Upper Paleozoic Carbonate Bank in East-Central Idaho—Snaky Canyon, Bluebird Mountain, and Arco Hills Formations, and their Paleotectonic Significance

GEOLOGICAL SURVEY BULLETIN 1486

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By Betty Skipp, R. D. Hoggan, D. L. Schleicher, *and* R. C. Douglass

CONTRIBUTIONS TO STRATIGRAPHY

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Three new formations in east-central Idaho and their paleotectonic significance

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By BETTY SKIPP, R. D. HOGGAN,[1] D. L. SCHLEICHER, and R. C. DOUGLASS

ABSTRACT

Approximately 1,400 m (meters) (4,600 ft or feet) of interbedded carbonate rocks, sandstone, siltstone, and mudstone of latest Mississippian to Early Permian age are assigned to the Arco Hills, Bluebird Mountain, and Snaky Canyon Formations in east-central Idaho north of the Snake River Plain. The Snaky Canyon Formation (largely Permian and Pennsylvanian, locally including latest Mississippian) is divided into three members, which are, in ascending order, Bloom, Gallagher Peak Sandstone, and Juniper Gulch. The new formations have been recognized, from west to east, in the southern Pioneer and White Knob Mountains, the southern Lemhi and Lost River Ranges, and the Beaverhead Mountains. The carbonate-bank sequence is overridden on the west by the Copper Basin allochthon and extends no farther east than the Medicine Lodge thrust. An arbitrary northern limit for the terminology is proposed at about latitude 44°30′.

The Arco Hills Formation (uppermost Mississippian) is underlain by the Surrett Canyon Formation of Late Mississippian age. The Bluebird Mountain Formation (uppermost Mississippian) is underlain by the White Knob Limestone in the central White Knob Mountains and by the Surrett Canyon Formation in the southern White Knob and Pioneer Mountains. From the Lost River Range east to the Blue Dome area of the southern Beaverhead Mountains, the Bluebird Mountain Formation is underlain by the Arco Hills Formation. In the remainder of the southern Beaverhead Mountains it is underlain by the Big Snowy Formation. The Snaky Canyon Formation (Lower Permian to uppermost Mississippian) overlies the Bluebird Mountain Formation and is overlain by the Phosphoria Formation in the southern Lemhi Range and Beaverhead Mountains, and by unnamed Permian beds in the White Knob Mountains. A remnant of the Triassic Dinwoody Formation is preserved above the Phosphoria Formation in the southern Beaverhead Mountains.

Sandstones in the Bluebird Mountain and Snaky Canyon Formations generally thin westward toward the Copper Basin allochthon and, thus, are not reworked flysch deposits. They are composed of craton-derived detritus which spread as far west as the

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White Knob Mountains where the Bluebird Mountain Formation is present above orogenic conglomerates in the White Knob Limestone. The presence of shallow-water carbonates in the Upper Mississippian part of the Copper Basin Formation, and the absence of western-derived detritus above the White Knob Limestone suggests that the Copper Basin flysch trough had ceased major subsidence by latest Mississippian time in central Idaho.

The Copper Basin highland, a newly recognized positive element in the approximate position of the former Copper Basin trough, separated the Permian-Pennsylvanian Wood River basin on the west from the mostly contemporaneous Snaky Canyon carbonate bank on the east during Middle and Late Pennsylvanian and probably Early Permian time. The highland contributed detritus to both areas. The western Wood River basin was shorter lived, subsided much more rapidly, and received more than twice as much sediment as the eastern Snaky Canyon carbonate-bank area.

INTRODUCTION

Recent mapping has confirmed that about 1,400 m (4,600 ft) of carbonate and sandstone beds of largely Permian and Pennsylvanian age, which lie above either the Upper Mississippian White Knob Limestone or the Surrett Canyon or Big Snowy Formation throughout east-central Idaho, can be divided into three formations. Two of the formations, which are named for exposures in the southern Beaverhead Mountains, are the Bluebird Mountain Formation (uppermost Mississippian) and the overlying Snaky Canyon Formation (largely Permian and Pennsylvanian). The Snaky Canyon Formation is divided into three members which are, in ascending order, Bloom, Gallagher Peak Sandstone, and Juniper Gulch. In the southern Beaverhead Mountains and the southern Lemhi Range, the Snaky Canyon Formation (Juniper Gulch Member) is overlain by the Phosphoria Formation.

Rocks representative of these two formations are present, from west to east, in the southern White Knob Mountains, the southern Lost River and Lemhi Ranges, and the southern Beaverhead Mountains (fig. 1).

The Upper Mississippian Arco Hills Formation, named for exposures in the Arco Hills at the southern tip of the Lost River Range, occurs between the Surrett Canyon Formation and the Bluebird Mountain Formation in the Lost River Range east to the Blue Dome area of the southern Beaverhead Mountains (fig. 1). In most of this area, the formation is composed largely of thin-bedded argillaceous or silty limestone, calcareous mudstone, shale, and siltstone, with a few very fine-grained sandstone beds and a few thick-bedded limestone beds. Limestone is the major lithology in western exposures, and in the White Knob and Pioneer Mountains, beds equivalent in age to the Arco Hills Formation are mapped with the Surrett Canyon Formation.

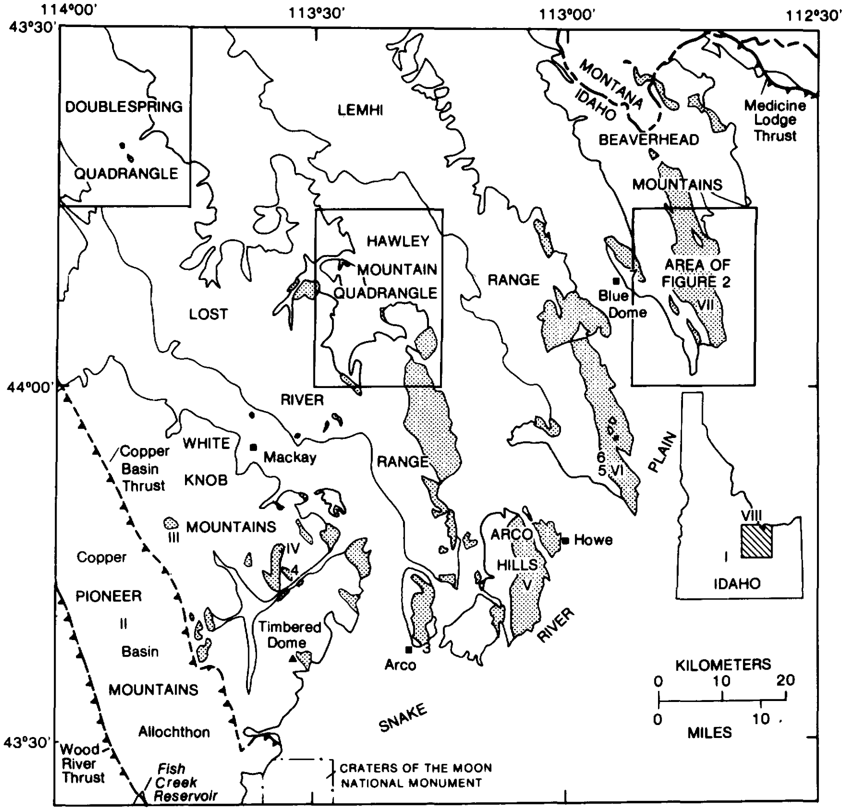


FIGURE 1.—Index map of east-central Idaho showing the areas in which the Arco Hills, Bluebird Mountain, and Snaky Canyon Formations are known to occur (stippled areas), outlines of mountain ranges, location of figure 2, locations of measured sections of Arco Hills and Bluebird Mountain Formations of figure 5, generalized traces of the Medicine Lodge, Copper Basin, and Wood River thrust systems (Skipp and Hait, 1977), locations of quadrangles referred to in text, and generalized locations (roman numerals) of stratigraphic columns used on correlation chart (fig. 4).

The carbonate-bank facies of the Arco Hills, Bluebird Mountain, and Snaky Canyon Formations are cut off on the west by the Copper Basin thrust system which brings Mississippian flysch of the Copper Basin Formation over upper and lower Paleozoic carbonate rocks (Skipp and Hall, 1975a, b; Dover and others, 1976; Skipp and Hait, 1977; Bond, 1978), and they extend no further east than the trace of the Medicine Lodge thrust (Sloss and Moritz, 1951; Scholten and others, 1955; Scholten, 1957; Skipp and Hait, 1977; Ruppel, 1978). The formations have not been recognized to date on the Medicine Lodge allochthon itself (Skipp and Hait, 1977). An arbitrary northern limit for use of the formation names is proposed at about latitude 44°30′ (fig. 1). North of this latitude, other terminology may be more appropriate (Scholten and Ramspott, 1968; Ruppel, 1968), though the sequences in the central Beaverhead Mountains differ only in being more sandy than those to the south. A natural southern limit is provided by the volcanic rocks along the northeast margin of the Snake River Plain.

The need for a formation breakdown such as we have proposed was recognized long ago by Shannon (1961) in the southern Lost River and Lemhi Ranges where he subdivided the Pennsylvanian and Permian rocks into units C, D and E. The Bluebird Mountain Formation largely embraces Shannon's unit C, and the Snaky Canyon Formation is comparable to his combined units D and E. The thin interval which makes up the Arco Hills Formation was included in either the lower part of unit C or the upper part of unit B. Shannon's units A and B consist of the Upper Mississippian limestones which Huh (1967) divided into four formations. These four Upper Mississippian formations, with the Surrett Canyon Formation at the top, formed the basis for the biostratigraphic study of Mamet, Skipp, Sando, and Mapel (1971). Above the four Mississippian formations, Mamet, Skipp, Sando, and Mapel (1971) recognized "an unnamed Pennsylvanian sandstone unit" overlain by "an unnamed limestone unit" in the central Lost River Range. These unnamed units, which are used as map units in the Lost River Range in the Doublespring Quadrangle (Mapel and others, 1965) and in the Hawley Mountain Quadrangle (Mapel and Shropshire, 1973) (fig. 1), are the Arco Hills, Bluebird Mountain and Snaky Canyon Formations of this report. The Arco Hills Formation, as interpreted here, is considered to be represented by approximately the lower half of the "unnamed Pennsylvanian sandstone" in the Hawley Mountain area (Mamet and others, 1971).

In the central Beaverhead Mountains, Scholten and Ramspott (1968), Ruppel (1968), and Lucchitta (1966) assigned beds to the "Pennsylvanian Quadrant Quartzite" and "Pennsylvanian Quadrant Limestone" which probably correlate with the Bluebird Mountain and Snaky Canyon Formations.

ACKNOWLEDGMENTS

Valuable assistance in the measurement of several sections and collection of fossils was given by James Davis, G. F. Embree, B. J. France, M. H. Hait, Jr., Craig Hall, Ellen Harrison, Penny Patterson, Linda Riglin, W. J. Sando, and E. J. Williams. E. K. Maughan first verified the presence of the Phosphoria and Dinwoody Formations. Peter Oberlindacher and R. David Hovland measured most of the

Phosphoria Formation in the southern Beaverhead Mountains. Fusulinid Foraminifera were identified by R. C. Douglass, and smaller calcareous Foraminifera and algae by Betty Skipp, unless otherwise noted. Many paleontologists, in addition to the authors, contributed important faunal determinations for this report. These include D. S. Crawford, J. T. Dutro, Jr., MacKenzie Gordon, Jr., O. L. Karklins, John Pojeta, John Repetski, W. J. Sando, G. J. Verville, B. R. Wardlaw, and E. L. Yochelson, whose individual work is cited in the text. Special thanks are extended to Paul Brenckle for the many hours of consultation concerning the identification and taxonomy of the Mississippian and lowest Pennsylvanian calcareous Foraminifera. The identifications and taxonomy used in this paper, however, are the sole responsibility of the senior author. The authors would also like to thank M. H. Hait, Jr., and B. R. Wardlaw for their helpful criticisms and suggestions.

UNDERLYING BEDS

In the southern Lost River and Lemhi Ranges and in the Blue Dome area of the southern Beaverhead Mountains (Skipp and Hait, 1977), the Arco Hills Formation is underlain gradationally by thick-bedded pure limestones of the Surrett Canyon Formation of Late Mississippian age and is overlain conformably by the Bluebird Mountain Formation. In the southern Pioneer and southern White Knob Mountains, limestone beds equivalent in age to the Arco Hills Formation are mapped with the Surrett Canyon Formation.

In the area of the type section of the White Knob Limestone, in the White Knob Mountains (III on fig. 1; Skipp, 1961; Skipp and Mamet, 1970), the White Knob is overlain gradationally by thin calcareous sandstone or sandy limestone beds considered to be correlative with the Bluebird Mountain Formation. Faunal studies of this area, including foraminiferal determinations of samples collected by R. A. Paull, indicate that the White Knob, which consists of interbedded shallow-water limestones and beach or bar conglomerates and sandstones (Skipp, 1961), is entirely of Late Mississippian age.

In the southern Beaverhead Mountains, exclusive of the Blue Dome area, the Bluebird Mountain Formation is underlain gradationally by the Big Snowy Formation also of Late Mississippian age. An incomplete section of 60 m (200 ft) of Big Snowy was measured below the type section of the Bluebird Mountain Formation on Gallagher Peak (figs. 2, 3). At this locality, the Big Snowy consists of medium-dark-gray, to dark-gray shale which weathers medium gray and contains interbedded medium-gray, fossiliferous, argillaceous, and sandy limestone and few thin beds of siltstone and very fine grained sandstone. A few thin zones of grayish-green shale are pres-

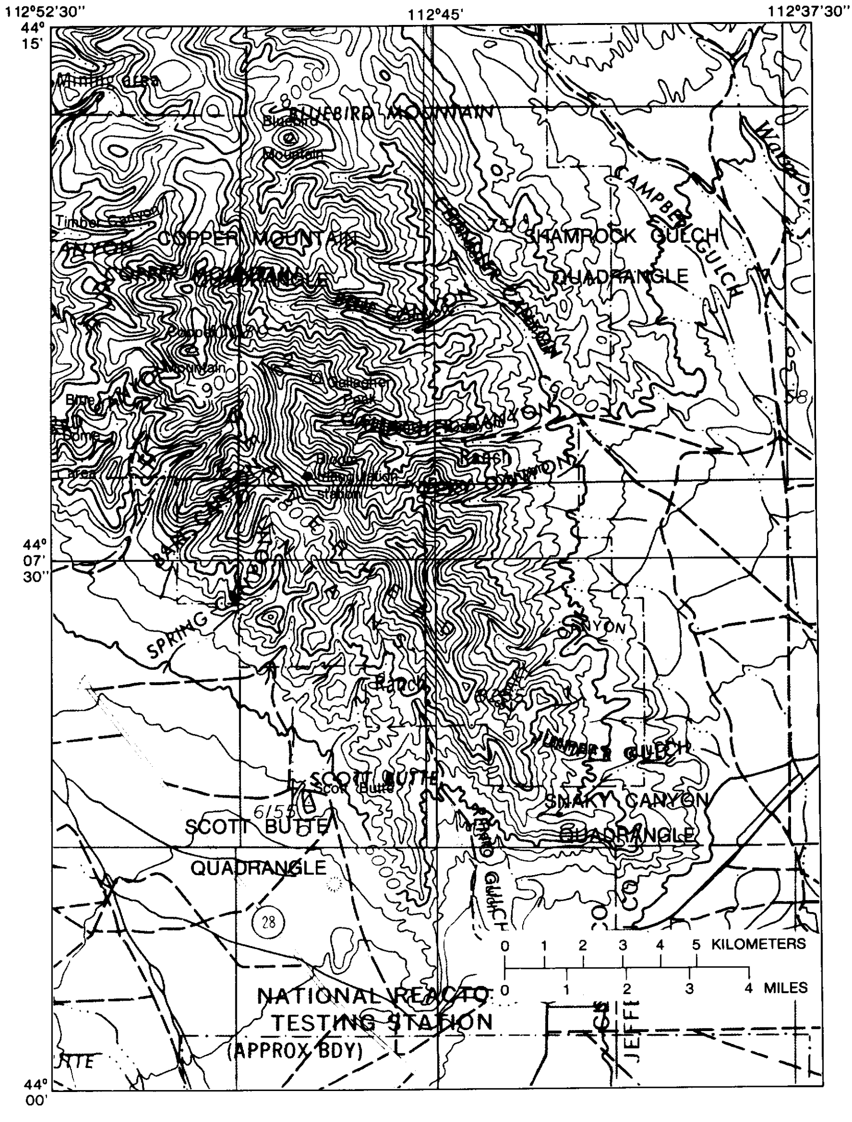


FIGURE 2.—Index map of southern Beaverhead Mountains showing location of the type sections of the Bluebird Mountain and Snaky Canyon Formations in Clark County, Idaho. 2, in the Copper Mountain 7½′ Quadrangle, is the type section of the Bluebird Mountain Formation (Mississippian) and the type section of the Bloom Member (Mississippian and Pennsylvanian) of the lower part of the Snaky Canyon Formation (Permian, Pennsylvanian, and uppermost Mississippian). 1, in the Snaky Canyon Quadrangle, is the type section of the upper part of the Snaky Canyon Formation consisting of the Gallagher Peak Sandstone Member (Pennsylvanian) and the overlying Juniper Gulch Member (Permian and Pennsylvanian).

ent in the uppermost shale zone. Below the measured section of fig. 3, the Big Snowy is estimated to be another 107 to 122 m (350–400 ft) thick with a faulted base, and, in addition to the above lithologies, contains lenticular beds of carbonate conglomerate with clasts as much as 12.5 cm (centimeters) (5 in. or inches) in diameter, abundant phosphatic granules and pebbles, and lenses of medium-light-gray, very fine grained quartzose sandstone. The lowermost dark-gray shale beds of the Big Snowy, about 46 m (150 ft) thick, contain large yellowish-brown-weathering limonitic calcareous concretions as much as 0.6 m (2 ft) in diameter. The thickness of the Big Snowy at this locality as reported here may be too thick. The section is both faulted and folded. Huh (1967) reported a thickness of about 91 m (300 ft) for the entire Big Snowy Formation in the vicinity of Copper Mountain. Throughout this area, the shales and mudstones of the Big Snowy form an incompetent unit which has been squeezed between the thick-bedded limestones of the Surrett Canyon Formation and the cliff-forming quartzites of the Bluebird Mountain.

A varied fauna of brachiopods, bryozoans, mollusks, corals, ostracods, conodonts, algae, and foraminifers was recovered from carbonate lenses in the Big Snowy and indicates a Late Mississippian (Chesterian) age for the formation. The inarticulate chitino-phosphatic brachiopod *Orbiculoidea* is relatively common in both shale and argillaceous limestone facies (Huh, 1967).

Brachiopods present 18 to 41 m (60–135 ft) below the top of the Big Snowy in the measured section of figure 3 were identified by J. T. Dutro, Jr., as:

Anthracospirifer shawi shawi Gordon
Inflatia sp.
Orbiculoidea cf. *O. wyomingensis* Branson and Greger.

All the forms are similar to those reported from the *Carlinia amsdeniana* assemblage in the Amsden Formation of Wyoming (Gordon, 1975), and the interval near the top of the Big Snowy apparently represents a late Chesterian equivalent (J. T. Dutro, Jr., written commun., 1976).

Foraminifera from 18 m (60 ft) below the top of the Big Snowy (fig. 3) are representative of Mamet Foraminiferal (or microfossil) Zone (F. Z.) 19 (uppermost Chesterian) (Mamet and Skipp, 1970), and the fauna includes the following forms:

Asteroarchaediscus sp.
Eosigmoilina explicata Ganelina 1956
"*Eosigmoilina*" *rugosa* Brazhnikova 1964
Hemiarchaediscus sp.
Neoarchaediscus sp.

