper surfaces of the high parts are strewn with boulders mostly less than 3 feet across, but with a few as much as 6 feet in diameter.

West of Oasis Valley and north of Beatty Wash the cobbles and boulders in the older fans consist mostly of tuff and welded tuff, but south of Beatty Wash and northeast of Meiklejohn Peak the boulders strewn on the dissected surfaces of the older fans are mostly of Paleozoic limestone, dolomite, and quartzite. These boulders are, in part, arranged in linear trains along ridge crests; these boulder trains probably represent channels of old streams that flowed out from the north part of Bare Mountain.

ALLUVIUM

Alluvial fans flank Bare Mountain and other mountains and hills in and adjacent to the Bare Mountain quadrangle. The gravel in these fans grades downward into sand and silt in the valley bottoms. Gravels also occur in stream channels, both on the fans and on the valley floors. The fans, particularly their lower ends, have large areas of smooth desert pavement broken by the gullies of ephemeral streams.

STRUCTURE

The structural history of the Bare Mountain area is complex and of long duration. The principal deformations were: 1. Folding, probably in the middle or late Paleozoic. 2. Intense thrust faulting and lateral faulting, probably in the Mesozoic. 3. Moderate thrusting and normal faulting in the middle or late Tertiary. 4. Normal faulting from late Tertiary to Recent.

1. The initial folding in the Bare Mountain quadrangle imparted a northerly dip to Paleozoic rocks from the Lower Cambrian Johnnie(?) formation to the Fluorspar Canyon formation of Devonian age. Evidence is lacking as to whether or not this deformation involved the Meiklejohn formation (Upper Mississippian); thus, folding could have occurred as early as middle Paleozoic time.

2. The Paleozoic rocks in Bare Mountain later were subjected to an intense deformation that was characterized by repeated thrusting, locally to the point of imbrication, and by related tear faults. The thrust faults are relatively low angle, dipping for the most part less than 40° and having undulating surfaces. The tear faults associated with thrust faults have apparent right-lateral displacements; they strike approximately north, and dip 50° to 70° to the east. Drag and horizontal displacements along the tear faults, and locally pronounced drag folds in the shaly beds above and below some of the thrust faults, indicate generally the relative movement of the thrust plates from northeast to southwest.

The close genetic relationship between tear faults and thrust faults is indicated not only by similar directions of displacement but also by the fact that some of north-trending tear faults change their strike direction abruptly to the northwest or west, and themselves become thrust faults.

Although the principal direction of thrusting of the rocks on Bare Mountain was toward the southwest, drag folds in weak shaly units in the Johnnie(?) and Carrara formations in the northwest part of Bare Mountain, south of Fluorspar Canyon, and in the Pogonip group on Meiklejohn Peak indicate that these thrust plates probably moved south or southeast with respect to the underlying rocks.

Several of the thrust faults have wrinkles or troughs, discernible on the map, that trend southwest. Examples are the thrust faults south of Joshua Hollow (see section C-C'), the fault overlain by Johnnie(?) formation that trends northeastward from Tungsten Canyon, outliers of which extend northwestward for 8,000 feet to the summit of Bare Mountain, and the fault that underlies Wildcat Peak (see section B-B'). These troughs or wrinkles may be due to folding of the thrust faults at a late stage of the deformation when the uppermost plates at the northwest end of Bare Mountain were thrust in a southeast direction. The attitudes of beds adjacent to warped faults, however, do not indicate that the faults were folded.

Thrust faulting, and particularly imbrication of thrust plates, occurred mostly in weak shaly units that are interbedded with the predominantly massive carbonate rocks of Bare Mountain. Such weak beds are found in the Johnnie(?), Carrara, and Meiklejohn formations. The Carrara formation is intensely imbricate in the area south of Fluorspar Canyon. Thrust plates of the Meiklejohn formation virtually surround a stubby plate of Stirling(?) quartzite and Carrara formation at Crescent Cliff. The Meiklejohn formation has been sheared out from between thrust plates of Pogonip group and Fluorspar Canyon formation at the south end of Razorback Ridge. These thrusting relations attest both to the intensity of the deformation to which the rocks were subjected, and also to the efficacy of shaly units as the loci of planes of rupture.

The age of the intense thrust and tear faulting on Bare Mountain must be younger than the youngest rocks involved, the Meiklejohn formation of probable Late Mississippian age, and older than tuff and welded tuff of probable Miocene age that crop out in the same area but were not involved in this intense orogeny. Northwest of Bare Mountain in the Hawthorne and Tonopah quadrangles intense thrust faulting occurred in the Jurassic (Ferguson and Muller, 1949, p. 7-13) with thrusting from the north followed by later thrusts from the northwest. This sequence of movements resembles that at Bare Mountain.

Longwell (1949, p. 965-966, and oral communication) has dated intense thrusting in the Muddy Mountains, near Las Vegas, as middle to Late Cretaceous with thrusting from the northwest. Noble (1941, p. 958) and Wright (Noble and Wright, 1954, p. 152) consider the major thrusting in the Virgin Springs area of southern Death Valley to have taken place in the middle or late Tertiary. The major deformation at Bare Mountain could not have occurred as late as middle Tertiary, and probably happened in the Jurassic or Cretaceous.

3. The Tertiary volcanic rocks, mainly tuff and welded tuff, were moderately deformed by faulting and tilting in the middle or late Tertiary. These rocks are separated from the Paleozoic rocks at the north end of Bare Mountain by a moderate- to low-angle, north-dipping fault; it is believed that the tuffs were thrust south over the Paleozoic rocks. Irregularities in the fault surface caused secondary faulting and tilting due to jostling of blocks as the plate moved. Deformation of this type was greatest near the thrust plane. The youngest tuff and welded tuff were not involved in this deformation and unconformably overlie older deformed tuff and welded tuff in Tates Wash, north of Meiklejohn Peak.

4. Normal faulting probably has continued intermittently from the late Tertiary to Recent. Only a few faults that definitely fall in this category have been mapped, and displacements, where observed, are small. These faults, with strikes ranging from northeast to northwest, occur in the relatively flat-lying younger tuff and welded tuff, and in alluvial fans. A normal fault with substantial displacement probably bounds the east side of Bare Mountain. Here Paleozoic rocks are cut off abruptly along a sharp, relatively straight line, and the alluvial fans are small and relatively undissected in comparison to those on the west side of Bare Mountain. A northeasterly trending fault or fissure is suggested by the alignment of Recent basalt cones in Crater Flat.

In addition to normal faulting, the tuff and welded tuff have locally been deformed by the intrusion of porphyry stocks in the northern and northeastern parts of the quadrangle.

ECONOMIC GEOLOGY

Mineral exploration has continued intermittently in the Bare Mountain quadrangle since 1905 (Lincoln, 1923, p. 167) when gold was discovered on the east side of Bare Mountain. Significant amounts of fluorspar have been mined since 1918, and a small production of mercury, ceramic silica, and pumicite has been recorded. Meager showings of gold, silver, and tungsten have been found in several prospects, but no production has been recorded. Unsuccessful attempts have been made to quarry marble at Carrara Canyon and perlite 3 miles northeast of Beatty.

The Daisy mine in Fluorspar Canyon (NW¼ sec. 23, T. 12 S., R. 47 E.) was discovered in 1918 and has produced fluorspar continuously since 1927. Total production has been nearly 100,000 tons of ore, and substantial reserves remain. The ore as mined runs about 80 percent CaF_2 and less than 2 percent SiO_2. It occurs as steeply dipping lenses along northeasterly trending shear zones in dolomite of the Upper Cambrian Nopah formation. The ore lenses are in part bounded by low-angle cross faults that dip gently northward; locally ore shoots extend along the intersections of these faults with the steeply dipping shear zones mentioned above.

A small deposit of fluorspar occurs along a shear zone in dolomite of the Nopah formation at the Diamond Queen mine on the east side of Bare Mountain. Production from this deposit was started on a small scale in 1958. A promising occurrence of fluorspar along a fault in the Lone Mountain dolomite on the south side of the mouth of Chuckwalla Canyon was being explored in 1958.