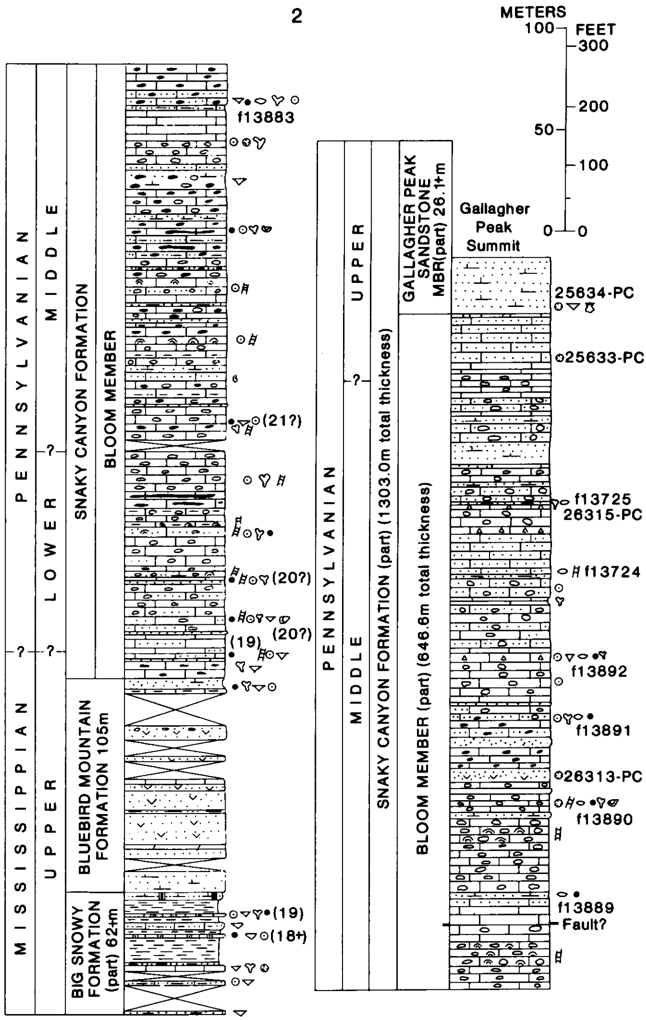
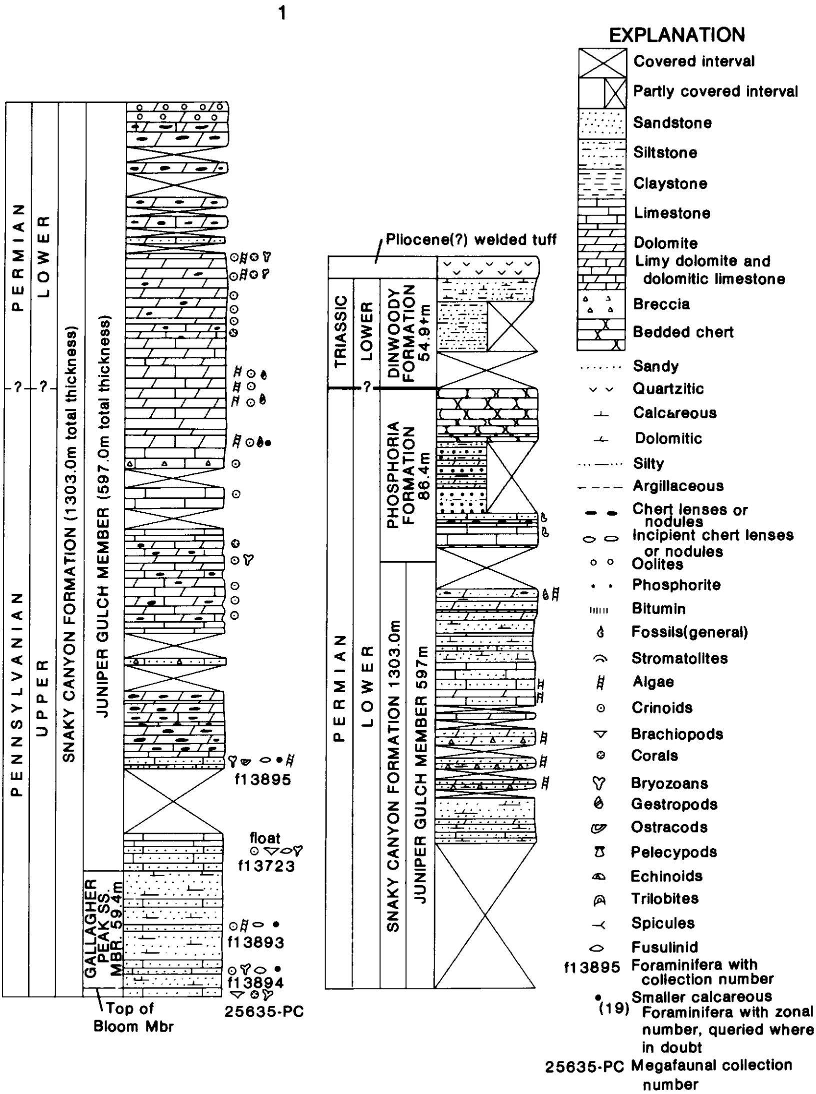


FIGURE 3.—Lithologic columnar sections of type Bluebird Mountain (2) and Snaky Canyon (2 and 1) Formations in southern

Other faunas collected from beds correlative with the upper beds of the Big Snowy in the measured section (fig. 3) include brachiopods, bryozoans, conodonts, and mollusks.

Brachiopods identified by J. T. Dutro, Jr. (written commun., 1975) include:

Anthracospirifer sp.



Beaverhead Mountains, secs. 29 and 30 (unsurveyed), T. 10 N., R. 31 E. (2), and sec. 21, T. 9 N., R. 32 E. (1), Clark County, Idaho.

Composita sp.
Diaphragmus? sp.
Inflatia sp.
Ovatia sp.
Reticularina? sp.

Bryozoans identified by O. L. Karklins (written commun., 1975) include:

Rhabdomesids, indet.
Archimedes sp.

Conodonts identified by John Repetski (written commun., 1976) include:

Adetognathus? sp. (one broken specimen)
Cavusgnathus sp.

Repetski states, "If this is indeed a specimen of *Adetognathus*, then I favor a late Chesterian assignment for this sample."

Mollusks identified by J. T. Dutro, Jr., written commun., 1975) include:

Pectinoid pelecypods, undet.
Platycerotid gastropod, indet.

Faunas from phosphatic limestone conglomerates near the middle of the formation include the brachiopods, *Orbiculoidea* sp. (large) and *Composita* sp. (J. T. Dutro, Jr., written commun., 1975), and the conodonts *Adetognathus unicornis* (Rexroad and Burton), *Cavusgnathus unicornis* Youngquist and Miller, and *Cavusgnathus* cf. *C. regularis,* (John Repetski, written commun, 1976).

Samples of sandy limestone collected at an estimated 46 m (150 ft) and 52 m (170 ft) above the faulted base of the Big Snowy and a few meters below the limestone conglomerates contain abundant green (codiacean) algae, some red algae, and the following Foraminifera:

Asteroarchaediscus spp.
Endothyra excellens (D. Zeller) 1953
"*Eosigmoilina*" *rugosa* Brazhnikova 1964
Neoarchaediscus spp.
Planospirodiscus sp.
Pseudoglomospira sp.
Zellerina sp.

This is a F. Z. 19, possibly upper 18, fauna of late Chesterian age (Mamet and Skipp, 1970). Reexamination of a foraminiferal fauna from a limestone bed about 23 m (75 ft) above the base of the Big Snowy in the vicinity of Copper Mountain reported by Crawford (1976) indicates that the fauna is representative of F. Z. 17 or younger.

Small silicified ostracods from about 30 m (100 ft) above the base of the Big Snowy in the same section (Crawford, 1976) include:

Healdia spinosa
?*Paraparchites* sp.

Though no faunas were found in the lowermost shale beds, physical stratigraphy and faunal evidence support a Late Mississippian (Chesterian) age for the entire Big Snowy Formation in the southern

Beaverhead Mountains. In much of the outcrop area of the Big Snowy Formation in the Snaky Canyon quadrangle (fig. 2), mudstones of the Big Snowy rest directly on limestones of the Scott Peak Formation with no intervening South Creek or Surrett Canyon Formation present. In these areas, it is possible that the lower part of the Big Snowy Formation includes beds as old as F. Z. 16s of early Chesterian age (Sando and others, 1975; fig. 4).

ARCO HILLS FORMATION

LITHOLOGY AND THICKNESS

The Arco Hills Formation is a slope-forming unit between the thick-bedded limestones of the Surrett Canyon Formation below and the ledge-forming sandstones of the Bluebird Mountain Formation above. It ranges in thickness from 76 m (249 ft) in the Arco Hills at the type section to 52 m (170 ft) in the southern Lemhi Range to about 93 m (307 ft) in the southern Beaverhead Mountains (fig. 5, secs. 3, 5, and 7). In three of the measured sections of figure 5, a thin, covered interval separates the Arco Hills from the underlying Surrett Canyon Formation. The formation in measured-section 5, in the southern Lemhi Range (figs. 1, and 5, sec. 5), is anomalously thin (52 m, 170 ft) and pervasively sheared. Another section measured about 2.7 km (kilometers) or (1.7 mi or miles) north of measured-section 5 along the ridge east of East Canyon (Tyler Peak Quadrangle) (fig. 1, sec. 6) above the type section of the underlying Surrett Canyon Formation is even thinner (42.7 m, 140 ft), and has no covered interval at the base. It, too, is sheared in places, but the local lateral continuity of beds suggests the thinness of the interval is due primarily to deposition, not to postdepositional tectonic effects. Beds equivalent to the Arco Hills Formation in the southern White Knob Mountains (fig. 5, sec. 4) are about 34 m (110 ft) thick.

The Arco Hills consists of interbedded medium-gray, olive-gray, yellowish-brown, and grayish-red thin-bedded, argillaceous, and silty or sandy limestone, calcareous mudstone or shale, siltstone and minor sandstone, and medium- to thick-bedded pure limestone. The limestones are variably cherty in the western sections and some phosphatic limestone was noted in the Lemhi Range section (measured section 5). The proportion of shale and (or) mudstone to limestone increases from west to east. No shale or mudstone is present in this part of the section in the southern Pioneer Mountains, (fig. 5, sec. 4), whereas mudstone and siltstone make up 35 percent of the exposed part of the type section (fig. 5, sec. 3) and 53 percent of the exposed part of the section in the Blue Dome area of the southern Beaverhead Mountains (fig. 5, sec. 7). Section 5 in the southern Lemhi Range (fig. 5, sec. 5) contains 28 percent shale and siltstone.

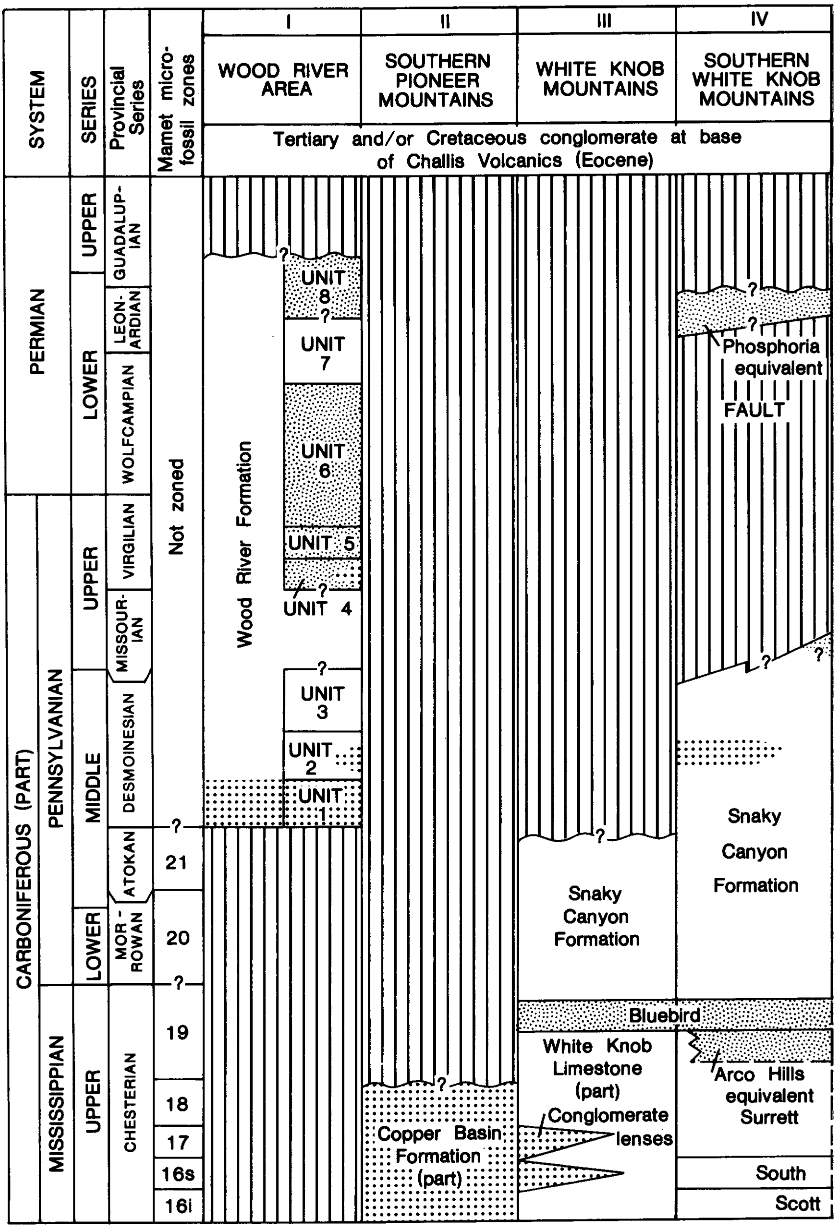
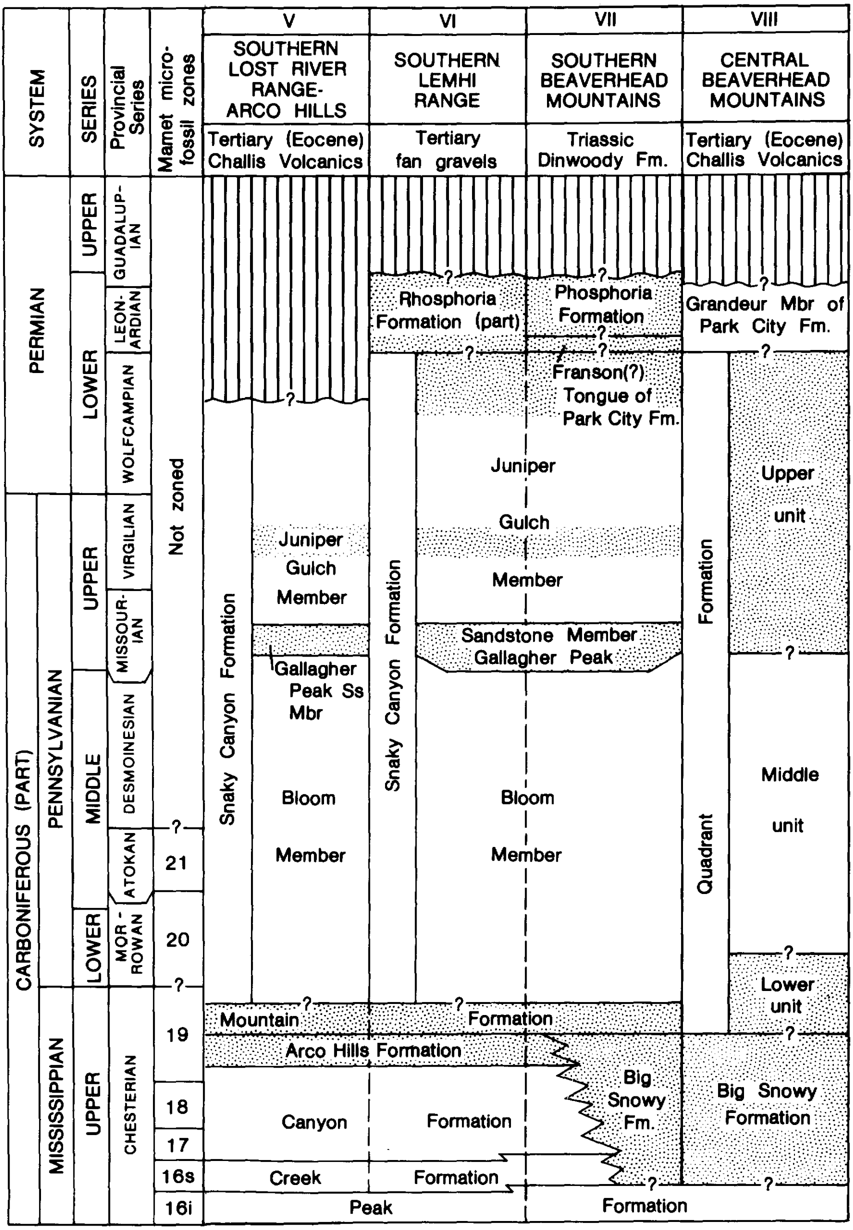


FIGURE 4.—Correlation chart showing ages of the Bluebird Mountain Formation and the Snaky Canyon Formation and its members in south-central Idaho, stratigraphic relations of the formations and members and associated strata with the Wood River Formation to the west, and inferred stratigraphic relations with Pennsylvanian and Permian sequences in the central Beaverhead Mountains.



Hiatus due to erosion or nondeposition shown by vertical lines. Orogenic sediments shown by dot pattern. Mostly craton derived sandstone and mudstone shown by stipple (includes Phosphoria Formation). Mostly carbonate-bank and related sediments shown by blank areas. Mamet microfossil zones (F. Z.) defined in Mamet and Skipp (1970). Sources for data in columns I through VIII are on next page.

FIGURE 4.—Continued

I. Hall, Batchelder, and Douglass, (1974); Skipp and Hall (1975a); Hall, Rye, and Doe, (1978).
II. Skipp and Hall (1975a); Skipp and Hait (1977).
III. Modified from Skipp and Mamet (1970) on the basis of foraminiferal determinations made on samples collected by R. A. Paull
IV. Ross (1962); Nelson and Ross (1969a, b); this paper.
V. Shannon (1961); Mamet, Skipp, Sando, and Mapel, (1971); this paper.
VI. Blackstone (1954); Ross (1961); Shannon (1961); Huh (1967); Buetner (1972); Skipp and Hait (1977); this paper.
VII. Huh (1967); Embree, Hoggan, Williams, and Skipp (1975); Skipp and Hait (1977); this paper.
VIII. Lucchitta (1966); Ruppel (1968); Scholten and Ramspott (1968); Skipp, unpublished data.

The Arco Hills Formation in many outcrop areas is buried beneath sandstone debris from the overlying Bluebird Mountain Formation and has not been recognized previously as a lithologic unit separate from the Bluebird Mountain or underlying Surrett Canyon Formation. Shannon (1961) apparently included it in the upper part of his unit B in the southern Lost River Range, and, possibly, in the lower part of his unit C in the southern Lemhi Range. Approximately the lower half of the "unnamed Pennsylvanian sandstone" of Mamet, Skipp, Sando, and Mapel (1971) probably is the Arco Hills Formation in the Hawley Mountain area (Mapel and Shropshire, 1973). This part of the section is poorly exposed and contains much thin-bedded limestone and some phosphorite pebbles (Mamet and others, 1971, p. 22, locs. 118 and 125). These sections have not been revisited, however, and at this time the correlation is somewhat speculative.

Beutner (1972) reported questionable Big Snowy Formation in the southern Lemhi Range, and it was this report which started the search for the shale unit which is here named the Arco Hills Formation. The Arco Hills undoubtedly is a western facies of the shales and limestones of the upper part of the Big Snowy Formation in the Beaverhead Mountains, and the fine-grained terrigenous detritus probably had a northeastern cratonic-platform source, indicating, perhaps, early pulses of the cratonic events which produced the sand of the overlying Bluebird Mountain Formation. In Arco Hills time, Late Mississippian carbonate-bank buildup was slowed by the influx of fine-grained terrigenous material.

Brachiopods, including *Orbiculoidea* sp., bryozoans, crinoid debris, and calcareous Foraminifera are abundant in the Arco Hills Formation. Corals and trilobites are sparse. Conodonts are probably present but were not looked for.

The upper contact of the Arco Hills Formation is sharp and is placed at the base of the stratigraphically lowest thick (4 m or more) sandstone or siltstone bed of the overlying Bluebird Mountain Formation.

AGE

The Arco Hills Formation is of Late Mississippian, latest Chesterian, age based both on fossil determinations and stratigraphic position. The upper part of the Surrett Canyon Formation which lies beneath the Arco Hills has been determined to be of latest Mississippian age (Mamet and others, 1971), and the overlying Bluebird Mountain also is of latest Mississippian age as presented in this paper.

Calcareous foraminifers representative of Mamet Foraminiferal Zone (F. Z.) 19 or F. Z. 18–19 have been recovered from several stratigraphic positions within all of the measured sections of figure 5. Faunas in individual samples are listed in the measured sections. Diagnostic Foraminifera present in most of the collections include:

Asteroarchaediscus sp.
Biseriella spp.
"*Eosigmoilina*" *rugosa* Ganelina 1956
Eosigmoilina explicata Brazhnikova 1964
Hemiarchaediscus sp.
Neoarchaediscus sp.
Planospirodiscus spp.
Pseudoammodiscus
Pseudoglomospira sp.
Zellerina spp.

Foraminiferal Zone 19 faunas also have been identified in samples from the lower 20 m of the "unnamed Pennsylvanian sandstone" of locality 118 in the Hawley Mountains (Mamet and others, 1971) since publication of that report.

Several specimens of the small horn coral *Amplexizaphrentis* sp., collected from a calcareous mudstone near the middle of the type section of the Arco Hills Formation, were identified by W. J. Sando (written commun., 1977), who states that "it is one of the few coral genera found in Mamet F. Z. 19."

Extensive brachiopod faunas recovered from the measured sections were identified by J. T. Dutro, Jr., (written commun., 1978) who considers the faunas compatible with a latest Mississippian (F. Z. 19) age. Individual collections are listed with the measured sections, but the forms identified include:

Anthracospirifer aff. *A. occiduus* (Sadlick), as used by Gordon (1975)
Anthracospirifer cf. *A. shawi* Gordon
Anthracospirifer aff. *A. welleri* (Branson and Gregor)
Antiquatonia? sp.
Carlinia? sp.
Composita cf. *C. poposiensis* Gordon

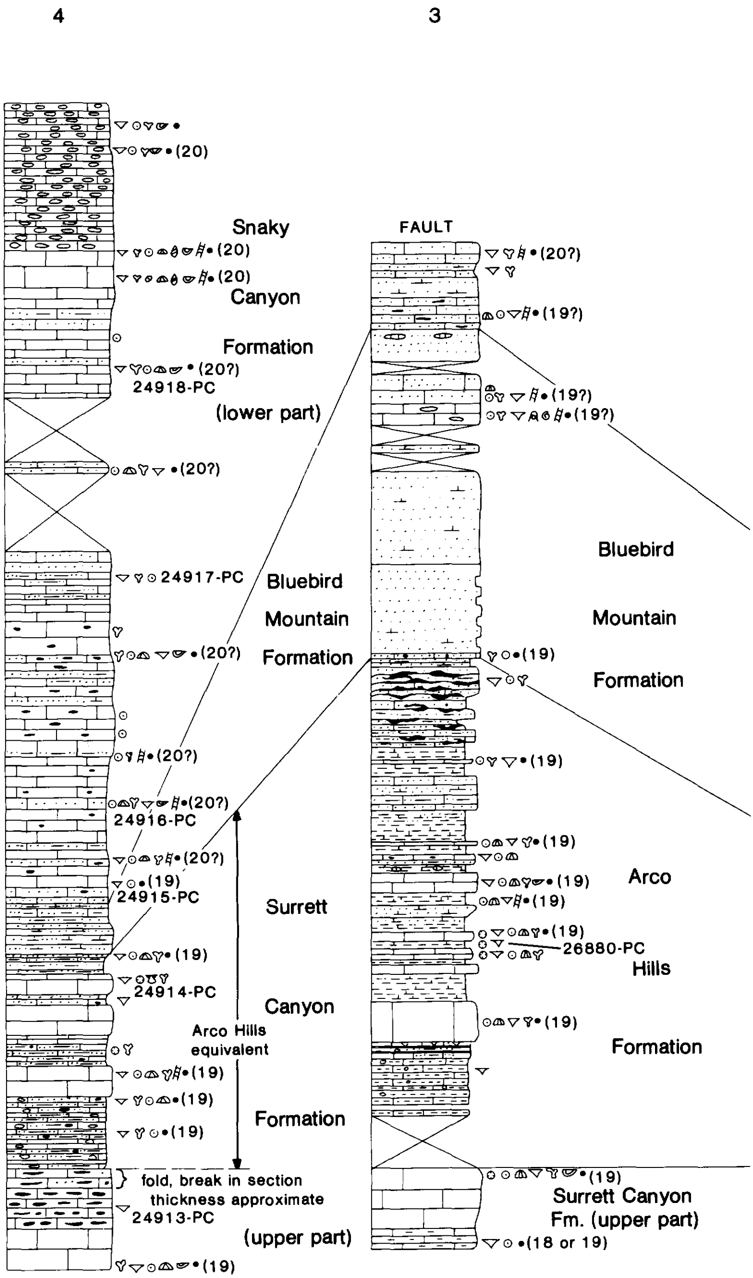
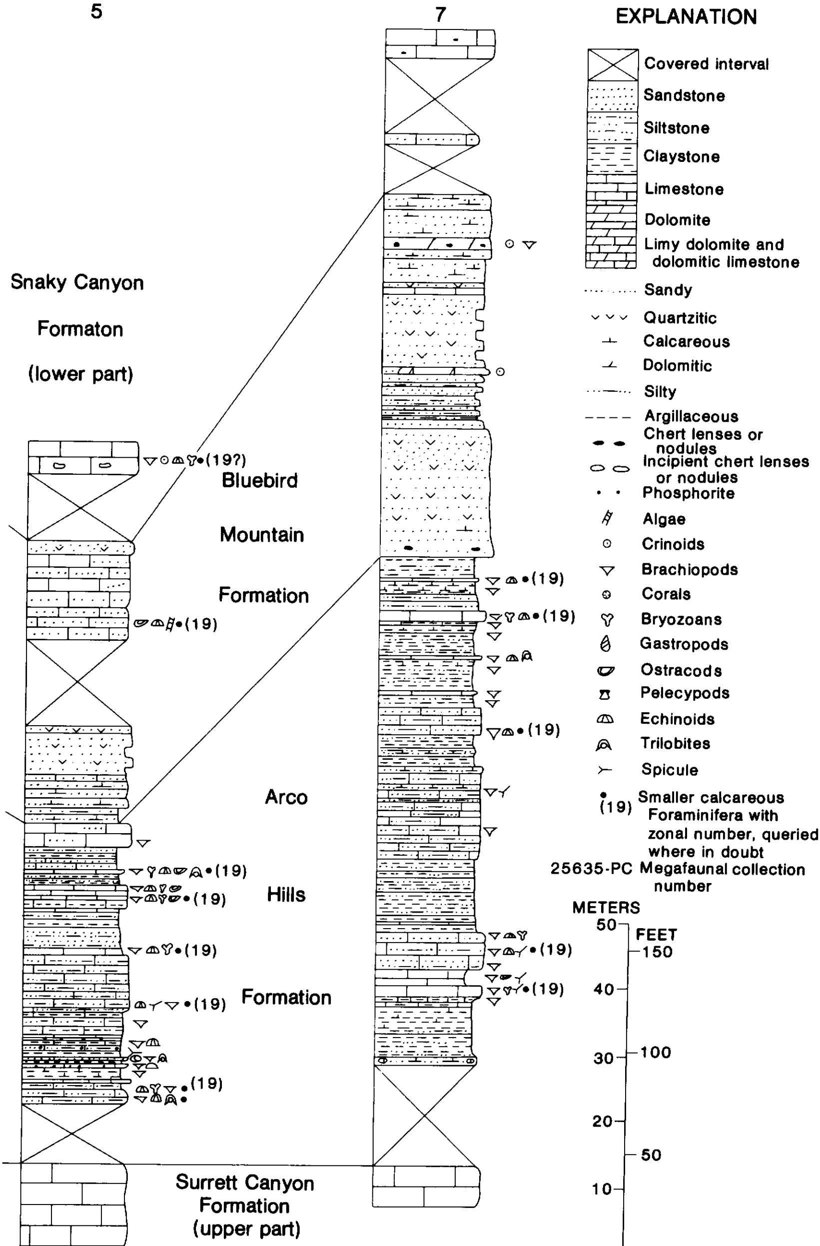


FIGURE 5.—Lithologic columnar sections and correlation of measured sections of the Arco Hills and Bluebird Mountain Formations and their equivalents: 4, southern White Knob Mountains (NW¼ sec. 29 and N½ sec. 30, T. 5 N., R. 25 E.), Custer County; 3, southern Lost River Range-Arco Hills (N½NE¼



sec. 31, T. 4 N., R. 27 E.), Butte County (type section of the Arco Hills Formation); 5, southern Lemhi Range (SE¼ sec. 6, T. 6. N., R. 30 E.) Butte County; 7, Blue Dome area of the southern Beaverhead Mountains (NW¼NW¼ sec. 28 and NE¼NE¼ sec. 29, T. 10 N., R. 30 E.), Clark County.

Diaphragmus sp.
Eolisochonetes pseudoliratus (Easton)
Flexaria? sp.
Inflatia sp.
Leiorhynchoidea sp.
Orbiculoidea cf. *O. wyomingensis* Branson and Gregor
Ovatia sp.

These faunas resemble those recovered from the Big Snowy Formation at Gallagher Peak (figs. 2 and 3) and suggest the Arco Hills Formation is a contemporaneous western facies of at least the upper part of the Big Snowy Formation west of the Medicine Lodge thrust (fig. 1).

BLUEBIRD MOUNTAIN FORMATION

LITHOLOGY AND THICKNESS

The Bluebird Mountain Formation is named for Bluebird Mountain in the Copper Mountain quadrangle (fig. 2). The formation is present along the west side of Bluebird Mountain just off the summit. The type section, however, is about 5.8 km (3.6 mi) south of Bluebird Mountain on the west flank of Gallagher Peak where exposures are good (fig. 2). There, the formation, 105 m (345 ft) thick (fig. 3), consists of medium-gray to medium-light-gray, very fine grained, quartzose, generally quartzitic, mostly thin-bedded (5 cm–0.6 m or 2 in.–2 ft), cliff-forming sandstone which weathers light brown, interbedded with minor beds (1.5 m or 5 ft thick) of gray dolomite and limestone (fig. 3). Siliceous nodules as much as 12.5 cm (5 in.) in diameter are present in several beds, and small-scale crossbedding is present locally. The contact with the overlying Snaky Canyon Formation is gradational. The top of the Bluebird Mountain in the type section was chosen at the base of the stratigraphically lowest (7.6 m or 25 ft) thick sequence of limestone beds of the overlying Snaky Canyon Formation.

The lower contact with the Big Snowy Formation in the type section is placed at the base of the lowest thick, calcareous, very fine grained ledge-forming quartzose sandstone (fig. 3).

In the ranges to the west, the Bluebird Mountain Formation gradationally overlies the Arco Hills Formation or its equivalents. In most sections however, the contact is sharp and is placed at the base of the lowest thick (5 m, 15 ft, or more) ledge-forming sandstone or quartzite beds (fig. 5). In some places, the calcareous sandstone beds form swales rather than ledges, as in measured section 5 in the southern Lemhi Range (fig. 5, sec. 5). In these areas, the brown weathering colors of the sandstones indicate their presence. In many places colluvium from the sandstones and quartzites covers the less resistant limestones and mudstones of the underlying Arco Hills Formation.

The upper contact of the Bluebird Mountain Formation, which is gradational with the overlying Snaky Canyon Formation, is placed, in general, at a position in the section above which limestones dominate the sequence. Covered intervals and variations in proportion of sand to carbonate in individual beds (fig. 5) make this a rather subjective contact, a major difficulty in determining age limits for the formation.

The lithologic character of the Bluebird Mountain varies from range to range. In the Pioneer and White Knob Mountains, it mostly consists of calcareous siltstone, very fine grained sandstone, and interbedded sandy limestone. Where it lies above the White Knob Limestone, the Bluebird Mountain is largely sandy limestone. In the central Lost River Range it consists of "cross-laminated, very fine grained calcareous sandstone and quartzite, interbedded with limestone containing minor amounts of sand and silt" (Mamet and others, 1971, p. 29).

In the southern Lost River Range, the Bluebird Mountain is made up of light-olive-gray, pale-yellowish-brown, and medium-light-gray, calcareous, very fine-grained, thin- to medium-bedded sandstone interbedded with medium-dark-gray sandy limestone. Some limestone beds are as much as 5 m (15 ft) thick. The quartzite and sandstone weather moderate brown, pale yellowish brown, light olive gray, and grayish orange.

In the southern Lemhi Range, the Bluebird Mountain consists of interbedded medium-gray to brownish-gray quartzite, pale-yellowish-brown, very fine-grained, calcareous sandstone, and medium-gray sandy limestone.

The Bluebird Mountain Formation ranges in thickness from about 105 m (345 ft) in the type section in the Beaverhead Mountains to about 7.6 m (25 ft) in the southern White Knob Mountains. Average thickness in the southern Lost River and Lemhi Ranges appears to be about 40–50 m (130–165 ft) (fig. 5). A thin section (30.9 m or 102 ft thick) was measured on the ridge east of East Canyon in the southern Lemhi Range (fig. 1, sec. 6).

In the central Lost River Range, Mamet, Skipp, Sando, and Mapel (1971) report 91 m (300 ft) of "unnamed Pennsylvanian sandstone," some of which probably correlates with the Arco Hills Formation.

AGE

The age of the Bluebird Mountain Formation appears to be latest Mississippian (latest Chesterian) in most places. Calcareous Foraminifera of F. Z. 19 are found above, within, and below the formation in several of the measured sections of figures 3 and 5, including the type section. Mamet, Skipp, Sando, and Mapel (1971, p. 29) report F. Z. 19 faunas immediately below beds equivalent to the

Bluebird Mountain Formation and F. Z. 20 (Lower Pennsylvanian) above, and tentatively placed the base of the Pennsylvanian System at the base of the sandstone unit. Foraminiferal faunas of F. Z. 19 have been identified recently within the lower 20 m of the "unnamed Pennsylvanian sandstone unit" of locality 118 (Mamet and others, 1971, p. 22) in beds which we tentatively correlate with the Arco Hills Formation. No new faunas have been identified from the sandstones above, and the upper contact drawn there may be higher and include more limestone in the upper part than would be included in the present definition of the Bluebird Mountain Formation.

Foraminiferal faunas, therefore, seem to indicate that the Mississippian-Pennsylvanian boundary is above the gradational top of the Bluebird Mountain Formation as defined in this paper.

The conodonts *Gnathodus bilineatus* and *Cavusgnathus* sp., identified by D. S. Crawford (written commun., 1978) from the upper part of the Bluebird Mountain Formation and the lowermost beds of the overlying Snaky Canyon Formation in the southern Lemhi Range (fig. 1, sec. 6), verify a Late Mississippian age for the Bluebird Mountain.

Except for the microfossils mentioned above, the unit is largely unfossiliferous. *Orbiculoidea* sp. is common in some of the calcareous siltstones, and brachiopods and associated encrinite debris are found locally in limestones interbedded with the sandstones and siltstones in the upper part of the formation.

SNAKY CANYON FORMATION

The Snaky Canyon Formation is named for Snaky Canyon in the Snaky Canyon quadrangle (fig. 2) where the entire formation and its three members, the Bloom, Gallagher Peak Sandstone, and Juniper Gulch, are present as distinctive map units shown on the geologic sketch map of the northwest part of the quadrangle (fig 6). In the Snaky Canyon quadrangle, the formation is about 1,200 m (3,940 ft) thick and is underlain gradationally by the Bluebird Mountain Formation and overlain conformably by the Phosphoria Formation of Permian age.

The formation largely consists of carbonate rocks interbedded with thin calcareous sandstones. The carbonates are medium- to light-gray, medium- to thin-bedded, microcrystalline to medium-grained limestone and dolomite which are sandy and silty through much of the interval. They are variably fossiliferous and contain numerous stromatolite mounds in the lower part and hydrozoan(?) and phylloid algal buildups in the upper part; they locally contain oolites and as much as 40 percent chert in nodules, layers, and complex networks. The thin calcareous sandstones are medium gray, pale grayish red, and grayish orange, weather light olive gray, light gray and light brown, and are very fine to fine grained.

A prominent thin sandstone unit about 59 m (195 ft) thick, which divides the formation approximately in half, is present locally in the southern Lost River and Lemhi Ranges, and the southern Beaverhead Mountains. This unit is named the Gallagher Peak Sandstone Member.

The Snaky Canyon Formation is present in the southern Pioneer and White Knob Mountains, the Lost River and Lemhi Ranges, and the Beaverhead Mountains. Incomplete thicknesses reported by Shannon (1961) are 3,403+ ft (1,037+ m) in the southern Lemhi Range, and 3,389+ ft (1,033+ m) in the Arco Hills area. An incomplete and faulted sequence at Timbered Dome in the southern White Knob Mountains is about 870 m (2,855 ft) thick and contains interbedded dark-gray argillaceous limestone, phosphatic in places, calcareous, shaly mudstone and siltstone, very fine grained calcareous, quartzose sandstone, medium- to coarse-grained calcareous sandstone or sandy limestone, some conglomeratic containing grains of quartz and chert, and a bed of chert- and quartzite-pebble and cobble conglomerate 14 m (46 ft) thick, in addition to impure limestone typical of the formation in the ranges to the east.

The age of the formation is largely Early Pennsylvanian to Early Permian, based on fusulinids and stratigraphic position, though some uppermost Mississippian beds are included in the base (fig. 4).

The Phosphoria Formation (Lower Permian) conformably overlies the Snaky Canyon in the Snaky Canyon area and in the southern Lemhi Range (Skipp and Hait, 1977); beds equivalent to the Phosphoria are faulted against the Snaky Canyon Formation in the southern Pioneer Mountains (fig 4, column IV; Skipp and Hait, 1977), indicating that throughout its outcrop area, the Snaky Canyon is nowhere younger than Early Permian.

Lower Permian fusulinid faunas reported years ago from the southern Lemhi Range (Blackstone, 1954; Ross, 1961) came from beds now assigned to the upper part of the Snaky Canyon Formation.

BLOOM MEMBER

The Bloom Member makes up approximately one-half of the Snaky Canyon Formation. In the type section of the member on Gallagher Peak, 647 m (2,125 ft) were measured below the Gallagher Peak Member (fig. 3). This thickness may include some minor repetition of beds along faults. Estimated average map thickness in the Snaky Canyon Quadrangle is about 550 m (1,800 ft). The Bloom Member is named for a triangulation station named Bloom in sec. 32 (unsurveyed), T. 10 N., R. 31 E. about 2.7 km (1.7 mi) south of Gallagher Peak in the Copper Mountain Quadrangle (fig. 2). The member strikes

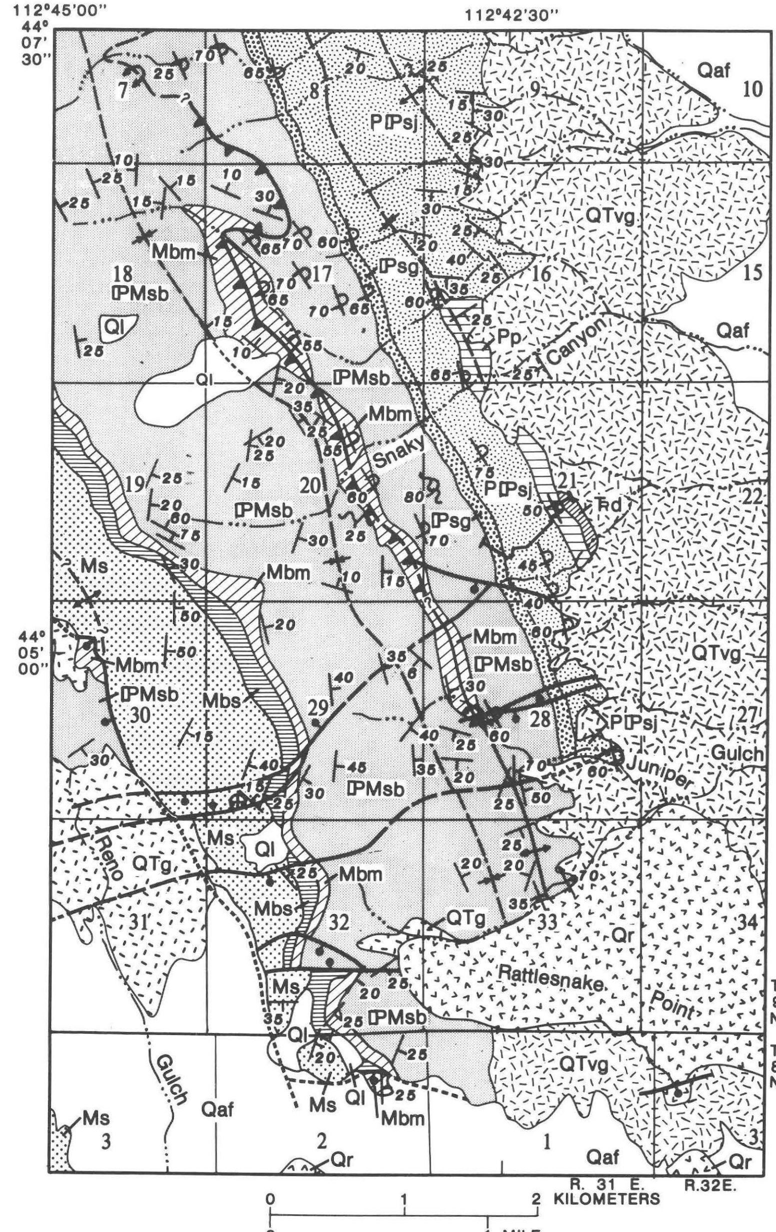
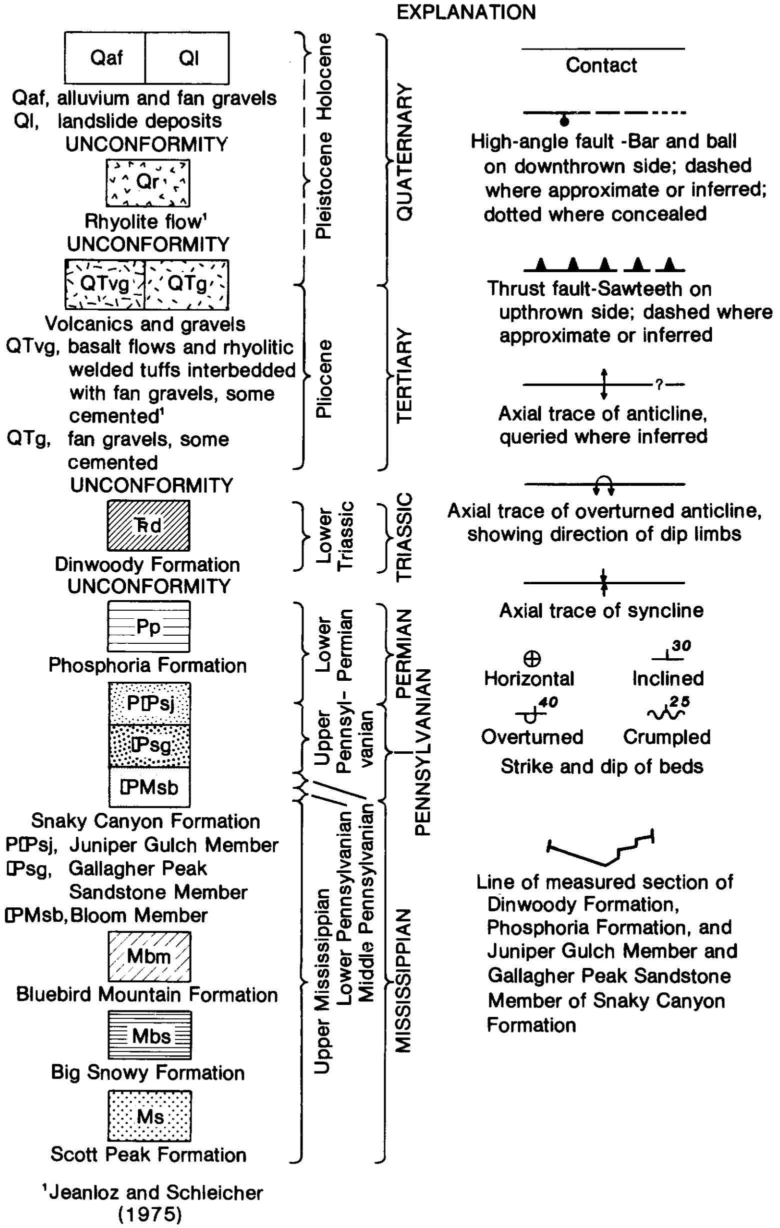


FIGURE 6.—Geologic sketch map of northwest part of Snaky Canyon Quadrangle showing location and distribution of type section of upper part of Snaky Canyon Formation and adjacent overlying and underlying upper



Paleozoic and Triassic formations. Geology by Betty Skipp, D. L. Schleicher, and Raymond Jeanloz, 1974, and by M. H. Hait, Jr., 1977; assisted by Linda Riglin, 1974.

generally north-south in this area and is well exposed on both Gallagher Peak and in the area of the Bloom triangulation station where it dips approximately 30° to the east.

The unit consists of medium-gray to medium-dark-gray limestone which weathers light gray to medium dark gray in beds 5 cm (2 in.) to 0.7 m (2 ft) thick, interbedded with thin beds of medium-gray, very fine grained quartzose sandstone or siltstone which weather pale yellowish brown and light olive gray (fig. 3). The limestone ranges in texture from aphanitic to coarse grained, is sandy or silty through much of the interval, and contains numerous gray chert and brown-weathering incipient chert nodules. The incipient chert nodules have rims of partly silicified material on the outside but are limestone on the inside. Brown-weathering, generally concentrically laminated, stromatolitic mounds are common and have both lenticular shapes with long axes parallel to bedding and moundlike forms with long axes perpendicular to bedding. Medium- to coarse-grained chert and quartz sandstone, shaly mudstone and siltstone, and minor conglomerate are also present in beds correlated with the Bloom Member in the southern White Knob Mountains.