Mercury was discovered in 1908 at the north end of Meiklejohn Peak (NW¼ sec. 18, T. 12 S., R. 48 E., unsurveyed). Production from this property, which is known as the Harvey mine and also as the Telluride mine, was recorded as 72 flasks up to 1943 according to Bailey and Phoenix (1944, p. 142). The mine was active again in 1956, but the amount of production is unknown and probably small. The mercury occurs in cinnabar sparsely disseminated in a lens of chalcedony and opal along a steeply dipping fissure in dolomite of the Fluorspar Canyon formation of Devonian age. Another small deposit known as the Tip Top mine is similar in occurrence to the Harvey mine and is located 600 feet north of it. Production here is reported as possibly about 100 flasks of mercury (Bailey and Phoenix, 1944, p. 144).

Small amounts of mercury have been found at the thoroughly explored Thompson mine in the northwest end of Yucca Mountain (sec. 29, T. 11 S., R. 48 E., unsurveyed). Cinnabar occurs locally as small seams and spheres in silicified and opalized rhyolitic tuff. Production has been very small (Bailey and Phoenix, 1944, p. 143).

The Silicon mine, located at the northwest end of Yucca Mountain (sec. 19, T. 11 S., R. 48 E., unsurveyed), has produced an unknown but moderate amount of ceramic silica that runs about 99.7 percent SiO_2 (Kral, 1951, p. 68). The rock is a thoroughly silicified rhyolitic tuff.

A moderate amount of pumicite has been quarried from a pumiceous tuff located about 3 miles north of Beatty (SE¼ sec. 28, T. 11 S., R. 47 E.) for use in the manufacture of lightweight aggregate building blocks according to Kral (1951, p. 68).

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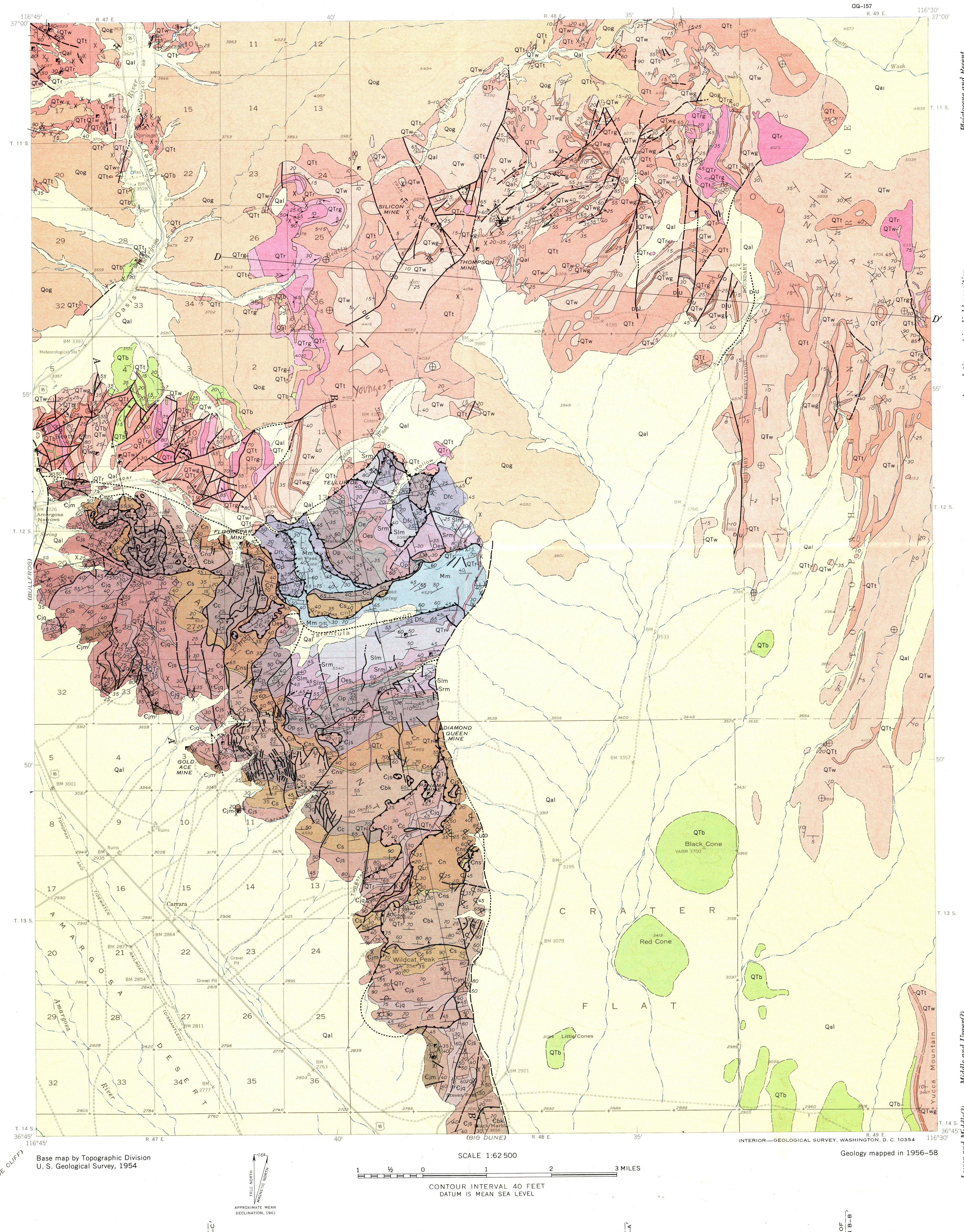
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE NEVADA BUREAU OF MINES