The member in most areas forms a series of ledges or smooth slopes with scattered ledges, in contrast to the underlying Mississippian limestones which are commonly cliff forming. An exception to this ledge form is present in the southern Pioneer Mountains where the lower beds of the Snaky Canyon Formation make striking cliffs. Here the Pennsylvanian rocks are distinguished from the Mississippian rocks by an abundance of impurities, notably sand and silt. In most of the region, the Pennsylvanian limestones are lighter colored than the underlying Mississippian rocks and show more variation in color on weathered surfaces, probably a result of the sand, silt, and clay impurities. Impure wackestones, packstones, and lesser spiculitic mudstones are the chief carbonate lithologies.

Fossils are fairly common in the unit, and, in addition to the stromatolites, include fusulinids and other Foraminifera, algae, brachiopods, corals, bryozoans, ostracodes, trilobites, mollusks, crinoid columnals, abundant encrinitic debris, and a few conularids.

Fusulinids and smaller calcareous Foraminifera from about 215 to 550 m (705–1,805 ft) above the base of the type section of the member include:

Beedeina sp.
Fusulinella sp.
Globivalvulina sp.
Millerella? sp.
Pseudostaffella sp.
Staffella sp.
Textulariid

The forms are diagnostic of a Middle Pennsylvanian (Atokan and Des Moinesian) age. Smaller calcareous Foraminifera from the lower 15 m (50 ft) of the Bloom Member in the type section are representative of zone 19 of latest Mississippian age (fig. 3 and measured-section 2). A zone 20 fauna is reported from the base of beds correlative with the lower part of the Bloom Member in the central Lost River Range (Mamet and others, 1971). Zone 20 faunas are present about 91 m (300 ft) above the base of the Snaky Canyon Formation in the southern White Knob Mountains (fig. 5, sec 4).

Fusulinids from near the top of the member in the Arco Hills include "a problematical fusulinid [that] meets the description of *Eowaeringella* sp. of Late Pennsylvanian (Missourian) age * * *. Latest Des Moinesian is also a possibility." (R. C. Douglass, written commun., 1976).

Fusulinids and smaller calcareous Foraminifera from a collection in the southern Lemhi Range interpreted to be from the upper 10 m (33 ft) of the Bloom Member include *Lunucammina*? sp., *Schubertella* sp., *Globivalvulina* sp., *Millerella* sp., and *Triticites* sp. The fauna is interpreted to be of post-Middle Pennsylvanian age.

Corals recovered from the Arco Hills collection that contained the fusulinid, *Eowaeringella* sp., were identified by W. J. Sando (written commun., 1976) as *Bradyphyllum*? sp. and *Multithecopora* sp. Sando states that they are compatible with a latest Middle to early Late Pennsylvanian age. Corals from the top of the Bloom Member just below the type section of the Gallagher Peak Sandstone Member (fig. 3, colln. 25635-PC, measured-section 1) include *Multithecopora* cf., *M. hypatitae* Wilson, *Caninia* sp., and *Dibunophyllum*? sp., identified by W. J. Sando (written commun., 1975) who assigns the fauna to the "Pennsylvanian, probably Middle or Upper." Brachiopods from the same collection identified by J. T. Dutro, Jr., (written commun., 1975) include *Waagenoconcha* sp. and productoid and punctate spiriferoid fragments. Dutro assigns a "Permian, or possibly latest Pennsylvanian" age to the collection. Bryozoans, also from the same collection, identified by O. L. Karklins (written commun., 1975), include *Ascopora*? sp., *Rhabdomeson* sp., and *Rhombotrypella* sp.. Karklins notes that the *Rhombotrypella* specimen is identical to a form which occurs in the lower Oquirrh or Wells Formation in southeastern Idaho, and that unpublished data suggest that the genus ranges across the boundary between the Pennsylvanian and Permian Systems.

As Late Pennsylvanian fusulinid faunas (fig. 3, colln. f13895) have been recovered from the measured section stratigraphically above these collections, a Late Pennsylvanian age for the uppermost part of the Bloom Member seems to best fit available faunal evidence. Thus, the member ranges in age from latest Mississippian to Late Pennsylvanian.

Other corals identified by W. J. Sando (written communs., 1975, 1976) from various stratigraphic positions within the member in the Arco Hills, southern Lemhi Range, and southern Beaverhead Mountains include *Caninia* sp., *Caninia* cf., *C. torquia* (Owen), and *Lophophyllidium* sp.

Brachiopods identified by J. T. Dutro, Jr. (written commun., 1975) from the lower part of the member in the Arco Hills and southern Beaverhead Mountains include *Crurithyris*? sp., *Linoproductus* sp., *Punctospirifer*? sp., *Schizophoria*? sp., and dictyoclostid and productoid fragments.

Bryozoans including *Archimedes* sp., *Ascopora* sp., *Rhombopora* sp., *Rhombotrypella* sp., and streblotyrpid and sulcoreteporid forms from the Bloom Member in the southern Lemhi Range and southern Beaverhead Mountains were identified by O. L. Karklins (written communs., 1975, 1977). The corals, brachiopods, and bryozoans are all compatible with a Pennsylvanian age.

Extensive Pennsylvanian faunas have been reported from limestone and silicified limestone beds in the southern White Knob and Pioneer Mountains (Nelson and Ross, 1969a, b) that are thought to be correlative with the Bloom Member of the Snaky Canyon Formation. More recent collections contain the algae, brachiopods, bryozoans, conularids, corals, fusulinids, and other foraminifers, mollusks, and trilobites listed below.

Brachiopods identified by J. T. Dutro, Jr., (written communs., 1971, 1973, 1974, 1978) include:

Anthracospirifer cf. *A. occiduus* (Sadlick)
Anthracospirifer sp.
Antiquatonia aff. *A. coloradoensis* (Girty)
Antiquatonia sp.
Cleiothyridina cf. *C. orbicularis* (McChesney)
Cleiothyridina sp. (large)
Composita cf. *C. subtilita* (Hall)
Composita sp.
Derbyia sp.
Dictyoclostus sp.
Hustedia sp.
Kozlowskia sp.
Leiorhynchoidea rockymontana (Marcou)
Linoproductus sp.
Martinia? sp.
Meekella sp.
Neospirifer aff. *N. alatus* Dunbar and Condra
Orbiculoidea sp.
Orthotetacean form

Punctospirifer sp.
Roemerella patula Girty
Rugoclostus sp.
Schizophoria sp.
Waagenoconcha? sp.
Wellerella? sp.

Bryozoans identified by O. L. Karklins (written commun., 1974) and J. T. Dutro, Jr. (written commun., 1971) include:

Fenestellid forms, indet.
Penniretepora? sp.
Rhabdomeson sp.
Rhombopora sp.
Rhombotrypellid forms, indet.
Stenocladia? sp.
Tabulipora sp.

The conularid, *Calloconularia*? cf. *C.*? *crustula* (White), was identified by J. T. Dutro, Jr. (written commun., 1978).

Corals identified by W. J. Sando (written communs., 1971, 1974) and J. T. Dutro, Jr. (written commun., 1978) include:

?*Bradyphyllum* sp.
?*Caninia* sp.
?*Chaetetes* sp.
Dibunophylloid coral
Michelinia sp.
Multithecopora? reptant sp.
Syringoporoid coral

Foraminifers and algae include:

A primitive form of *Fusulinella* sp.
Archaediscus sp.
Asphaltina sp.
Asteroarchaediscus spp.
Beresellid algae
Biseriella spp.
Primitive bradyinid
Earlandia spp.
Endothyra of the group *E. bowmani* Phillips, emend Brady
Endothyra excellens (D. E. N. Zeller)
Endothyranella sp.
"*Eosigmoilina*" *rugosa* Brazhnikova
Eostaffella spp.
Eostaffellina sp.
Hemiarchaediscus sp.
Millerella spp.
Monotaxinoides sp.
Neoarchaediscus spp.

Planospirodiscus sp.
Pseudoammodiscus sp.
Pseudoendothyra spp.
Pseudoglomospira sp.
Stacheoides sp.
Ungdarella sp.
Volvotextularia sp.
Zellerina spp.

Mollusks identified by John Pojeta (written commun., 1978), E. L. Yochelson (written communs., 1974, 1978), and MacKenzie Gordon, Jr. (written commun., 1978) include:

Cephalopods:
Liroceras? sp.
Orthoconic nautiloid cephalopod, indet.

Gastropods:
Glabrocingulum (Glabrocingulum) sp.
Glabrocingulum (Ananias) sp.
Glabrocingulum aff. *G. nevadensis* (Walcott)
Trepospira sp.

Pelecypods:
Aviculopecten sp.
Bellerophontacean form
Nuculopsis cf. *N. girtyi*: Schenck
Phestia cf. *P. bellistriata* (Stevens)

Trilobites identified by MacKenzie Gordon, Jr., (written commun., 1978) and J. T. Dutro, Jr. (written commun., 1974) include:

Proetid trilobite fragment, indet.
Sevillea trinucleata (Herrick)

These faunas support a latest Mississippian to Late Pennsylvanian age for the Snaky Canyon Formation (Bloom Member) in the southern Pioneer and White Knob Mountains.

The contact of the Bloom Member with the overlying Gallagher Peak Sandstone Member is gradational everywhere.

GALLAGHER PEAK SANDSTONE MEMBER

Medium-gray and light-brownish-gray, very fine grained, thin-bedded, calcareous, quartzose sandstone makes up the bulk of the Gallagher Peak Sandstone Member which is 59 m (195 ft) thick in the type section near Snaky Canyon and makes up the summit of Gallagher Peak, for which it is named. The section on Gallagher Peak, however, is incomplete.

The type section which is overturned near Snaky Canyon (fig. 6) is overlain gradationally by the lower beds of the Juniper Gulch Member.

The Gallagher Peak Sandstone Member has been mapped locally in the Beaverhead Mountains and in the Lemhi and Lost River Ranges to the west. It is less than 30 m (100 ft) thick in exposures in the Arco Hills, and, like the sandstone of the Bluebird Mountain Formation, appears to thin to the west. It has not been recognized with certainty west of the southern Lost River Range, but it may be present. Reconnaissance mapping also suggests that the sandstone may not be laterally continuous everywhere. It may constitute a series of extensive lenses rather than one continuous bed.

Beds at or near the base of the member locally are fossiliferous and contain large brachiopods, pelecypods, both solitary and colonial corals, and bryozoans. J. T. Dutro, Jr. (written commun., 1975) identified *Thamnosia*? sp., *Kochiproductus*? sp. (very large specimens), and a pectenoid pelecypod fragment from the base of the member on Gallagher Peak (fig. 3, colln. 25634-PC). Dutro considers the forms to be of "Permian, or possibly latest Pennsylvanian" age, the same age determination made on colln. 25635-PC (fig. 3) from the uppermost beds of the Bloom Member, immediately below the type section of the Gallagher Peak Sandstone.

Fusulinids from within and just above the Gallagher Peak Sandstone Member in the type section include staffellid forms and small forms with a fusulinellid wall that suggest *Fusulinella* sp. A Middle Pennsylvanian age is suggested in the absence of any fragments suggesting a younger age. A fauna 51.8 m (170 ft) above the Gallagher Peak Member in the type section of the overlying Juniper Gulch Member, however, contains rare *Triticites* sp., which are assigned to the Upper Pennsylvanian (Missourian). In the Arco Hills, fusulinids collected about 65 m (213 ft) above the base of the Gallagher Peak are identified as *Eowaeringella* sp. of probable Missourian, but possibly latest Des Moinesian, age.

Faunal and stratigraphic evidence point to a Late Pennsylvanian age for the Gallagher Peak Sandstone Member, as Upper Pennsylvanian faunas are present both above and below the member.

JUNIPER GULCH MEMBER

The carbonate rocks of the Juniper Gulch Member gradationally overlie the Gallagher Peak Sandstone Member in the type section which is overturned and dips to the west 45° to 60° near Snaky Canyon (fig. 6). The member is named for Juniper Gulch which lies about 1 km (less than 1 mi) south of the type section (fig. 2).

The Phosphoria Formation conformably overlies the Juniper Gulch Member in the type area.

Reconnaissance mapping indicates that the member probably is present only in the southernmost parts of the Beaverhead Mountains and the southern Lost River and Lemhi Ranges. Rocks correlative with the Juniper Gulch have not been recognized in the southern Pioneer and White Knob Mountains.

The member is 597 m (1,960 ft) thick in the type section and consists of interbedded sandy and cherty, generally light-gray-weathering, thin- to thick-bedded limestone and dolomite. Light-gray to grayish-black chert in the form of nodules, beds, and complex networks forms as much as 40 percent of the interval in places. In the line of the measured section, dolomite makes up about two-thirds of the unit and is more abundant in the upper half. Some beds of sandy, ripple-marked dolomite, dolomite breccia, and conglomeratic (granule) dolomite are present. A medium-dark-gray, oolitic, ledge-forming, dolomite marker bed, 9 m (30 ft) thick, is present about 374 m (1,227 ft) above the base of the member in the type section. This lithology has been found as far west as the Arco Hills (fig. 2).

The base of the member contains some sandy beds just above the Gallagher Peak Sandstone Member, and the upper 141 m (463 ft) of the member below the Phosphoria is interbedded sandy limestone and dolomite and very fine grained calcareous or dolomitic sandstone.

The member is characterized by its generally light-colored weathering habit—medium to light gray, light olive gray, and light brown. It forms steep slopes or a series of alternating ledges and steep slopes. The lower part of the unit is thick to medium bedded, the upper part is thin to medium bedded.

The Juniper Gulch Member, in general, is much less fossiliferous than the Bloom Member. Beds rich in crinoidal debris are common in the lower part of the type section along with a few beds composed largely of crinoid stems, some of which are as much as 2 cm (0.8 in.) in diameter. Scattered fusulinids, gastropods, brachiopods, bryozoans, and both solitary and colonial corals are present throughout the member. Hydrozoans(?), calcareous phylloid algae, and encrusting foraminifers described from correlative strata in the Lemhi Range and Arco Hills to the west (Breuninger, 1976) are characteristic of the middle part of this member, and the algal-foraminiferal facies are present also in the type section in the southern Beaverhead Mountains in both the middle and upper parts.

Fusulinids were recovered from only the lower 58 m (190 ft) of the type section (fig. 3 and measured-section 1). *Fusulinella* sp. is present in the lower 18.3 m (60 ft) and *Triticites* sp. of Late Pennsylvanian (Missourian) age is present about 55 m (180 ft) above the base. *Eowaeringella* sp. is present in lower beds of the member in the Arco Hills area as discussed under the Gallagher Peak Sandstone Member.

Fusulinid faunas of Late Pennsylvanian and Early Permian age were collected from the Juniper Gulch Member in several areas.

Triticites sp. of Late Pennsylvanian (Virgilian) age is present within the Juniper Gulch Member in both the Arco Hills and the southern Lemhi Range. Several species of *Triticites* including *T.* cf. *meeki, T.* cf. *ventricosus*? and *T.* sp. were identified from beds correlative with the Juniper Gulch in the Arco Hills by the late L. D. Holcomb (*in* Breuninger, 1976, p. 585 and 587). Lower Permian (Wolfcampian) fusulinid faunas from the upper part of the Juniper Gulch include: (1) *Pseudofusulina* sp. identified by Douglass from the Arco Hills and near Bloom triangulation station in the Copper Mountain Quadrangle (figs. 1 and 2); (2) *Schwagerina* sp. from the Lemhi Range (Blackstone, 1954; Ross, 1961; Shannon, 1961) and the Arco Hills (Shannon, 1961; L. D. Holcomb *in* Breuninger, 1976; G. J. Verville, written commun., 1977), and (3) *Pseudoschwagerina* cf. *P. gerontica* Thompson collected and identified by G. J. Verville (written commun., 1977) from about 230 m (755 ft) above the highest hydrozoan(?) mound reported by Breuninger (1976) in his North Howe section in the Arco Hills area.

The age range of the member based on fusulinid faunas is, therefore, Late Pennsylvanian to Early Permian.

Brachiopod, coral, and gastropod faunas from the Juniper Gulch Member support a Late Pennsylvanian and Early Permian age for the member. Corals from the Pennsylvanian part of the member in the Arco Hills identified by W. J. Sando (written commun., 1976) include:

Caninia sp.
Caninia cf. *C. torquia* (Owen)
Multithecopora? sp.
Syringoporoid coral, undet.

The brachiopod *Linoproductus* sp., identified by J. T. Dutro, Jr. (written commun., 1976) from an Arco Hills collection, is "of [a] size and form [that] indicate an Upper Pennsylvanian (post-Des Moinesian) to Lower Permian (Wolfcampian) range."

Lower Permian coral faunas from the upper part of the Juniper Gulch in the Arco Hills and southern Lemhi Range identified by W. J. Sando (written communs., 1976, 1978) are *Durhamia* sp., *Heritschiella* sp., *Heritschoides* sp., *Multithecopora* sp., and *Syringopora* cf., *S. multattenuata* McChesney. A coral tentatively identified as *Heintzella*? sp. by W. J. Sando (written commun., 1978) was recovered from the middle part of the member in the southern Lemhi Range and may be of either Late Pennsylvanian or Early Permian age. The gastropod *Omphalotrochus* sp. which may belong to the species *O. whitneyi* Meek was identified by E. L. Yochelson (written commun., 1976) in an Arco Hills collection and assigned to the Lower Permian.

Carbonate buildups in the Juniper Gulch Member are composed largely of the hydrozoan(?) *Palaeoaplysina*, the calcareous phylloid alga *Eugonophyllum*, other phylloid algae, bryozoans, and less common gastropods, crinoids, brachiopods, and encrusting foraminifers. The mounds, dated by associated fusulinid faunas, span the Pennsylvanian-Permian boundary and consist, in part, of lenticular buildups which "stood topographically above the adjacent sea floor while they formed" (Breuninger, 1976, p. 584). The algal facies studied by Breuninger (1976) in the Lemhi Range and Arco Hills are also present in the southern Beaverhead Mountains, though not studied there.

The upper contact of the Juniper Gulch Member of the Snaky Canyon Formation with the overlying Phosphoria Formation was not observed in the southern Beaverhead Mountains in the area of the measured section (fig. 3), but is exposed in the southern Lemhi Range (Skipp and Hait, 1977) where it is abrupt and conformable.

OVERLYING UNITS

The Snaky Canyon Formation is overlain conformably by the Phosphoria Formation of Early Permian age. In the line of the measured section (figs. 2, 3, measured-section 1), the Phosphoria is about 86 m (282 ft) thick. The base is covered at this locality, but E. K. Maughan (written commun., 1975) identified 5 to 7 m (16–23 ft) of siltstone which he assigns to the Meade Peak Member of the Phosphoria in Snaky Canyon itself 1.6 km (1 mi) to the northwest. A thin Rex Chert Member of the Phosphoria may also be present there as it is in the Lemhi Range. Above the basal covered interval of the measured section, 17 m (56 ft) of interbedded limestone and dolomite, some of it cherty or sandy, and minor chert are assigned to the Franson Tongue (of the Park City Formation). Above the Franson is a covered interval, 35 m (115 ft) thick, with abundant subcrop of phosphorite, dolomite, and siltstone of the Retort Phosphatic Shale Member. The phosphorite is medium to dark gray or brownish gray, fine grained, oolitic, and sandy and silty in places. The dolomite is brownish gray, silty or sandy, and has oolitic phosphorite laminations and nodules. The siltstone is moderate yellowish brown to light reddish brown, sandy or muddy, laminated to thin bedded, with phosphatic laminations and lenses. Above the covered interval of the Retort is 27.4 m (90 ft) of the well-exposed ledge-forming Tosi Chert Member. The chert is grayish black to medium dark gray, mostly fine grained, thin to medium bedded (0.15–1.0 m, 0.5–3 ft), and is interbedded in the basal 3 m (10 ft) with dark-brownish-gray and medium-gray, oolitic, phosphatic limestone.

Incomplete sequences of the Phosphoria Formation are preserved in a graben in the southern Lemhi Range (Skipp and Hait, 1977). In this area,about 4.5 m (15 ft) of interbedded grayish-black chert and light-gray to medium-gray dolomite conformably overlie light-gray-weathering dolomite of the Snaky Canyon Formation. The chert is medium bedded (1 m, 3 ft) to irregularly (nodular) bedded and forms conspicuous ledges. The dolomite is fine grained with a few lenses of bioclastic material and contains nodules and lenses of phosphorite. The brachiopod *Orbiculoidea* sp. is present in all facies. The chert unit tentatively is assigned to the Rex Chert Member of the Phosphoria. The Rex(?) Chert Member is overlain by a minimum of 25 m (82 ft) of very dark gray organic-rich mudstone, coarse-grained oolitic phosphorite, and phosphatic siltstone (E. K. Maughan, written commun., 1979) similar to that described for the Retort Phosphatic Shale Member in the measured section near Snaky Canyon in the southern Beaverhead Mountains. The phosphorite and siltstone contain the brachiopods *Orbiculoidea* cf. *O. missouriensis* (Shumard) and *Cancrinella* cf *C. phosphatica* (Girty), "two species [that] occur commonly in the Meade Park Member of the Phosphoria Formation in southeast Idaho and western Wyoming" (J. T. Dutro, Jr., written commun, 1978).

Along Antelope Creek just west of measured-section 4 (fig. 1; Skipp and Hait, 1977), a minimum of 50 m (164 ft) of dark-gray thin-bedded argillaceous and silty limestone, some of it phosphatic, is present in a small graben. The contained fauna consists of brachiopods, bryozoans, and mollusks that indicate an Early Permian (probably Word equivalent) age for the sequence which is correlative with part of the Phosphoria Formation (Nelson and Ross, 1969a, b). In addition to the extensive faunal list in Nelson and Ross (p. 84–85), the following brachiopods were identified by B. R. Wardlaw (written commun., 1978) from the same collection:

Dielasmid form
Linoproductus? sp.
Orbiculoidea sp.
Peniculauris sp.
Waagenoconcha montpelierensis (Girty)

Additional brachiopod collections from the same locality identified by J. T. Dutro, Jr. (written communs., 1971, 1974) and B. R. Wardlaw (written commun., 1978) contain:

Cancrinella cf. *C. phosphatica* (Girty)
Echinoconchus cf. *E. inexpectatus* (Cooper)
Orbiculoidea sp.
Peniculauris sp.
Pterinopectinella? sp.
Spiriferinid form
Waagenoconcha cf. *W. montpelierensis* (Girty)

According to Wardlaw (written commun., 1978), both of these faunas indicate a latest Leonardian age for the sequence and equivalence to the Meade Peak Member of the Phosphoria in southwestern Montana and southeastern Idaho.