GEOLOGY OF THE
BARE MOUNTAIN QUADRANGLE
NEVADA
GQ-157



Base map by Topographic Division
U. S. Geological Survey, 1954

SCALE 1:62 500
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1961

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C. 10354

Geology mapped in 1956–58

EXPLANATION

QUATERNARY (Pleistocene and Recent)

Qal — **Alluvium**
Fan and stream gravels flanking mountains and hills and grading into sand and silt in valley bottoms

Qog — **Older gravels**
Boulders, cobbles, and finer material of varied lithology in partly dissected fans

TERTIARY AND QUATERNARY (Age relations not implied by position)

QTb — **Basalt**
Fine-grained to aphanitic, dark gray to black, porphyritic basalt flows, dikes, and cinder cones. The rock in flow tops and fragmental cinder cones is mostly vesicular and reddish brown to red. Probable range in age: Pliocene to Recent

QTr, QTrg — **Porphyry intrusive or flow**
Dikes, stocks, and flows of white, gray, brown, or reddish brown rhyolite porphyry and minor dacite and rhyodacite porphyry; Glassy parts of bodies, QTrg. Probable range in age: Miocene to Pleistocene

QTt — **Tuff**
White, gray, and yellowish brown tuff; loosely consolidated to well lithified, mostly massive, but locally stratified; contains broken crystals and small fragments of pumice, stony rhyolite and rhyolitic glass in a pumiceous matrix. Probable range in age: Miocene to Recent

QTw, QTwg — **Welded tuff**
Stony, rhyolitic welded tuff, QTw, gray to reddish brown in color; commonly contains conspicuous crystals of feldspar and quartz, and small fragments of stony and glassy rhyolite. Glass zones, QTwg, generally occur at the base of welded tuff units and locally are found in the interior or upper parts. Probable range in age: Miocene to Pleistocene

MISSISSIPPIAN (Upper Mississippian)

Mm — **Meiklejohn formation**
Light-colored, pink, gray, and brown tuffaceous (?) siltstone, claystone and shale with subordinate but locally dominant intercalated beds of dark gray chert, brown sandstone and conglomerate, and long thin lenses of medium gray limestone. Minor lithologies commonly cyclical, with graded bedding in clastic rocks. Fossils locally abundant

DEVONIAN (Middle Devonian)

Dfc — **Fluorspar Canyon formation**
Medium- to dark-gray, locally petroliferous fine- to medium-grained saccharoidal dolomite with minor but conspicuous zones of deep pink and brown quartzitic and dolomitic sand and a thick zone of medium gray limestone. Fossils sparse to abundant in the limestone and dolomite