In the Snaky Canyon quadrangle (fig. 2), the Phosphoria Formation is overlain, presumably conformably (the contact is not exposed), by 54.9 m (180 ft) of poorly exposed interbedded light- to moderate-brown calcareous siltstone and pale-olive-gray and yellowish-brown shale, micaceous in places, of the Triassic Dinwoody Formation (figs. 3 and 6). This is the westernmost recognized outcrop of Triassic rocks west of the Medicine Lodge thrust zone (Embree and others, 1975; Skipp and Hait, 1977; Ruppel, 1978) north of the Snake River Plain in Idaho. Fragments of Dinwoody lithologies, however, have been found by Skipp in Tertiary gravels in the southern Lemhi Range.

Gently tilted rhyolitic welded tuffs of Pliocene(?) age unconformably overlap overturned Triassic beds in the southern Beaverhead Mountains (H. J. Prostka, written commun., 1976).

PALEOTECTONIC SIGNIFICANCE

The present distribution of the formations discussed in the preceding sections has been determined by post-Paleozoic tectonic events, particularly eastward thrusting of late Mesozoic and early Tertiary age and major block faulting (basin-and-range) of later Tertiary and Quaternary age. The units are all allochthonous, having been transported eastward and internally deformed along several major thrusts (Scholten and others, 1955; Scholten and Ramspott, 1968; Skipp and Hait, 1977; Ruppel, 1978). They are assumed to be preserved in their relative geographic depositional positions, even though much of the record has been destroyed or is unavailable.

The Arco Hills and Big Snowy Formations record an influx of fine-grained cratonic terrigenous material, largely clay and silt, into south-central Idaho which, in the Beaverhead Mountains, interrupted Late Mississippian carbonate-bank buildup (Rose, 1976) possibly as early as early Chesterian time. West of the area of Big Snowy deposition, carbonate buildup recorded in the thick- bedded pure limestones of the Surrett Canyon Formation and the White Knob Limestone continued into late Chesterian time. In latest Chesterian time, fine-grained terrigenous material present in the Arco Hills Formation spread as far west as the Lost River Range. Carbonate deposition continued without major interruption west of the Lost River Range in the White Knob Mountains.

Upper Mississippian strata preserved in the western overlying Copper Basin allochthon (fig. 1, Skipp and Hait, 1977) include a few shallow-water limestone and dolomite lenses, and coaly beds which indicate that by middle to late Chesterian time, flysch sedimentation had ceased in much of the area of the former deepwater flysch trough (Nilsen, 1977; Skipp and Hait, 1977; Skipp and others, 1979).

The uppermost Mississippian Bluebird Mountain Formation which overlies the Big Snowy and Arco Hills Formations also overlies the White Knob Limestone (fig. 4). The very fine grained craton-derived sandstones of the Bluebird Mountain thin westward, and though the evidence has been removed by erosion and thrusting, the sandstones of the Bluebird Mountain Formation may have overlapped some of the Copper Basin terrane, completing the demise of the flysch trough and marking the end of the Antler orogenic highland described by Poole (1974) and Poole and Sandberg (1977) in this part of Idaho.

As the Antler orogenic belt subsided and deposition ceased in the area of the flysch trough, the thick wedge of flysch deposits of the Copper Basin Formation began to rise, probably due to thrusting or block faulting (Skipp and others, 1979). By Middle Pennsylvanian time, parts of the Copper Basin terrane were emergent and being eroded. Westward-thinning proximal turbidites composed of reworked Copper Basin orogenic detritus are present in easternmost allochthonous exposures of the Wood River Formation (Skipp and Hall, 1975a). To the east, the presence of the Copper Basin highland (Skipp and others, 1979) is recorded in the medium- to coarse-grained chert and quartzite sandstones and conglomerates in the Pennsylvanian parts of the Snaky Canyon Formation in the White Knob Mountains area. Orogenic material of this kind is not present in the Snaky Canyon Formation east of the White Knob Mountains.

More indirect evidence for the Copper Basin highland is present in the *Palaeoaplysina*-algal mounds in the Pennsylvanian and Lower Permian Juniper Gulch Member of the Snaky Canyon Formation according to Breuninger (1976, p. 604), who hypothesizes a protective "local tectonic uplift directly west and northwest of the buildup area." Because beds correlative with the Juniper Gulch Member of the Snaky Canyon Formation have not been identified west of the Lost River Range-Arco Hills area, it may be that the area of the White Knob Mountains itself was high during latest Pennsylvanian and part of Early Permian time and formed the eastern part of an uplift immediately west of the *Palaeoaplysina*-algal-mound buildups.

Evidence of the Copper Basin highland is also present south of the Snake River Plain in the northern Sublett Range where southward-thinning chert-pebble and granule conglomerates are present in the Pennsylvanian part of the Oquirrh Formation (R. L. Armstrong, written commun., 1977; Skipp and others, 1979).

The Copper Basin highland remained a source for detritus in the Wood River Formation in the Fish Creek Reservoir area (fig. 1) at least as late as Late Pennsylvanian time (Skipp and Hall, 1975a). The highland probably was the major physiographic feature which separated the two Permian-Pennsylvanian depocenters of south-central Idaho—the Wood River basin on the west, and the Snaky Canyon carbonate bank on the east (Skipp and others, 1979).

The Wood River basin developed slightly later (Des Moinesian, possibly Atokan time) and received more than twice as much sediment (more than 3,000 m or 9,850 ft vs. 1,300 m or 4,265 ft) as the Snaky Canyon area during Pennsylvanian and Permian time. The bulk of the terrigenous detritus, however, in both areas consists of very fine grained quartz sand and silt that probably had northeastern and (or) southern cratonic sources.

The lower three units of the Wood River Formation (fig. 4), excluding the basal conglomerate facies, are largely sandy and silty limestone with interbedded very fine grained calcareous sandstone quite similar to the lithologies of the upper part of the Bloom Member and the Gallagher Peak Sandstone Member of the Snaky Canyon Formation and approximately the same age, though Upper Pennsylvanian (Missourian) faunas have not been found in the Wood River Formation. The Juniper Gulch Member of the Snaky Canyon Formation is about the same age as units 4 through 6 of the Wood River Formation (fig. 4), but there is little lithologic resemblance. Thick sequences of very fine grained sandstone and sandy limestone with abundant fusulinid faunas characterize the Wood River (Umpleby and others, 1930; Bostwick, 1955; Hall and others, 1974), whereas sandy and cherty carbonate-bank facies including hydrozoan(?) and phylloid algal buildups, oolitic carbonate sand, and laminated dolomites make up much of the Juniper Gulch Member. Stevens (1971) in a study of Middle Pennsylvanian rocks in Colorado concluded that phylloid algae thrived in water depths of 5 to 7 m (16–23 ft), whereas fusulinid foraminifers preferred water depths of 15 m (50 ft) or slightly more. The hydrozoan(?) *Palaeoaplysina* buildups probably formed in the uppermost subtidal zone (Breuninger, 1976). Laminated dolomites and sandstones and dolomite breccias may represent stromatolitic deposits formed in intertidal environments. In general, therefore, the Wood River basin was characterized by deeper water environments and greater subsidence than the Snaky Canyon carbonate-bank area.

Facies of the Phosphoria equivalent rocks in the southern White Knob Mountains suggest that the area of the Copper Basin highland may have continued to have an influence on sedimentation patterns into latest Early Permian time. Thin-bedded silty and argillaceous limestones containing abundant mollusks and brachiopods indicate deposition within a normal marine basin of shallow or moderate water depths. There is no evidence of westward-derived orogenic detritus in these rocks, however.

Correlative strata in the Wood River Formation appear to have had deeper water origins; they include unit 7 and possibly, unit 8. Unit 7 consists of interbedded banded dark-gray chert and gray sandy limestone (Hall and others, 1974, p. 94), and unit 8 is a thick sequence (possibly 1,770 m or 5,800 ft) of interbedded gray and brown siltstone, siltite, quartzite, and dark-gray silicious argillite that contains locally abundant worm tubes, and minor silty and sandy limestone beds (Hall and others, 1978). The units are poorly fossiliferous with sparse trace fossils, radiolarians, and foraminifers.

The Copper Basin highland in the relative position of the present Copper Basin allochthon, therefore, contributed minor amounts of detritus to depocenters in central and southern Idaho through Middle and Late Pennsylvanian time. Its role in Early Permian time is less well defined, but hydrozoan and algal mounds in the Lower Permian part of the Juniper Gulch Member in the southern Lost River and Lemhi Ranges require a protective highland on the west and northwest (Breuninger, 1976) in the general position of the Copper Basin highland. Relatively shallow-water facies of Phosphoria equivalent rocks in the White Knob Mountains contrasted with the deeper water sediments of correlative parts of the Wood River Formation suggest that the highland may have remained a physiographic barrier in central Idaho as late as latest Early Permian time.

MEASURED SECTIONS

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*

[All of the strata including the overlying Phosphoria and Park City Formations and an incomplete section of the Dinwoody Formation (figs. 2 and 3, sec. 1) were measured in sec. 21, T. 9 N., R. 32 E., Clark County, Idaho. Members of the Snaky Canyon Formation and the Dinwoody Formation were measured by Betty Skipp, Linda Riglin, and James Davis in August 1974 and June 1976. The Phosphoria and Park City Formations were measured by Peter Oberlindacher and R. D. Hovland in August 1976].

	Thickness in meters	*feet*
Welded tuffs (Pliocene?): contact with Dinwoody Formation is angular unconformity	5.0+	16+
Total incomplete welded tuff section	5.0+	16+
Dinwoody Formation (Triassic) (incomplete):		
Siltstone and shale, poorly exposed.		
Siltstone, light-brown, medium-brown, and dark yellowish orange, calcareous, weathers dark-yellowish orange, thin bedded. Shale, pale olive, yellowish brown, some micaceous. Forms slope	36.6	120
Covered interval	18.3	60
Total thickness incomplete Dinwoody Formation	54.9	180

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*—Continued

	Thickness in meters	feet
Phosphoria Formation (Permian):		
Tosi Chert Member:		
Chert and limestone. Chert, grayish-black to medium-dark-gray, fine- to coarse grained, thin- to medium-bedded (0.15-1 m or 0.5–3 ft). Limestone in basal 3 m (10 ft), dark-brownish-gray, medium-gray, phosphatic, oolitic. Member forms low ledge	27.4	90
Total thickness Tosi Chert Member	27.4	90
Retort Phosphatic Shale Member:		
Phosphorite, siltstone and dolomite, mostly covered. Phosphorite in float, brownish gray, medium-gray to dark-gray, fine grained, oolitic, pelletal and nodular, sandy in places, fetid odor, weathers light reddish brown with bluish-white bloom on surface. Siltstone, moderate yellowish-brown, light-reddish-brown, pale-reddish-gray, sandy in places, argillaceous in places, laminated to thin-bedded, calcareous in places, phosphatic laminations and lenses. Dolomite, brownish-gray to pale-brown, sandy and silty, oolitic phosphatic laminations and reworked fragments and nodules, weathers very pale brown	35.0	115
Total thickness Retort Phosphatic Shale Member	35.0	115
Park City Formation (Permian):		
Franson(?) Tongue:		
Limestone, chert, and dolomite.		
Limestone, medium-gray, sandy in places, fossiliferous, weathers to light brownish gray, thick-bedded. Chert, dark-gray, sandy in places, in nodules, lenses, and beds (5–29 cm or 2–9.5 in. in thickness), present only in upper and lower parts. Dolomite, medium-gray, sandy, interbedded with chert. Unit forms irregular ledges	17.0	56
Total thickness Franson(?) Tongue	17.0	56
Covered interval (Meade Peak? Member of Phosphoria Formation)	7.0	23
Total thickness covered interval	7.0	23
Total thickness Phosphoria and Park City Formations	86.4	284
Snaky Canyon Formation (Permian to Mississippian):		
Juniper Gulch Member (Lower Permian to Upper Pennsylvanian):		
24. Covered interval. Float limestone and dolomite	14.0	46
23. Dolomite and sandstone. Dolomite, medium light-gray, sandy, (fine-grained quartz), fossiliferous (phylloid algae, gastropods, tubular foraminiferas), porous, medium-bedded. Sandstone, dark-gray, quartzose, calcareous, very fine grained. Forms ledges	15.2	50

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*—Continued

	Thickness in meters	feet
22. Sandstone, quartzose, calcareous, and sandy limestone. Sandstone, pale yellowish-brown, light-olive-gray, very fine grained, weathers light brown and orange, thin-bedded to laminated. Sandy limestone, light gray. Forms slope	21.3	70
21. Limestone and sandstone. Limestone, medium-gray, light-gray, medium grained, sandy streaks, phylloid algae, weathers medium light gray, medium-bedded (0.3 m or 1 ft). Sandstone, calcareous, quartzose, medium-gray, very fine grained, forms thin beds. Forms ledges	11.0	36
20. Limestone, dolomite, dolomitic limestone, and sandstone. Limestone and sandstone in upper 10.3 m (34 ft) similar to unit 21. Lower 12.2 m (40 ft) partly covered interval with ledges of dolomite, light-gray to medium gray, fine-grained, and medium gray dolomitic limestone. Forms upper ledge and lower slope	22.5	74
19. Dolomite, dolomite breccia, and dolomitic sandstone, 50 percent exposed. Dolomite, medium-gray, moderate-yellowish-brown, pale-red, mottled yellowish-brown and medium-gray near top, fine-grained to conglomeratic (granule), sandy in places (very fine to medium-grained quartz), weathers medium light gray, moderate yellowish brown, and pale red, thin-to medium-bedded (0.03–0.6 m or 1–2 ft). Dolomite breccia, fragments of laminated dolomite in sandstone matrix. Dolomitic sandstone, medium gray, quartzose, very fine grained. Unit forms low ledges	34.1	112
18. Sandstone, dolomitic, light-gray, very pale yellowish brown, light-brown, medium-olive-gray, quartzose, very fine to fine-grained, laminated in part, ripple-marked, weathers light gray to pale red, thin- to medium bedded (0.15–0.3 m or 0.5–1 ft), forms slope	10.7	35
17. Dolomite, sandstone, and sandy limestone. Dolomite at top, medium-gray, sandy, very fine grained. Sandstone, light gray to yellowish-orange, quartzose, calcareous, fine-grained to very fine grained, friable. Limestone, sandy, light gray, grayish-orange-pink, yellowish-gray, in part mottled light gray and yellowish brown. Unit thin to medium bedded, forms slope	12.2	40
16. Covered interval. Subcrop is dolomitic limestone, medium-dark-gray with boxwork chert, weathers medium gray. Doubly terminated quartz crystals in float	73.2	240
15. Dolomite, medium-dark-gray, oolitic, medium- to very coarse grained, calcareous in places, weathers medium light gray and light olive gray, thick-bedded, forms cliff	9.1	30

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*—Continued

	Thickness in meters	feet
14. Limestone, dolomitic, and dolomite, light gray to dark-gray, 30–50 percent exposed, fine-grained, cherty zones; chert, medium-gray, weathers yellowish brown, as much as 20 percent of interval in places, in beds 0.07 to 0.14 m (0.25–0.5 ft) thick; weathers medium light gray, medium-to thick bedded (as much as 3 m or 10 ft), forms alternating ledges and slopes	53.3	175
13. Covered interval. Subcrop is calcareous sandstone or dolomitic limestone, light-gray and light-brownish-gray, weathers light gray, thin-bedded, forms slope.	13.4	44
12. Dolomite, medium-gray to medium-dark gray, fine- to medium-grained, scattered grayish-black chert nodules which weather yellowish brown, fossiliferous in upper one-half (crinoid columnals, corals, algae, bryozoans), crinoidal debris common throughout, thick-bedded, forms ledge or cliff	35.3	116
11. Dolomite, calcareous, medium-gray to medium-light-gray, coarse-grained, some fine-grained, few light-brown weathering chert nodules, small silicified corals, weathers medium light gray, thick-bedded to massive (average 3 m or 10 ft), forms ledge	7.6	25
10. Dolomite, calcareous, medium-gray to light-gray, coarse- to fine-grained, light-brown-weathering chert nodules in upper part, weathers medium light gray, thick-bedded, forms ledge	13.0	43
9. Dolomite, calcareous, medium-gray to light-gray, coarse-grained, fossiliferous (crinoid columnals, hydrozoans(?), phylloid algae, gastropods), weathers medium light gray, thick-bedded, forms ledges	21.0	68
8. Dolomite similar to unit 10	13.7	45
7. Dolomite, calcareous, medium-gray to light-gray, coarse-grained, fossiliferous (phylloid algae, foraminifers), weathers medium light gray, thick-bedded, forms ledges	7.2	24
6. Limestone, light-gray to medium-gray, medium-grained, some crinoidal debris present, breccia near top, vuggy-weathering, weathers yellowish gray, light gray, and pale reddish gray, thick-bedded, 50 percent covered, forms swale	47.2	155
5. Dolomite, calcareous, and dolomitic limestone, medium-light-gray to dark-gray, fine- to medium-grained, fossiliferous (much crinoid detritus, one coral in float, bryozoans), scattered medium-gray to medium light-gray chert in blebs, nodules, and irregular layers which weather pinkish or yellowish brown; weathers medium light gray with rough surface, thick-bedded (1.5–1.8 m or 5–6 ft), 80 percent exposed, forms series of irregular steps	46.6	153

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*—Continued

	Thickness in meters	feet
4. Covered interval. Subcrop is sandy limestone, calcareous sandstone, and minor breccia. Calcareous sandstone weathers light brown, forms slope	29.0	95
3. Dolomite, calcareous in places, and chert. Dolomite, medium-gray to medium-light-gray, weathers yellowish gray or light gray, medium-bedded (0.06–0.3 m or 0.2–1 ft). Chert, light-gray to medium-gray, weathers light gray, thin-bedded (0.07–0.14 m or 0.25–0.5 ft), forms low ledge	28.6	94
2. Limestone, medium-gray, fine-grained with some fossil hash, fossiliferous (phylloid algae, bryozoans, fusulinid and other Foraminifera, and ostracodes), sandy streaks present, weathers medium gray, forms ledge. Fusulinid and other Foraminifera are *Triticites* sp., globivalvulinid and endothyrid forms (USGS colln. f13895)	6.0	20
1. Covered interval. Float is sandy limestone and very fine grained calcareous sandstone. Float from lower 18.3 m (60 ft) contains fragments of fusulinids that suggest *Fusulinella* sp. (USGS colln. f13723), crinoid debris, brachiopods, and bryozoans	51.8	170
Total thickness Juniper Gulch Member	597.0	1960
Gallagher Peak Sandstone Member (Upper Pennsylvanian):		
Sandstone and limestone (poorly exposed). Sandstone, medium-gray, medium-light-gray, pale-grayish red, grayish-orange, very fine grained to fine-grained, weathers medium light gray, light olive gray and light brown, thin- to medium bedded. Limestone, sandy, medium gray, medium-bedded. Microfaunas from near the middle of member contain a small form with fusulinellid wall (USGS colln. f13933) *Earlandia* spp., *Globivalvulina* sp., *Eotuberitina* sp., and fragments of echinoderms, trilobites, and mollusks. A collection from 5 m (15 ft) above base contains staffellid forms and small forms with fusulinellid wall (USGS colln. f13894) ?*Climmacammina* sp. and pelmatazoan, bryozoan, and trilobite debris	59.4	195
Total thickness Gallagher Peak Sandstone Member	59.4	195
Bloom Member, part (Upper Pennsylvanian to uppermost Mississippian):		
Limestone, medium-dark-gray, sandy, fine grained. Corals, brachiopods, and bryozoans collected from this locality (USGS colln. 25635-PC). Corals identified by W. J. Sando (written commun., 1975) are *Multithecopora* cf. *M. hypatiae* Wilson, *Caninia* sp., and *Dibunophyllum*? sp. Bryozoans identified by O. L. Karklins (written com-		

SECTION 1.—*Type section of the Gallagher Peak Sandstone and Juniper Gulch Members of the Snaky Canyon Formation*—Continued

	Thickness in meters	*feet*
mun., 1975) are *Ascopora*? sp., *Rhabdomeson* sp., *Rhombotrypella* sp., and stenoporid, indet. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1975) are *Waagenoconcha* sp., productoid fragment, and punctate spiriferoid, and also indeterminate echinoderm debris ..	3.0	10
Incomplete thickness of Bloom Member	3.0	10

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*

[Measured in secs. 29 and 30 (unsurveyed), T. 10 N., R. 31 E., Clark County, Idaho, on east side of saddle between Copper Mountain and Gallagher Peak (figs. 2 and 3, sec. 2). Base of section at approximately 2,865 m (9,400 ft) elevation. Part of section may be repeated by local faulting. Includes a partial section of the Big Snowy Formation. Measured by R. D. Hoggan, G. F. Embree, and E. J. Williams in June 1974]

	Thickness in meters	*feet*
Snaky Canyon Formation, part (Upper Pennsylvanian to uppermost Mississippian):		
Gallagher Peak Sandstone Member (Upper Pennsylvanian) (incomplete):		
Sandstone and sandy limestone. Sandstone, light brownish-gray, light-olive-gray, quartzose, calcareous, very fine grained, weathers pale yellowish brown, thin-bedded. Sandy limestone in lower part like unit 67 below. Forms talus slope interspersed with thin ledges on summit of Gallagher Peak. Corals present near base. Brachiopods and pelecypods from base of unit include *Thamnosia*? sp., *Kochiproductus*? sp. (very large specimens), and pectenoid pelecypod fragments (USGS colln. 25634-PC, identified by J. T. Dutro, Jr., written commun., 1975)	26.1	85
Total thickness incomplete Gallagher Peak Sandstone Member	26.1	85
Gradational contact.		
Bloom Member (Upper Pennsylvanian to uppermost Mississippian):		
68. Limestone, gray, medium-grained, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), incipient chert nodules, forms cliff	1.5	5
67. Limestone, medium-dark-gray, sandy (as much as 50 percent fine-grained quartz in some units), fine-grained, weathers medium dark gray, thin- to medium bedded (0.05–0.3 m or 2 in.–1 ft), stylolites, forms cliffs. The coral *Caninia*? sp. (USGS colln. 25633-PC) was identified by W. J. Sando (written commun., 1975) from lower part of unit	24.4	80
66. Limestone, gray, microcrystalline, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	6.1	20

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	*feet*
65. Limestone, gray, medium-grained, weathers gray, incipient chert nodules present, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	9.1	30
64. Limestone, gray, microcrystalline, sparry fragments, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	3.0	10
63. Limestone, gray, medium-grained, incipient chert nodules present, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	9.1	30
62. Sandstone, gray, quartzose, calcareous, very fine grained, grains subrounded, well sorted, weathers pale yellowish brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	4.6	15
61. Limestone, gray, medium-grained, incipient chert nodules present, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	9.1	30
60. Sandstone, gray, quartzose, calcareous, very fine grained, grains subrounded, well sorted, weathers pale yellowish brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff	10.7	35
59. Limestone, gray, microcrystalline, weathers light gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	1.5	5
58. Limestone, gray, medium-grained, incipient chert nodules present, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	7.6	25
57. Sandstone, medium-light-gray, quartzose, calcareous, very fine grained, grains subrounded, well-sorted, thin-to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	1.5	5
56. Limestone, gray, medium-grained, incipient chert nodules present, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	7.6	25
55. Limestone, gray, fine grained, fossiliferous, weathers light gray, contains chert nodules 2–3 cm (1 in.) in diameter, thin to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms slope. Fusulinids are *Fusulinella* sp. (USGS colln. f13725). Bryozoans include *Archimedes* sp., "probable new species that is somewhat similar to *A. gillulyi* Condra and Elias, 1944," (USGS colln. 26315–PC) identified by O. L. Karklins (written commun., 1976)	1.5	5
54. Limestone, gray, microcrystalline, brecciated, weathers gray, forms ledge	1.5	5
53. Limestone, gray, medium-grained, incipient chert nodules present, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	9.1	30
52. Limestone, gray, microcrystalline, brecciated, weathers light gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	4.6	15

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
51. Limestone, sandy, gray, medium-grained, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff. Lower part pelletal with oncolites. Fusulinids in lower part identified as early *Beedeina* sp. (USGS colln. f13724)	19.8	65
50. Sandstone, gray, quartzose, calcareous, very fine grained, grains subrounded, well-sorted, weathers pale yellowish brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	1.5	5
49. Limestone, gray, medium- to coarse-grained, crinoid detritus, incipient chert nodules present, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	9.1	30
48. Limestone, gray, fine grained, contains chert nodules 2–3 cm (1 in.) in diameter, contains twiggy bryozoans, weathers light gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms slope	3.0	10
47. Limestone, gray, medium-grained, contains incipient chert nodules, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	24.4	80
46. Limestone, gray, slightly sandy (very fine grained quartz), microcrystalline, brecciated, fossiliferous, weathers gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff. Microfauna includes pseudostaffellid? and fusulinellid? forms, *Millerella*? sp., and textularid forms (USGS colln. f13892) and *Globivalvulina* sp. Pelmatazoan and bryozoan fragments common	4.6	15
45. Limestone, gray, medium grained, much crinoid debris, contains incipient chert nodules, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	19.8	65
44. Sandstone, gray, quartzose, calcareous, very fine grained, well-sorted, weathers pale yellowish brown, thin to medium-bedded (0.05–0.3 m or 2 in.–1 ft) forms ledge	1.5	5
43. Limestone, gray, medium-grained, sandy (very fine grained quartz), much pelmatazoan and bryozoan debris, incipient chert nodules in upper part and chert nodules in lower part, medium bedded (0.3–0.6 m or 1–2 ft) forms cliff. Foraminifera from upper part (USGS colln. f13891) include *Millerella*?, textularids (?*Climmacammina* sp.), and small forms with fusulinellid wall, some fairly straight septa, heavy chomata	15.2	50
42. Sandstone, gray, quartzose, quartzitic, very fine grained, well-sorted, weathers gray and pale yellowish brown, microcrossbedding, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft) forms ledge	6.1	20

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
41. Limestone, gray, medium-grained, contains chert nodules 5 cm, (2 in.) in diameter, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	10.7	35
40. Sandstone and thin interbedded limestone. Sandstone, gray, quartzose, quartzitic, very fine grained, well-sorted, weathers gray to pale yellowish brown, microcrossbedding, slabby-bedded, forms slope. Limestone interbed, gray, thin, contains syringoporoid corals (USGS colln. 26313–PC) identified by W. J. Sando (written commun., 1976) as *Multithecopora* cf. *M. hypatiae* Wilson	7.6	25
39. Limestone, gray, medium-grained, contains incipient chert nodules, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms ledge	3.0	10
38. Sandstone, gray, quartzose, quartzitic, very fine grained, well-sorted, weathers pale yellowish brown, slabby-bedded, forms slope	3.0	10
37. Limestone, gray, medium-grained, contains incipient chert nodules, much pelmatazoan, some bryozoan and arthropod debris, syringoporid coral heads common, weathers light gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff. Microfauna (USGS colln. f13890) includes stacheiid algae, tubular foraminifers, and small *Fusulinella* sp., and *Globivalvulina* sp.	9.1	30
36. Sandstone, gray, quartzose, calcareous, very fine grained, very well sorted, contains incipient chert nodules, weathers gray and pale yellowish brown, laminated, thin-bedded, forms ledge	3.0	10
35. Limestone, gray, medium-grained, contains incipient chert nodules, some with long axis perpendicular to bedding, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft) forms cliff	36.6	120
34. Sandstone, gray, quartzose, calcareous, fine grained, well sorted, weathers gray, laminated with cross laminations, forms ledge. Foraminifera (USGS colln. f13889) include *Tuberitina* sp., endothyrid forms and small forms with profusullinid-fusulinellid wall	3.0	10
33. Limestone, gray, medium grained, weathers gray, contains minor incipient chert nodules in lower part, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft) forms cliff. Possible fault with minor displacement in lower beds	21.3	70
32. Limestone, gray, medium grained, incipient chert nodules with vertical annular rings as much as 20 cm (8 in.) in length, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	12.2	40
31. Limestone, gray, medium-grained, incipient chert nodules, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft) forms cliff	12.2	40

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
30. Limestone, gray, sandy (very fine grained quartz) and silty, medium-grained, large productid and spiriferid brachiopods in lower part, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff. Microfauna (USGS f13888) includes small forms with profusulinellid-fusulinellid wall and pelmatazoan, bryozoan and brachiopod debris	21.3	70
29. Limestone, gray, fine grained, weathers gray, slabby bedded, forms slope	1.5	5
28. Limestone, gray, medium-grained, fossiliferous (crinoid columnals, tetracorals, and bryozoans), weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	16.7	55
27. Limestone, gray, medium-grained, incipient chert nodules, basal beds sandy, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	13.7	45
26. Sandstone, gray, quartzose, calcareous, very fine grained, well sorted, black and brown chert associated with incipient chert nodules, small brachiopods in some units, weathers light gray, thin-bedded, forms slope	9.1	30
25. Limestone, gray, medium-grained, black chert and incipient chert nodules, stylolites, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	13.7	45
24. Sandstone, gray, quartzose, calcareous, medium-grained, subrounded, moderate sorting, weathers gray and light brown, crossbeds with 7.6-cm (3 in.) sets, thin to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms slope	3.0	10
23. Limestone, medium-gray to medium-dark gray, medium-grained, silty and sandy (very fine grained to fine-grained quartz), pelmatazoan, bryozoan, ostracod debris, some foraminifers, chert in beds and nodules, incipient chert nodules, weathers medium light gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	22.9	75
22. Sandstone, gray, quartzose, calcareous, very fine grained, well-sorted, 30-percent light-gray chert nodules, weathers pale yellowish brown, thin-bedded, forms ledge	1.5	5
21. Limestone, medium-gray to medium-light gray, medium-grained, chert and incipient chert nodules, some 3-cm-(about 1 in.) thick sandstone stringers, stromatolites, and large (1.3 cm or 0.5 in. in diameter) crinoid columnals, weathers medium light gray and pale yellowish brown, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	16.8	55

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
20. Sandstone, gray, quartzose, calcareous, very fine grained, subrounded, well sorted, weathers pale yellowish brown, medium-bedded (0.3–0.6 m or 1–2 ft) forms ledge	1.5	5
19. Limestone, gray, medium-grained, chert and incipient chert nodules, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	7.6	25
18. Siltstone, gray, weathers light brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft) forms ledge	1.5	5
17. Limestone, gray, medium grained, chert and incipient chert nodules, syringoporid corals in middle of unit, weathers gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	22.9	75
16. Sandstone, gray, quartzose, calcareous, very fine grained, subrounded, well sorted, weathers pale yellowish brown, laminated, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	3.0	10
15. Limestone, light-gray, fine-grained, incipient chert nodules, scattered fossil fragments, weathers light gray and medium light gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	15.2	50
14. Sandstone, gray, quartzose, calcareous, very fine grained, subrounded, well sorted, weathers light yellowish brown, laminated, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	1.5	5
13. Limestone, medium-dark-gray, medium grained, sandy (very fine grained quartz), chert and incipient chert nodules, large brachiopods, pelmatazoan and bryozoan debris, stromatolites, Foraminifera (*Earlandia* sp., *Endothyra* sp., and *Climmacammina* cf. *C. moelleri*), F. Z. 21?, weathers medium gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	16.8	55
12. Covered interval	6.1	20
11. Limestone, gray, very fine grained, incipient chert nodules and 5-cm (2 in.) thick chert beds, fossiliferous (crinoid columnals, bryozoan debris, stromatolites), weathers gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff	35.0	115
10. Limestone, medium-light-gray, fine grained, sandy (as much as 30 percent very fine grained quartz), pelmatazoan and bryozoan debris, stromatolites, ?*Eostaffella* sp., weathers medium light gray, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	4.6	15
9. Limestone, gray, medium-grained, incipient chert nodules, weathers gray, medium bedded (0.3–0.6 m or 1–2 ft), forms cliff	18.3	60

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
8. Sandstone, gray, quartzose, calcareous, very fine grained, well-sorted, incipient chert nodules and beds, stromatolites, weathers pale yellowish brown, thin-bedded, forms ledge	3.0	10
7. Limestone, medium-dark-gray, medium grained, sandy (as much as 15 percent medium-grained quartz with overgrowths), stromatolites, algae (*Osagia* sp., stacheiids), foraminifers (*Biseriella* sp., *Endothyra* sp., *Zellerina* sp.), weathers medium gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	1.5	5
6. Sandstone, gray, quartzose, calcareous, very fine grained, subrounded, well sorted, weathers pale yellowish brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft) forms ledge	1.5	5
5. Limestone, medium gray, fine grained, sandstone stringers (silt to medium grained quartz), incipient chert nodules, pelmatazoan, brachiopod, gastropod, ostracod, and bryozoan debris, foraminifers from base of unit (*Asteroarchaediscus* sp., encrusting tubular foraminifers, *Neoarchaediscus* sp., ?*Planospirodiscus* sp.), F. Z. 20?, algae (*Asphaltina* sp., *Osagia* sp.) from the lower 6.1 m (20 ft), weathers medium gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	24.4	80
4. Sandstone, gray, quartzose, calcareous, very fine grained, well-sorted, weathers pale yellowish brown, thin bedded, forms ledge	1.5	5
3. Limestone, medium-gray, fine-grained, sandy, some in stringers (very fine grained quartz, well sorted), pelmatazoan and brachiopod debris, algae (*Osagia* sp.), foraminifers representative of F. Z. 19 ("*Eosigmoilina*" *rugosa* Ganelina, *Zellerina* sp.), weathers medium gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft) forms cliff	12.2	40
2. Sandstone, gray, quartzose, calcareous, very fine grained, well-sorted, weathers pale yellowish brown, medium-bedded (0.3–0.6 m or 1–2 ft) forms ledge	1.5	5
1. Limestone, gray, microcrystalline, chert nodules and thin (5 cm or 2 in.) beds, bryozoans and shell debris, weathers gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff	7.6	25
Total thickness Bloom Member	646.6	2,125
Total composite thickness of three members Snaky Canyon Formation	1,303.0	4,280

Gradational contact.

Bluebird Mountain Formation (uppermost Mississippian):

16. Sandstone, medium-light-gray, quartzose, calcareous, very fine grained, well-sorted, weathers grayish orange, thin-bedded (0.05–0.3 m or 2 in.–1 ft), forms

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
slope. Thin gray limestone interbed	4.6	15
15. Limestone, medium-dark-gray, fine to coarse-grained, dark-gray chert nodules 10 cm (4 in.) in diameter, slightly sandy (very fine grained quartz), bryozoan, brachiopod, and crinoid debris, Foraminifera (*Biseriella* sp., *Endothyra* sp., ?*Hemiarchaediscus* sp., *Zellerina* of the group *Z. discoidea* (Girty, 1915), weathers medium dark gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms ledge	1.5	5
14. Covered interval	16.8	55
13. Sandstone, light-gray, quartzose, quartzitic, very fine grained, well sorted, upper 3 m (1 ft) contains siliceous nodules 10–13 cm (4–5 in.) in diameter, weathers light gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	7.6	25
12. Covered interval	9.1	30
11. Sandstone, light-gray, quartzose, quartzitic, very fine grained, well-sorted, weathers light brown, thin to medium bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	1.5	5
10. Covered interval	9.1	30
9. Limestone, medium-gray, fine-grained, medium-dark-gray chert nodules 2–3 cm (1 in.) in diameter, weathers medium gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms ledge	1.5	5
8. Sandstone, medium-gray, quartzose, quartzitic, some calcareous, fine grained, subrounded, very well sorted, siliceous nodules, weathers light olive gray, crossbedded with 15-cm (6-in.) sets, medium-bedded (0.3–0.6 m or 1–2 ft) forms cliff	3.0	10
7. Sandstone, light-gray, quartzose, quartzitic, very fine grained, well sorted, weathers light brown, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff	9.1	30
6. Siltstone, gray, quartzose, quartzitic, thin chert beds, weathers brown, medium bedded, forms cliff	1.5	5
5. Sandstone, light-gray, quartzose, quartzitic, very fine grained, well sorted, weathers light brown, thin- to medium-bedded (0.5–0.3 m or 2 in.–1 ft) forms cliff	15.2	50
4. Dolomite, gray, coarsely crystalline, weathers light brown, thin bedded, forms cliff	1.5	5
3. Sandstone, medium-light-gray, quartzose, quartzitic, very fine grained, well sorted, weathers medium olive gray, thin- to medium-bedded (0.05–0.3 m or 2 in.–1 ft), forms cliff	4.6	15
2. Covered interval	7.6	25
1. Sandstone, medium-dark-gray, quartzose, calcareous, very fine grained, angular to subangular, well-sorted, as much as 30-percent bitumin, weathers pale yellowish brown, thin-bedded, forms cliff	10.7	35
Total Bluebird Mountain Formation	104.9	345

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
Gradational contact.		
Big Snowy Formation, upper part (Upper Mississippian):		
14. Siltstone, dark-gray, quartzose, calcareous, bituminous, weathers pale yellowish brown, thick-bedded, forms cliff	4.5	15
13. Shale, medium-dark-gray to dark-gray, weathers medium dark gray, laminated, forms slope	6.1	20
12. Limestone, dark-olive-gray, very fine to coarse-grained, sandy (very fine grained quartz), abundant limonite, pelmatazoan, brachiopod, and bryozoan debris, foraminifers of F. Z. 19 (*Eosigmoilina explicata* Ganelina, "*Eosigmoilina*" *rugosa* Brazhnikova), weathers light olive gray, thick bedded, forms ledge	1.5	5
11. Shale, medium-gray, noncalcareous, weathers medium gray and light olive gray, laminated, forms slope	3.0	10
10. Limestone, medium-dark-gray, very fine grained, slightly silty, limonitic, minor pelmatazoan and brachiopod debris, the brachiopod *Inflatia* sp. was identified by J. T. Dutro, Jr., (written commun., 1976), weathers medium gray and light olive gray, thin bedded, forms ledge	3.0	10
9. Shale, dark-gray to grayish-black, calcareous, weathers medium gray, laminated, forms slope	3.0	10
8. Limestone, medium-gray, coarse-grained, sandy (very fine grained quartz), abundant limonite, pelmatazoan, brachiopod, and bryozoan debris, the brachiopod *Anthracospirifer shawi shawi* Gordon was identified by J. T. Dutro, Jr., (written commun., 1976), foraminifers of F. Z. 18 or younger (*Hemiarchaediscus* sp.), weathers medium light gray and light olive gray, very thin bedded, forms ledge	1.5	5
7. Shale, argillaceous limestone, and siltstone, medium-gray to dark gray, calcareous, fine-grained, limonitic, contains brachiopods in thin (3–5 cm or 1–2 in.) limestone units, *Orbiculoidea* cf. *O. wyomingensis* Branson and Greger identified by J. T. Dutro, Jr., (written commun., 1976) from lower part, weathers dark gray to pale yellowish brown, laminated, forms slope	13.7	45
6. Siltstone, medium-gray, calcareous, limonitic, contains brachiopod and other shell debris, weathers grayish orange to pale yellowish brown, very thin bedded, forms slope	1.5	5
5. Limestone, medium-dark-gray, very fine grained, silty, fossiliferous (brachiopods, corals, and bryozoans), *Inflatia*? sp. identified by J. T. Dutro, Jr., (written commun., 1976), weathers very pale orange and medium dark gray, thin-bedded, forms ledge	3.0	10
4. Covered interval	4.5	15

SECTION 2.—*Type sections of the Bloom Member of the Snaky Canyon Formation and of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
3. Limestone, medium-dark-gray, fine- to coarse-grained, silty, limonitic, scattered pelmatazoan, brachiopod, and bryozoan debris, crinoid columnals, brachiopods, weathers light olive gray, thin-bedded, forms ledge	1.5	5
2. Covered interval	13.7	45
1. Sandstone, medium-light-gray, light olive-gray, quartzose, calcareous, very fine grained, well-sorted, brachiopods, weathers very pale orange, pale yellowish brown, very thin bedded, forms slope	1.5	5
Total thickness incomplete Big Snowy Formation	62.0	205

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain Formation*

[Measured in the Arco Hills (figs. 1 and 5, sec. 3), about 1 km (0.6 mi) east of the town of Arco in the N½NE¼ sec. 31, T. 4 N., R. 27 E., Butte County, Idaho, by Betty Skipp and Penny Patterson, July 1976]

	Thickness in meters	feet
Snaky Canyon Formation:		
Bloom Member lower part incomplete (Pennsylvanian and uppermost Mississippian?):		
40. Limestone, medium-dark-gray, fine- to coarse-grained, sandy (medium grained quartz), fossiliferous (bryozoans, brachiopods, algae, and foraminifers), weathers medium dark gray, thick-bedded (1–2 m or 3–6 ft), forms low ledge. The productoid brachiopod *Ovatia* sp. was identified by J. T. Dutro, Jr., (written commun., 1978). Algae include: *Calcisphaera* sp., *Girvanella* sp., and stacheiid forms. Foraminifera include *Asteroarchaediscus* sp., *Biseriella* sp., *Endothyra bowmani, Eostaffella* spp., *Eotuberitina* sp., ?*Millerella* sp., *Pseudoglomospira* sp., and *Zellerina* sp., representative of foraminiferal F. Z. 20?	3.0	10
39. Sandstone, quartzose, calcareous, and sandy limestone, medium-light-gray, very fine grained, fossiliferous (brachiopods and bryozoans), weathers pale brown and moderate yellowish brown, medium-bedded (0.3–0.5 m or 1–1.5 ft), forms low ledge	2.1	7
38. Sandstone, quartzose, calcareous, as in unit 36	3.0	10
37. Limestone, medium-dark-gray to medium-gray, fine- to coarse-grained, sandy (fine grained quartz, some with overgrowths), fossiliferous (abundant pelmatazoan debris, brachiopods, algae, and foraminifers), weathers medium gray and light olive gray, scattered lenses of incipient chert, thick-bedded (0.3–1.4 m or 1–4.5 ft), forms cliff. Productoid brachiopod fragment identifed by J. T. Dutro, Jr., (written commun., 1978). The algae *Aoujgalia* sp. and *Asphaltina cordilleriensis* are present. Foraminifers represen-		

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
tative of F. Z. 19? include: *Asteroarchaediscus* sp., *Biseriella moderata, Endothyra bowmani, Eosigmoilina explicata*?, *Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Zellerina* of the group *Z. discoidea*, and *Zellerina* sp.	4.6	15
Total thickness incomplete Snaky Canyon Formation	12.7	42

Gradational contact

Bluebird Mountain Formation (uppermost Mississippian):

	Thickness in meters	feet
36. Sandstone, calcareous, and sandy limestone. Sandstone, medium light-gray, quartzose, very fine grained, weathers moderate brown to pale brown, blocky, thick-bedded (0.6–2.0 m or 2–6.6 ft), forms ledge. Limestone, medium light-gray, very fine grained, sandy (very fine grained quartz), weathers grayish orange, forms pods near top of unit	4.6	15.0
35. Covered interval. Float is calcareous very fine grained sandstone	1.8	6.0
34. Limestone, medium-dark-gray, fine- to coarse-grained, sandy (very fine grained quartz), some sandstone stringers, fossiliferous (pelmatazoan, bryozoan, and brachiopod debris, abundant algae, and a few foraminifers), weathers medium light gray, sand stringers weather moderate brown, thick-bedded, forms cliff with unit 33. Algae from lower part include abundant *Stacheoides* spp. Foraminifera representative of F. Z. 19? include apterrinellids, *Asteroarchaediscus* of the group *A. rugosus, Biseriella moderata*, calcivertellids, *Endothyra* sp., *Neoarchaediscus* sp., *Zellerina* of the group *Z. discoidea*, and *Zellerina* sp.	4.4	14.5
33. Limestone, medium-dark-gray, some brownish-gray, coarse-grained, slightly silty, some stringers of moderate brown incipient chert, fossiliferous (abundant crinoidal, bryozoan, trilobite, and mollusk debris, brachiopods, algae, and foraminifers), weathers medium gray, thick-bedded (0.4–1.3 m or 1.5–4 ft), forms lower step part of cliff with unit 34). Large fragment of indeterminate productoid brachiopod identified by J. T. Dutro, Jr., (written commun., 1978). Foraminifera and algae of F. Z. 19? include *Asphaltina cordilleriensis, Asteroarchaediscus* sp., *Biseriella parva, Earlandia* sp., *Endothyra* sp. *Globoendothyra* sp., *Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Pseudoglomospira* sp., *Zellerina* of the group *Z. discoidea*, and *Zellerina* sp.	3.0	10.0

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain Formation*—Continued

	Thickness in meters	feet
32. Covered interval. Float and one ledge in middle of unit are calcareous quartzose sandstone, medium-light-gray, very fine grained, weathers moderate brown, forms steep slope	7.0	23.0
31. Sandstone, light-olive-gray, medium-light gray, grayish-orange, pale-yellowish brown, quartzose, calcareous, very fine grained, weathers moderate brown and pale yellowish brown, weathered rinds as much as 2 cm (0.75 in.) thick, liesegang banding, more than 50 percent exposed, thin- to medium-bedded (0.15–0.6 m or 0.5–2 ft), forms steep slope	14.0	45.8
30. Sandstone, quartzose, slightly calcareous, very fine grained. Upper part light olive gray and grayish orange, weathers pale yellowish brown and light olive gray. Lower beds light olive gray and pale yellowish brown, weather moderate brown. Some limonite staining. More than 50 percent exposed. Thin to medium bedded (0.15–0.6 m or 0.5–2 ft), forms steep slope	13.1	43.0
29. Limestone, very sandy, and calcareous sandstone, medium-gray, quartzose, very fine to medium-grained, scattered phosporite nodules, bryozoan and crinoidal debris, crossbedded, weathers medium gray and moderate brown, forms ledge. Foraminifers of F. Z. 19 include *Asteroarchaediscus rugosus, Eosigmoilina explicata,* "*Eosigmoilina*" *rugosa,* and *Planospirodiscus* sp.	.7	2.4
Total thickness Bluebird Mountain Formation	48.6	159.7

Gradational contact.