SILURIAN

Slm — **Lone Mountain dolomite** (Upper Silurian)
Indistinctly stratified, massive, homogeneous, partly recrystallized, saccharoidal dolomite that is fine- to medium-grained. Weathers to a pitted light gray surface in lower and upper parts, and to a blotched light- and medium-dark gray in middle part. Fragments of poorly preserved crinoid stems abundant locally

Srm — **Roberts Mountains formation** (Middle Silurian)
Light- to dark-gray dolomite, limy dolomite, and limestone. Sandy and cherty dolomite at base, platy limestone in middle, and dolomite in upper part. Formation is faintly to distinctly stratified, laminated to thin bedded and platy to slabby. Fossils abundant in middle. Uppermost dolomite is partly recrystallized and transitional into overlying formation

ORDOVICIAN

Oes — **Ely Springs dolomite** (Upper Ordovician)
Cherty dark-gray very thin-bedded aphanitic to fine-grained dolomite; chert as anastomosing and finely intercalated lenses comprises 10 percent of entire formation, but locally is much more abundant. Quartzose sandstone at base

Oe — **Eureka quartzite** (Middle and Upper(?) Ordovician)
Vitreous quartzite with thin sandstone beds at the base and top. Quartzite is chiefly white and grayish-orange with some brown staining, fine-grained with well rounded and well sorted grains; distinctly to indistinctly thin- to thick-bedded with local faint low angle cross-stratification

Op — **Pogonip group** (Lower and Middle(?) Ordovician)
Medium-gray limestone and olive-gray to olive-brown shaly limestone. Lower third has silty and cherty layers that give a yellowish-gray to brownish-gray color. Upper part is also cherty and shaly and grades through a very thin sandy zone into the overlying Eureka quartzite. Fossils abundant locally

CAMBRIAN

Єn, Єns — **Nopah formation** (Upper Cambrian)
Fine- to coarse-grained light-to dark-gray dolomite, medium- to dark-gray limestone, and brown shale. Dolomite predominates in alternating thin and thick, light-and dark-gray bands, and is partly sandy in the lower part. Basal beds, Єns, are shale and laminated limestone

Єbk — **Bonanza King formation** (Middle and Upper(?) Cambrian)
Fine-grained gray dolomite with indistinct thick stratification, and fine- to medium-grained dolomite with alternating light- and dark-gray thin to thick beds. Lower part is uniformly gray; middle and upper parts are conspicuously striped light and dark gray

Єc — **Carrara formation** (Lower and Middle Cambrian)
Interstratified greenish-gray to brownish-gray micaceous shale with interstratified dark-gray very fine-grained limestone and minor siltstone in lower half, and white to orange and brown, fine-grained limestone and marble in upper half. Small ellipsoidal algal structures common in some limestones in lower half; shale in lower half locally contains trilobites

Єs — **Stirling(?) quartzite*** (Lower Cambrian)
Light-gray, orange, and brown, indistinctly stratified, fine- to medium-grained quartzite with thin lenses of schistose siltstone and phyllitic shale intercalated in basal and top parts. The quartzite is gritty and conglomeratic locally, thinly laminated to thin bedded, slabby to massive, parallel and low angle cross-stratified where visibly layered

Єjs, Єjq, Єjm — **Johnnie(?) formation*** (Lower Cambrian)
Sandstone, siltstone, shale, and minor carbonate rock and conglomerate interstratified in zones as much as several hundred feet thick. Commonly metamorphosed to phyllite, schist, quartzite and marble. One marble bed in the upper part of the formation is oolitic
Єjs, light-olive-, greenish-, or brownish-gray micaceous shale and intercalated sandstone
Єjq, light-gray quartzite
Єjm, yellowish-brown marble

*Recent studies of the Lower Cambrian rocks in the Bare Mountain and surrounding areas by the present authors, and C. A. Nelson, A. R. Palmer, and J. H. Stewart indicate that the rocks here mapped as Stirling(?) quartzite are probably actually equivalent to the Zabriskie quartzite of Hazzard (1937, p. 309), and that the upper part of the underlying Johnnie(?) formation, in which fossils have been found, is probably equivalent to the Wood Canyon formation. The designation Johnnie(?) for the lower part of that formation is still considered to be valid.