Arco Hills Formation (uppermost Mississippian):

28. Sandstone and limestone. Sandstone, olive gray, quartzose, calcareous, very fine grained, weathers moderate brown, yellowish gray, and medium light gray. Limestone, medium-gray, medium-grained, crinoidal, weathers medium gray, forms lens near top which grades into sandstone above and below. Unit thin to medium bedded, forms slope	1.6	5.1
27. Limestone and chert. Limestone, dark gray, medium-dark-gray, olive-gray, fine- to medium-grained, siliceous, sandy (very fine grained quartz) with sand stringers in upper part, fossiliferous (crinoid columnals, brachiopods, bryozoans), crossbedded, thin-bedded (0.08–0.3 m or 0.25 in.–1 ft). Chert, grayish-black, olive-gray, and medium light-gray, some laminated, forms blebs 2.5 to 10 cm (1–4 in.) across and irregular layers. Unit forms cliff. The brachiopod *Orbiculoidea* sp. (large) occurs near top	4.3	14.0

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain*—Continued

	Thickness in meters	feet
26. Limestone, medium-dark-gray, dark-gray, brownish-gray, fine-grained, silty, sandy, and cherty, sand laminations common in upper part, grayish-black and olive-gray chert in elongate or round nodules, weathers medium light gray, grayish orange, and grayish red, thin-bedded to platy (0.8–15 cm or 0.25–6 in.), forms slope with small ledges	7.9	26.0
25. Mudstone, pale-yellow-brown to grayish orange, calcareous, not bedded, forms pale-yellowish-brown slope	2.1	7.0
24. Limestone, medium-brownish-gray, coarse grained, slightly sandy (medium grained quartz), porous, partly silicified, fossiliferous (crinoidal and bryozoan debris, brachiopods, foraminifers), thin-bedded (7.5 cm or 3 in.), forms ledge between mudstone units. Foraminifera of F. Z. 19 include *Asteroarchaediscus* sp., *Eosigmoilina explicata*, "*Eosigmoilina*" *rugosa*, *Globoendothyra* sp., and *Hemiarchaediscus* sp.....	.3	1.0
23. Covered interval. Float is mudstone like unit 25	2.0	6.5
22. Limestone and calcareous sandstone. Limestone, medium-dark-gray with flecks of dark-yellow limonite, coarse-grained, porous, sand-streaked (medium-grained quartz) in places, fossiliferous (crinoidal, bryozoan, and trilobite debris, silicified brachiopods, and Foraminifera), weathers medium gray with sandy zones moderate brown. Sandstone, dusky-yellow or moderate yellowish-brown, quartzose, calcareous, very fine grained, fossiliferous (brachiopods), weathers moderate yellowish brown. Unit is medium bedded and forms cliff. Foraminifera of F. Z. 19 include *Eosigmoilina explicata* and "*Eosigmoilina*" *rugosa*	5.3	17.4
21. Mudstone, dark-yellowish-brown, pale yellowish-brown, silty, calcareous, carbonaceous, forms slope (trenched)	4.6	15.2
20. Mudstone and limestone. Limestone, medium-dark-gray to dark-gray, coarse-grained, sandy (very fine grained quartz), fossiliferous (bryozoans, echinoderm debris, brachiopods, foraminifers), weathers medium gray and moderate brown, forms ledge (0.3 m or 1 ft) at top of unit. Mudstone, light-olive-gray, calcareous, forms slope. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) are *Carlinia*? sp. and *Composita*? sp. Foraminifera of F. Z. 19 include *Archaediscus* sp., ?*Asteroarchaediscus* sp., *Eosigmoilina explicata*, "*Eosigmoilina*" *rugosa*	1.6	5.1
19. Limestone, medium-gray, fine- to coarse grained, sandy (very fine to fine grained quartz), nodules of black chert at base, fossiliferous (brachiopods,		

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain*—Continued

	Thickness in meters	feet
pelmatazoan debris), weathers medium light gray and light olive gray, medium-bedded (0.15–0.45 m or 0.5–1.5 ft), forms ledge with unit 18. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978), include *Anthracospirifer* sp., *Diaphragmus* sp., and *Inflatia*? sp.	.6	2.0
18. Sandstone, pale-yellowish-brown, light-olive gray, quartzose, calcareous, very fine grained, liesegang banding, weathers moderate brown, forms ledge with unit 19	.6	2.1
17. Mudstone, light-olive-gray, calcareous, with abundant limestone nodules, forms slope	1.2	4.0
16. Limestone, medium-gray to medium-dark-gray, fine- to coarse-grained, slightly sandy (fine-grained quartz), fossiliferous (brachiopods, echinoderm, bryozoan and ostracod debis, foraminifers), weathers medium gray and greenish gray, thin- to medium-bedded, thinner bedded and finer grained at top, forms ledge. Foraminifers of F. Z. 19 include *Eosigmoilina explicata* and "*E.*" *rugosa*	2.7	9
15. Mudstone, very pale orange, calcareous, forms slope	1.7	5.5
14. Limestone, medium-dark-gray, coarse grained, slightly sandy (very fine grained quartz), fossiliferous (echinoderm and bryozoan debris, brachiopods, some phosphatic, algae, and foraminifers), limonitic, weathers medium gray, forms slope. The brachiopod *Inflatia*? sp. (corroded specimen) identified by J. T. Dutro, Jr., (written comun., 1978). Foraminifera and algae of F. Z. 19 include *Asteroarchaediscus* sp., *Asphaltina* sp., and "*Eosigmoilina*"*rugosa*	.1	0.3
13. Sandstone, light-olive-gray and brownish gray, quartzose, calcareous, very fine grained, some friable, weathers medium light gray and moderate brown, mostly thick-bedded, forms cliff	1.8	6.0
12. Mudstone, yellowish-gray, calcareous at base, grading upward into grayish-orange and pale-olive silty calcareous mudstone or argillaceous siltstone, forms slope	2.1	7
11. Limestone, medium-dark-gray, coarse-grained, silty, fossiliferous (silicified corals and brachiopods, echinoderm and bryozoan debris, foraminifers), weathers medium gray with dark yellowish-brown staining on surface, medium-bedded (0.3 m or 1 ft), forms ledge. Brachiopods *Anthracospirifer* sp. and *Inflatia* sp., identified by J. T. Dutro, Jr., (written commun., 1978). Foraminifera of F. Z. 19 include *Archaediscus* sp., *Endothyra* sp., "*Eosigmoilina*" *rugosa*, and *Eotuberitina* sp.	1.2	4

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain*—Continued

	Thickness in meters	*feet*
10. Mudstone, light-olive-gray and yellowish gray, calcareous, carbonaceous, limestone nodules, fossiliferous (corals and brachiopods), weathers light brownish gray and yellowish gray, forms slope. The coral *Amplexizaphrentis* sp. (USGS colln. 26880-PC) identified by W. J. Sando (written commun., 1977). Brachiopods, *Inflatia* sp. (small), and *Anthracospirifer* aff. *A. welleri* (Branson and Greger) identified by J. T. Dutro, Jr., (written commun., 1978)	1.2	4
9. Limestone, dark-gray to medium-dark-gray, coarse-grained, slightly silty, fossiliferous (corals, brachiopods, echinoderm and bryozoan debris), partly silicified, weathers medium gray and pale yellowish brown, medium bedded (15–35 cm or 6–14 in.), forms ledge. The coral, *Amplexizaphrentis*? sp. and productoid brachiopod fragments identified by J. T. Dutro, Jr., (written commun., 1978)	1.5	5
8. Mudstone, yellowish-gray, calcareous, weathers yellowish gray, forms slope	.8	2.5
7. Limestone, medium-gray, coarse-grained, silty, fossiliferous (corals, brachiopods, echinoderm and bryozoan debris, foraminifers), partly silicified, weathers medium olive gray, thin-to medium-bedded (5 cm–1 m or 2 in.–3 ft), thin beds at top, forms ledge. Foraminifera of F. Z. 19 include *Archaediscus* sp., *Endothyra bowmani, ?Eosigmoilina* sp.	1.2	3.8
6. Mudstone, light-greenish-gray and yellowish gray, calcareous, weathers to yellowish gray slope	4.3	14
5. Limestone, medium-gray, coarse-grained, silty and sandy (very fine grained quartz), some limonitic spots, breccia at top, silicified in places, fossiliferous (echinoderm, brachiopod, and bryozoan debris, foraminifers), weathers medium gray, some very pale orange, one thick bed, forms ledge. Foraminifera of F. Z. 19 include *Asteroarchaediscus* sp., "*Eosigmoilina*" *rugosa, Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *Priscella* sp.	6.1	20
4. Limestone, silicified, and chert, interbedded, pale-yellowish-brown, medium-gray, olive gray, weathers dark yellowish orange, grayish orange, and olive gray, some medium-gray bioclastic limestone nodules in upper part, thin-bedded, forms low ledge.	2.4	8
3. Limestone, medium-gray, aphanitic, argillaceous, small medium-gray chert nodules and lenses, large black orbiculoid brachiopods in float, weathers pale yellowish orange and medium gray, thin-bedded (0.05–0.3 m or 2 in.–1 ft) forms slope or series of low steps	4.6	15

SECTION 3.—*Type section of the Arco Hills Formation and reference section of the Bluebird Mountain*—Continued

	Thickness in meters	feet
2. Limestone and mudstone. Limestone, medium light-gray to light-gray, fine grained, argillaceous, weathers light olive gray. Mudstone, yellowish-gray and light-olive-gray, calcareous, silty, scattered dark-gray chert nodules, weathers yellowish gray. Unit partly covered, forms slope	4.0	13
1. Covered interval. Subcrop from upper part like unit 2	7.9	26
Total thickness Arco Hills Formation	75.7	248.5
Abrupt conformable contact.		
Surrett Canyon Formation, upper part (Upper Mississippian):		
Limestone, medium-dark-gray and medium gray, fine- to coarse-grained, slightly sandy (fine-grained quartz with overgrowths), grayish-black chert in nodules and thin beds, fossiliferous (brachiopods, corals, echinoderm, bryozoan and ostracode debris, foraminifers and algae),weathers medium gray, upper part thick-bedded, lower part thin- to medium-bedded, forms ledge. Sample from top contains the coral *Caninia* sp. and the Foraminifera and algae of F. Z. 19: "*Eosigmoilina*" *rugosa*, *Globoendothyra* sp., and *Stacheoides* sp. Sample from base contains the phosphatic brachiopod *Orbiculoidea* cf. *O. wyomingensis* Branson and Gregor, identified by J. T. Dutro, Jr., (written commun., 1978) and Foraminifera of F. Z. 18 or 19, ?"*Eosigmoilina*" sp., *Hemiarchaediscus* sp., and *Planospirodiscus* sp.	12.2	40
Total thickness incomplete Surrett Canyon Formation	12.2	40

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*

[Measured in the White Knob Mountains, (figs. 1 and 5, sec. 4), just north of the junction of Wood Canyon and Antelope Creek in the NW¼ sec. 29 and N½ sec. 30, T. 5 N., R. 25 E., Custer County, Idaho, by Betty Skipp and Ellen Harrison in August 1970]

	Thickness in meters	feet
Snaky Canyon Formation, lower part (Permian to uppermost Mississippian):		
16. Limestone and incipient chert. Limestone, dark-gray to medium gray, mostly fine-grained, slightly silty, fossiliferous (brachiopods, crinoid, ostracod, and bryozoan debris, and foraminifers), weathers light gray to light medium gray, thin bedded. Incipient chert, dark-gray to medium-gray, forms as much as 30 percent of unit, weathers reddish brown, forms layers as much as 15 cm (6 in.) thick. Unit forms cliff with unit 15. Foraminifera of F. Z. 20 from base of unit include archaediscids, *Endothyra* of group *E. excellens*, and *Millerella* sp.	6.1	20

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*—Continued

	Thickness in meters	feet
15. Limestone and chert as in unit 16, forms cliff. Foraminifera and algae of F. Z. 20 from top of unit include *Asphaltina* sp., *Asteroarchaediscus* sp., beresellid algae, *Biseriella* sp., *Calcispheara* sp., *Earlandia* sp., encrusting tubular foraminifers, *Endothyra excellens, Endothyra* sp., *Eostaffella* sp., *Eotuberitina* sp., *?Globivalvulina* sp., *Endothyranella* sp., *Millerella* sp., Millerella of group *M. pressa, Neoarchaediscus* sp., *Pseudoammodiscus* sp., and *Zellerina*? of group *Z*? *cooperi*	15.2	50
14. Limestone. Upper part--limestone, medium gray, fine- to medium-grained, slightly sandy (fine-grained quartz), fossiliferous (brachiopods, bryozoans, ostracods, gastropods, echinoderm debris, algae, and Foraminifera), weathers medium gray, medium- to thick bedded (0.3–1.5 m or 1–5 ft), forms cliff. Algae and Foraminifera (F. Z. 20) from top of unit include *Asphaltina* sp., *Asteroarchaediscus* sp., *Biseriella* sp., *Eostaffella* sp., *?Globivalvulina* sp., *Millerella* sp., *Neoarchaediscus* sp., *Stacheoides* spp., *Ungdarella* sp., and *Zellerina* spp. Foraminifera and algae (F. Z. 20?) from middle of upper part include *Asphaltina* sp., *Asteroarchaediscus* sp., *Biseriella* sp., *Eostaffella* sp., *?Globivalvulina* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *Stacheoides meandriformis, Ungdarella* sp., *Zellerina* sp., and *Zellerina* of group *Z. discoidea.* Lower part—limestone, dark-gray, very fine grained, very sandy in lower part (very fine grained quartz), minor echinoderm debris, weathers dark gray, thin- to medium- bedded, forms steep slope	16.8	55
13. Limestone, medium-dark-gray, fine-grained, very slightly sandy (very fine grained quartz), fossiliferous (brachiopods, bryozoan, echinoderm, ostracode debris, Foraminifera), weathers light gray, thin-bedded (0.15–0.3 m or 6 in.-1 ft), forms steep slope. The brachiopod *Antiquatonia*? sp. (USGS colln. 24918–PC) identified by J. T. Dutro, Jr., (written commun., 1973). Foraminifera of F. Z 20? include *Asteroarchaediscus rugosus, Eotuberitina* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *?Zellerina* sp.	4.6	15
12. Covered interval. Float is thin-bedded light-gray and medium-gray limestone and some sandstone	10.7	35
11. Mostly covered interval. Subcrop is limestone, medium-gray, fine-grained, sandy or silty, minor chert, fossiliferous (echinoderm, bryozoan, and brachiopod debris), thin- to medium bedded (0.15–0.3 m or 6 in.-1 ft), forms slope. Sample from small ledge		

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*—Continued

	Thickness in meters	feet
at top of unit contains Foraminifera of F. Z 20?: *Asteroarchaediscus* sp., *Endothyra* sp., *Eostaffella* sp., *Neoarchaediscus* sp., *Zellerina* sp.	12.2	40
10. Limestone and sandstone. Upper 6.1 m (20 ft)—limestone, dark-brownish-gray to dark gray, medium- to coarse-grained, sandy (medium-grained quartz), minor grayish-black chert nodules, fossiliferous (brachiopods, bryozoan and echinoderm debris), weathers dark gray, thin-bedded. Sandstone, medium gray, very fine grained, quartzose, calcareous, forms one 1-m (3 ft)-thick bed 1 m (3 ft) from top. USGS colln. 24917-PC from upper beds contains fenestrate bryozoans, *Linoproductus* sp., and productoid fragments identified by J. T. Dutro, Jr., (written commun., 1973). Lower 9.1 m (30 ft)—limestone, medium gray, fine-grained, minor grayish black and olive-gray chert nodules, fossiliferous (bryozoans), weathers medium gray, medium-bedded (0.15–0.6 m or 6 in.–2 ft), forms steep slope	15.2	50
9. Limestone and sandstone. Upper 7.6 m (25 ft) interbedded limestone and sandstone. Limestone, medium-gray to dark-gray, fine-grained, sandy (fine-grained to very fine grained quartz), black chert nodules common, fossiliferous (crinoidal and bryozoan debris, brachiopods, some phosphatic, ostracodes, foraminifers), weathers olive gray to medium gray, medium-bedded. Sandstone, light-yellow gray and orange-gray, quartzose, calcareous, fine-grained, weathers brownish yellow, medium-bedded (0.15–0.45 m or 6–18 in.). Foraminifera from top of upper part representative of F. Z. 20?. include *Archaediscus* sp., *Asteroarchaediscus* sp., *Biseriella moderata, Biseriella parva, Eostaffella* sp., *Eotuberitina* sp., *Neoarchaediscus* sp., *Planoendothyra* sp., *Zellerina* of group *Z. discoidea,* and *Zellerina* sp. Lower 7.6 m (25 ft) limestone, medium-dark-gray, coarse-grained, crinoidal, weathers medium gray, medium-bedded (0.15–0.6 m or 6 in.–2 ft), forms steplike ledges	15.2	50
8. Limestone, medium-gray, fine- to medium grained, silty and sandy (very fine grained quartz) in places, scattered olive-gray to grayish-black chert nodules, fossiliferous (brachiopods, some phosphatic, echinoderm, bryozoan, and ostracode debris, algae, and Foraminifera), weathers light gray to medium gray, thin-to medium-bedded (0.15–0.3 m or 6 in.–1 ft), forms steep slope of steplike ledges. Interval one third covered, but subcrop indicates character of beds. Brachiopods from middle of unit (USGS colln.		