Contact
Dashed where approximately located

Normal or reverse fault, showing dip and relative movement
Dashed where approximately located, dotted where concealed. U, *upthrown side;* D, *downthrown side*

Thrust fault, showing dip
Dashed where approximately located, dotted where concealed. Saw-teeth indicate upper plate

Strike and dip of inclined beds

Strike and dip of overturned beds

Strike and dip of vertical beds

Horizontal beds

Strike and dip of inclined foliation

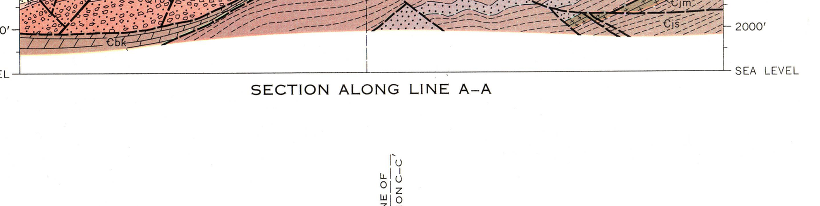
Strike and dip of vertical foliation

Shaft

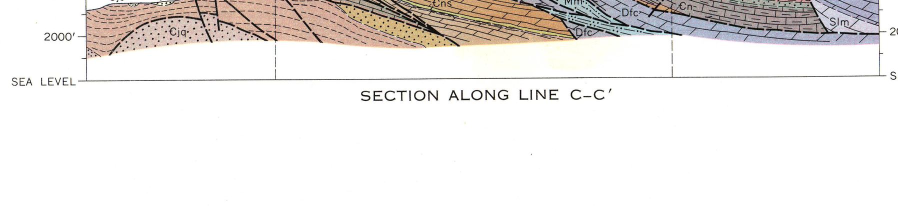
Adit

Quarry

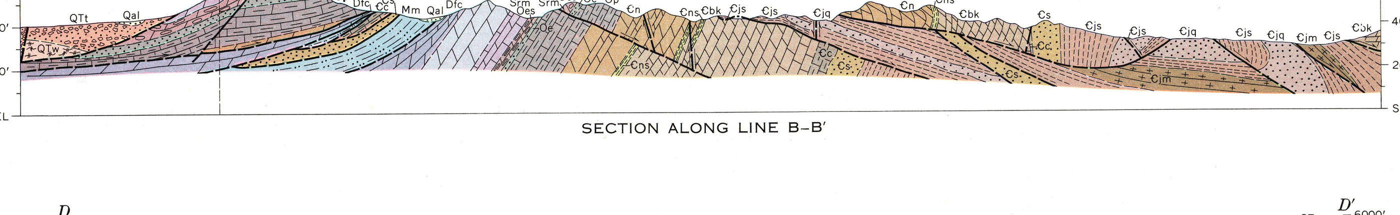
Prospect pit



SECTION ALONG LINE A–A



SECTION ALONG LINE C–C'



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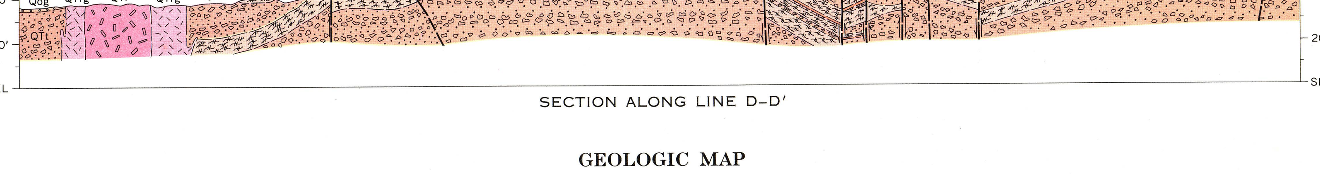

SECTION ALONG LINE D–D'

GEOLOGIC MAP
OF THE
BARE MOUNTAIN QUADRANGLE, NEVADA

By
H. R. Cornwall and F. J. Kleinhampl

1961