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*—Continued

	Thickness in meters	feet
24916-PC) include *Wellerella* sp. and *Composita* sp., identified by J. T. Dutro, Jr., (written commun., 1973). Foraminifera and algae (F. Z. 20?) from top of unit include *Archaediscus* sp., *Archaediscus pauxilles, Asphaltina cordilleriensis, Asteroarchaediscus* sp., *Biseriella moderata, Biseriella* sp., *Calcisphaera* sp., *Hemiarchaediscus* sp., *Planospirodiscus* sp., and *Zellerina* spp. Foraminifera and algae (F. Z. 20?) from middle of unit include archaediscids, *Asteroarchaediscus* spp., *Biseriella* sp., *Earlandia* spp., encrusting tubular foraminifers, *Girvanella* sp., ?*Hemiarchaediscus* sp., *Monotaxinoides* sp., *Neoarchaediscus* sp., *Stacheoides* sp., and *Zellerina* sp. .	15.2	50
7. Limestone, medium-gray, medium- to coarse grained, sandy (fine-grained quartz), scattered nodules of black chert, fossiliferous (brachiopods, crinoidal, echinoderm, and bryozoan debris, algae and Foraminifera), weathers medium gray, medium-bedded (0.3 m, 1 ft) forms steplike ledges. Linoproductid and productoid brachiopod fragments (USGS colln. 24915-PC) identified by J. T. Dutro, Jr., (written commun., 1973). Foraminifera and algae of F. Z. 20? at top of unit are *Biseriella* spp., encrusting tubular foraminifers, ?*Globivalvulina* sp., and *Stacheoides* sp. Foraminifera of F. Z. 19 in middle of unit include "*Eosigmoilina*" *rugosa* and *Biseriella* sp.	6.7	22
Total incomplete Snaky Canyon Formation	117.9	387
Gradational contact.		
Bluebird Mountain Formation (uppermost Mississippian):		
6. Siltstone, sandstone, and limestone. Siltstone and sandstone, gray, very fine grained, calcareous, weathers yellowish brown, thin-bedded. Limestone, olive-gray and medium gray, fine- to medium-grained, silty in places, fossiliferous (bryozoan and echinoderm debris) in part, weathers medium gray, thin-bedded, forms low ledge	3.0	10
5. Siltstone and sandstone, calcareous, and silty limestone, light-olive-gray, yellowish-brown, light-brownish gray, quartzose, very fine grained, weathers yellowish brown and reddish brown, platy to thin-bedded (0.5–10 cm or 0.12–4 in.), forms ledge	4.6	15
Total thickness Bluebird Mountain Formation	7.6	25

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*—Continued

	Thickness in meters	*feet*
Gradational contact.		
Surrett Canyon Formation, part:		
Arco Hills equivalent (Upper Mississippian):		
4. Limestone, crinoidal, and silty and sandy limestone, interbedded. Crinoidal limestone, medium-light-gray and light-olive-gray, medium- to coarse grained, fossiliferous (corals, brachiopods, some phosphatic, pelecypods, algae, foraminifers), weathers medium light gray and olive gray, thick-bedded (0.6–1 m or 2–3 ft), forms ledges. Silty and sandy limestone, dark-gray and medium-olive-gray, very fine grained, fossiliferous (scattered brachiopods, bryozoans, and corals), weathers with tints of yellow, orange, and red, thin-bedded (0.5–5.0 cm or 0.25–2 in.), forms slopes. Foraminifera from top (F. Z. 19) include *Eosigmoilina explicata* and *Neoarchaediscus* sp.; USGS colln. 24914-PC from the upper limestone ledge includes: a horn coral, *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Inflatia* sp., and a pelecypod, indet., identified by J. T. Dutro, Jr. (written commun., 1973). Foraminifera and algae (F. Z. 19) from the basal limestone ledge include *Asteroarchaediscus* sp., encrusting tubular foraminifers, "*Eosigmoilina*" *rugosa*, *Eotuberitina* sp., and *Stacheoides* sp.	22.9	75
3. Limestone, dark-gray and medium-olive-gray, fine-grained, silty and sandy (very fine grained quartz), abundant chert and incipient chert nodules, fossiliferous (brachiopods, some phosphatic, bryozoans, echinoderm and crinoid debris, foraminifers), weathers light gray with tints of yellow orange and red, thin-bedded to platy (0.5 cm or 0.25 in.), forms partly covered slope. Foraminifera (F. Z. 19) from top include "*Eosigmoilina*" *rugosa*, *Eostaffellina* sp., *Neoarchaediscus* sp., and *Zellerina* sp. Foraminifera of F. Z. 19 from middle of unit include ?*Asteroarchaediscus* sp., "*Eosigmoilina*" *rugosa*, and *Neoarchaediscus* sp.	10.7	35
Total thickness Arco Hills equivalent (upper part of Surrett Canyon Formation)	33.6	110
Small fold		
2. Limestone and interbedded chert. Limestone, medium-gray and medium-dark-gray, very fine grained,		

SECTION 4.—*Reference section of the Bluebird Mountain Formation with associated partial sections of the overlying Snaky Canyon Formation and the underlying Surrett Canyon Formation*—Continued

	Thickness in meters	feet
slightly silty in places, a few brachiopods present, weathers light gray and light bluish gray, thin-bedded (5–15 cm or 2–6 in.), forms ledge. Chert, gray, lavender, olive-gray, grayish-black, weathers yellow orange or shades of gray, thin bedded (5–15 cm or 2–6 in.), forms 25 percent of interval, forms ledge. USGS colln. 24913-PC from float in lower half of unit contains brachiopods; *Composita* sp., *Leiorhynchoidea*? sp., and *Ovatia* sp., identified by J. T. Dutro, Jr., (written commun., 1973)	9.1	30
1. Limestone, medium-gray, coarse-grained, fossiliferous (bryozoan, brachiopod, echinoderm, crinoid, and ostracod debris, foraminifers), weathers medium gray, thick-bedded (3 m or 1 ft), forms cliff. Foraminifera (F. Z. 19) from base of unit include *Asteroarchaediscus* sp., *Earlandia* spp., *Endothyra* sp., "*Eosigmoilina*" *rugosa*, *Neoarchaediscus* sp., *Pseudoendothyra* sp., and *Zellerina* sp.	6.1	20
Total thickness incomplete Surrett Canyon Formation	48.8	160

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations*

[Measured in the southern Lemhi Range (figs. 1 and 5, sec. 5), SE¼ sec. 6, T. 6 N., R. 30 E., Butte County, Idaho, by Betty Skipp, Penny Patterson, and W. J. Sando in July 1976]

	Thickness in meters	feet
Snaky Canyon Formation, lower part (Permian to Pennsylvanian):		
54. Limestone, medium-light-gray to medium-gray, coarse-grained, sandy (fine-grained quartz), fossiliferous (brachiopod, echinoderm, and bryozoan debris, foraminifers), weathers medium light gray with dark-yellowish brown chert layers, thick-bedded, forms ledge. Foraminifera of F. Z. 19? include *Biseriella* sp. and *Zellerina* sp	4.6	15
53. Covered interval. Float mostly limestone as in unit 54, but also some yellowish-brown weathering very fine grained quartzose sandstone	10.4	34
Total thickness incomplete Snaky Canyon Formation	15.0	49
Gradational contact.		
Bluebird Mountain Formation (uppermost Mississippian):		
52. Sandstone, light-gray to medium-light gray, very fine grained, quartzose, quartzitic, weathers light brown, crossbedded in lower part, forms ledge	1.7	5.5

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations* —Continued

	Thickness in meters	feet
51. Limestone, medium-light-gray, some grayish orange at base, fine-grained, some very sandy (very fine to fine-grained quartz), weathers medium gray, grayish orange, and olive gray, medium- to thick-bedded (1–2 m or 3–6 ft), forms ledges, more than 50 percent outcrop	7.9	26.0
50. Limestone, medium-gray, fine-grained, sandy (very fine to fine-grained quartz), fossiliferous (ostracod and echinoderm debris, algae, many foraminifers), weathers medium gray, thick-bedded, forms ledge. Foraminifera and algae of F. Z. 19 include *Archaediscus* sp., *Asteroarchaediscus* sp., *Biseriella* sp., *Calcisphaera* sp., *Earlandia* sp., "*Eosigmoilina*" *rugosa*, *Eotuberitina* sp., *Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *Pseudoglomospira* sp., and *Zellerina* sp.	4.6	15.0
49. Mostly covered interval. Float 90-percent very fine grained calcareous quartzose sandstone. Two meters of sandstone exposed at base, greenish-gray, quartzose, quartzitic, very fine grained, weathers light olive gray with 1-cm (0.4 in.)- thick weathering rind, forms slope	13.7	45.0
48. Sandstone, brownish-gray to medium-gray, quartzose, quartzitic, very fine grained, weathers brownish gray and pale brown, thin- to medium-bedded (0.15–0.3 m or 6 in.–1 ft), forms ledges	6.5	21.4
47. Limestone lens in sandstone. Limestone, medium-gray, medium-grained, very sandy (fine- to medium-grained), fossiliferous (brachiopod, some phosphatic, echinoderm, gastropod debris, algae, and Foraminifera), weathers medium gray, thick-bedded. Foraminifera and algae of F. Z. 19 include *Asteroarchaediscus* sp., *Biseriella* sp., "*Eosigmoilina*" *rugosa*, *Eostaffella* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *Stacheoides* sp., and *Zellerina* sp.	.9	3.0
46. Sandstone, pale-yellowish-brown, dark yellowish-brown, quartzose, calcareous, very fine grained, weathers pale yellowish brown and brownish gray, thin- to medium-bedded (0.1–0.45 m or 0.3–1.5 ft) forms ledges	5.3	17.5
45. Sandstone, dark-yellowish-orange, quartzose, calcareous, very fine grained, friable, weathers medium orange, thin-bedded, forms slope	1.2	3.9
Total thickness Bluebird Mountain Formation	41.8	137.3

Gradational contact.

Arco Hills Formation (Upper Mississippian):

44. Limestone, medium-gray, light-olive-gray, aphanitic, silty, some siltstone wispy zones, fossiliferous

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations* —Continued

	Thickness in meters	feet
(brachiopods), weathers medium gray and light brown, thick-bedded, forms ledge. Brachiopods from base include: *Orbiculoidea* cf. *O. wyomingensis* Branson and Gregor, *Leiorhynchoidea* sp., *Anthracospirifer* sp., identified by J. T. Dutro, Jr., (written commun., 1978)	3.4	11.0
43. Siltstone, olive-gray and light-olive-gray, slightly calcareous, weathers light olive gray, shaly, forms slope	.3	1.0
42. Siltstone, dark-yellowish-brown, calcareous, weathers pale brown and light brown, thin-bedded (0.07–0.15 m or 3–6 in.), forms slope	.5	1.7
41. Mudstone and siltstone. Mudstone, light brownish-gray, slightly calcareous, light-brown ironstone concretions, weathers light brownish gray, platy, forms slope. Siltstone at base, grayish-orange, slightly calcareous, friable, 0.15 m (6 in.) thick, forms slope	.8	2.6
40. Limestone, sandy, and calcareous sandstone, medium-gray and medium dark-gray, very fine grained, weathers pale yellowish brown and medium gray, single bed, forms ledge with unit 39	.6	2.0
39. Limestone, medium-dark-gray, fine-grained, sandy (very fine grained quartz), weathers medium gray and moderate brown, forms ledge with unit 40	.2	0.5
38. Limestone, medium-dark-gray, fine-grained, silty or argillaceous, weathers light olive gray, thin-bedded, forms swale between limestone ledges	.9	3.0
37. Limestone, medium-gray with grayish-orange limonite specks, fine-grained, slightly sandy (very fine grained quartz), fossiliferous (brachiopods, bryozoan, echinoderm, tribolite, and ostracod debris, Foraminifera), weathers medium gray, single bed, forms ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Composita* sp., orthotetids, and productoids. Foraminifera of F. Z. 19 include *Asteroarchaediscus* sp., "*Eosigmoilina*" *rugosa*, and silcified *Pseudoglomospira* sp.	.5	1.6
36. Siltstone, grayish-olive, argillaceous, slightly calcareous, thin-bedded to platy, forms slope with units 34 and 35	1.0	3.3
35. Siltstone, light-brown and grayish-olive, argillaceous, noncalcareous, weathers grayish orange or light brown, laminated, thin-bedded, forms slope	.3	1.1
34. Mudstone, grayish-olive and dusky-yellow, slightly calcareous, forms slope	.5	1.5
33. Limestone, medium-gray with specks and bands of grayish-orange limonite, fine to coarse-grained, very sandy (very fine grained quartz), fossiliferous (brachiopods, echinoderm, ostracod, and bryozoan		

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations* —Continued

	Thickness in meters	feet
debris), weathers medium gray with moderate yellowish-brown banding, medium- to thick-bedded (as much as 1 m or 3 ft), forms ledge with unit 32. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* sp. and productoid fragments	1.4	4.6
32. Limestone as unit 33. Brachiopods same as 33. Foraminifera (F. Z. 19) include ?*Pseudoglomospira* sp. and *Zellerina* sp.	.7	1.7
31. Limestone, medium-light-gray, very argillaceous, weathers medium light gray, platy, forms slope	1.3	4.3
30. Limestone, dark-gray, fine- to coarse-grained, silty, fossil fragments (crinoid and echinoderm debris), weathers light olive gray and pale yellowish brown, medium-bedded, forms slope	.6	2.0
29. Siltstone, medium-light-gray and yellowish brown, noncalcareous to slightly calcareous, weathers yellowish brown, medium gray, and grayish brown, thin bedded, forms slope	1.2	3.8
28. Mudstone, varicolored--medium-gray, light gray, light-greenish-gray, dark yellowish-orange, shaly, forms slope	1.2	4.0
27. Siltstone and very fine grained sandstone, medium-dark-gray and olive-gray, slightly calcareous, carbonaceous, weathers gray, greenish gray, and yellowish brown, banded, thin-bedded, forms slope	3.0	10.0
26. Limestone, medium-gray with some grayish orange limonitic streaks, medium- to coarse-grained, slightly silty and sandy (very fine grained quartz), fossiliferous, silicified in part (brachiopods, echinoderm and bryozoan debris, foraminifers), weathers medium gray with grayish-orange streaks, medium-bedded (0.6 m or 2 ft), forms slope. The brachiopod *Anthracospirifer*? sp. identified by J. T. Dutro, Jr., (written commun., 1978). Foraminifera (F. Z. 19) include *Neoarchaediscus* sp. and silicified *Pseudoglomospira* sp.	1.1	3.7
25. Limestone as unit 24, forms ledge	6.6	21.8
24. Limestone, banded medium-gray and yellowish orange or moderate-yellowish-brown, aphanitic, slightly sandy (very fine grained quartz), poorly fossiliferous (echinoderm, sponge, and brachiopod debris, foraminifers), weathers same as fresh surfaces, thin-bedded (0.15–0.3 m or 6 in.–1 ft), highly fractured, forms ledge. Poorly preserved foraminifers are *Asteroarchaediscus* sp. and *Earlandia* sp.	2.1	7.0
23. Limestone, light-brownish-gray, light-olive gray, some medium-dark-gray, very fine grained, argillaceous and silty, fossiliferous (phosphatic brachiopods), weathers light brownish gray, light brown, and		

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations* —Continued

	Thickness in meters	feet
yellowish brown, thin-bedded (8–20 cm or 3–8 in.), breaks into small chips, forms slope	4.0	13.1
22. Mudstone, calcareous, and argillaceous limestone, pale-yellowish-brown on both fresh and weathered surfaces, shaly, forms slope	.5	1.5
21. Shale, grayish-black with bluish-white phosphate bloom	.01	0.1
20. Limestone, argillaceous as in unit 18	.3	1.0
19. Limestone, medium-gray, medium-dark-gray, fine-grained, sandy (very fine grained quartz), very fossiliferous (echinoderm debris, brachiopods), weathers medium dark gray and yellowish orange, single bed, forms small ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) are *Composita* sp. (exfoliated specimens) and *Orbiculoidea*? sp.	.14	0.5
18. Limestone, medium-gray, argillaceous, weathers pale brown, very thin bedded, forms slope	.1	0.3
17. Limestone, light-olive-gray, medium-grained to conglomeratic, sandy, phosphatic, weathers light olive gray, banded light olive gray and grayish orange, thin-to medium-bedded (7.5–10 cm or 3–4 in.), forms slope	.6	1.9
16. Siltstone, pale-brown, light-brown, calcareous, weathers grayish orange, forms slope	.1	0.3
15. Limestone, medium- dark-gray, very fine grained, slightly silty, much iron oxide, spicular mudstone, weathers medium dark gray and pale yellowish brown, thin-bedded (7.5–10 cm or 3–6 in.), forms slope	.9	2.9
14. Mudstone, light-olive-gray, calcareous, weathers light olive gray, shaly, forms slope	.2	0.8
13. Limestone, medium-gray, fine-grained, silty, fossiliferous (echinoderm, tribolite debris, brachiopods), weathers medium gray and grayish orange, thin-bedded, sheared, forms slope. The brachiopod *Anthracospirifer* aff. *A. occiduus* (Sadlick) identified by J. T. Dutro, Jr., (written commun., 1978)	.6	1.8
12. Limestone, argillaceous, and calcareous silty claystone, olive-gray, fine-grained, fossiliferous (brachiopod fragments), weathers medium gray and pale yellowish brown, thin-bedded, forms slope	.6	2.1
11. Limestone, medium-gray, medium- to coarse grained, phosphatic, fossiliferous (brachiopods and echinoderm debris), weathers dark yellowish brown and medium gray, forms ledge	.6	1.6
10. Limestone, argillaceous, and calcareous mudstone, olive-gray, medium-gray, dark-yellowish-brown, very fine grained, sparsely fossiliferous (brachiopods), weathers olive gray and grayish red, thin-bedded,		

SECTION 5.—*Reference section of the Arco Hills and Bluebird Mountain Formations* —Continued

	Thickness in meters	feet
sheared, breaks into small chips or thin pencillike fragments, forms slope	2.1	6.8
9. Limestone, medium-gray, fine-grained, silty, weathers medium gray and grayish orange, medium-bedded, sheared, forms ledge	.6	2.0
8. Limestone, medium-gray to brownish-gray, fine-grained, silty, weathers medium brownish gray and yellowish gray, thin-bedded, forms slope	.9	3.0
7. Limestone, medium-gray, fine- to very coarse grained, slightly sandy (very fine grained quartz), fossiliferous (brachiopods, some phosphatic, echinoderm and bryozoan debris, foraminifers), weathers medium gray, single bed, forms ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include an indeterminate orthotetid, *Anthracospirifer*? sp. and *Inflatia*? sp. Foraminifera of F. Z. 19 include *Archaediscus* sp., *Earlandia* sp., *Endothyra* sp., "*Eosigmoilina*" *rugosa*, *Hemiarchaediscus* sp., and *Neoarchaediscus* sp.	.5	1.5
6. Limestone, medium-gray and pale-red, fine grained, silty, weathers grayish red, forms slope	.4	1.2
5. Limestone, medium-gray, fine- to medium grained, sandy (very fine grained quartz), fossiliferous (brachiopods, echinoderm and trilobite debris, Foraminifera), weathers medium gray, single bed, forms low ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include *Composita* sp. and productoid fragments. Foraminifera of Mississippian age include calcitornellids, *Earlandia* sp., *Endothyra* of group *E. bowmani*, *Globoendothyra* sp., and *Priscella* sp.	.5	1.5
4. Limestone as in unit 6	.2	0.7
3. Limestone as in unit 5	.3	1.0
2. Limestone as in unit 6	.5	1.5
1. Covered interval, thickness estimated	9.1	30.0
Total thickness Arco Hills Formation	52.0	169.3

SECTION 6.—*Reference section of the Arco Hills and Bluebird Mountain Formations*

[Measured in the southern Lemhi Range (fig. 1, sec. 6), on the ridge east of East Canyon in the SE¼ sec. 36 (unsurveyed), T. 7 N., R. 29 E., Butte County, Idaho, by Betty Skipp, Becky Watson, and D. S. Crawford in July, 1978]

	Thickness in meters	feet
Snaky Canyon Formation, lower part (Lower Permian to uppermost Mississippian):		
20. Limestone, medium-gray, fine-grained, sandy (very fine to fine grained quartz), abundant algae (Spongiostromata), some brachiopod, pelmatazoan,		

SECTION 6.—*Reference section of the Arco Hills and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
and ostracod debris, conodonts and foraminifers, weathers medium light gray, medium- to thick-bedded, forms cliff. Foraminifera and algae of F. Z. 19? include *Asteroarchaediscus* sp., *Biseriella moderata*, *Earlandia* sp., *Endothyra* cf. *E. excellens*, "*Eosigmoilina*" *rugosa*?, *Eotuberitina* sp., *Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Pseudoglomospira* sp., and *Stacheoides* sp. Conodonts of Late Mississippian age include *Gnathodus bilineatus* and *Cavusgnathus* sp. (identified by D. S. Crawford, written commun., 1978)	1.2	4
Total thickness incomplete Snaky Canyon Formation	1.2	4
Bluebird Mountain Formation (uppermost Mississippian):		
19. Sandstone, light-brown, very fine grained, quartzose with as much as 1 percent opaque iron oxide, calcareous in upper part, siliceous in lower, weathers light brown and dark yellowish brown, medium- to thick-bedded (0.3–1 m or 1–3 ft), forms cliff	3.7	12
18. Sandstone, light-brown, very fine grained, quartzose with siliceous or argillaceous cement, weathers dark yellowish brown, shaly, forms slope	.6	2
17. Sandstone as in unit 19, one bed, forms cliff	1.5	5
16. Dolomite, sandy, and dolomitic sandstone, medium-light-gray and light-brown, sandy dolomite makes up upper part, dolomitic sandstone lower part, very fine grained carbonate mosaic, fine grained quartz sand weathers orange gray and dark yellowish brown, thick-bedded, forms slope	2.1	7
15. Limestone, medium-gray, medium- to coarse-grained, slightly silty, a few black chert nodules, fossiliferous (brachiopods, some phosphatic, ostracods, conodonts, pelmatazoan and bryozoan debris, and abundant algae and foraminifers), weathers medium dark gray, medium-bedded (approximately 0.3 m or 1 ft), forms cliff. Foraminifera and algae of F. Z. 19 include *Archaediscus* sp., *Asteroarchaediscus* sp., *Biseriella* sp., *Earlandia* spp., *Endothyra* of group *E. bowmani*, *Eosigmoilina explicata*, "*Eosigmoilina*" *rugosa*, *Eostaffella* spp., *Eostaffellina* sp., *Eotuberitina* sp., *Hemiarchaediscus* sp., *Neoarchaediscus* sp., *Planoendothyra* sp., *Planospirodiscus* sp., *Pseudoglomospira* sp., *Stacheoides* sp., *Tetrataxis* spp., *Zellerina* sp., and *Zellerina discoidea*. Conodonts of Late Mississippian age identified by D. S. Crawford (written commun., 1978) include *Gnathodus bilineatus* and *Cavusgnathus* sp.	1.5	5

SECTION 6.—*Reference section of the Arco Hills and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
14. Sandstone, light-brown, very fine grained, quartzose, part calcareous and part siliceous cement, weathers dark yellowish brown and olive gray, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	1.8	6
13. Sandstone with pods of sandy limestone, light-gray and light-olive-gray, very fine grained, quartzose, calcareous, weathers very light brown, medium bedded (0.3–0.6 m or 1–2 ft), forms slope	.6	2
12. Sandstone, light-gray and light-brown, very fine grained, quartzose, quartzitic, weathers light brown and dark yellowish brown, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	2.1	7
11. Limestone, medium-gray, medium-grained, sandy (very fine grained quartz), fossiliferous (brachiopods and foraminifers), weathers medium gray, shaly to medium-bedded, forms slope. Foraminifers of F. Z. 19 include *Archaediscus* spp., ?*Asteroarchaediscus* sp., "*Eosigmoilina*" *rugosa*, *Eostaffella* sp., *Neoarchaediscus* sp., *Planospirodiscus* sp., *Tetrataxis* sp., and *Zellerina* sp.	.6	2
10. Sandstone, light-brown and medium light-gray, very fine grained, quartzose, calcareous in part, siliceous in part, weathers light brown, olive gray, and dark yellowish brown, medium-bedded (0.3–0.6 m or 1–2 ft), forms cliff	14.0	46
9. Limestone, medium-light-gray, fine grained, very sandy (very fine grained to fine-grained quartz), phosphatic, fossiliferous (productoid brachiopods, pelmatazoan and bryozoan debris, foraminifers), weathers medium light gray and light brown, one bed, forms slope. Foraminifers of F. Z. 19 include *Archaediscus* sp., "*Eosigmoilina*" *rugosa*, and ?*Hemiarchaediscus* sp.	.6	2
8. Dolomite, medium-gray, very fine grained, sandy (fine-grained quartz), calcareous, scattered medium-gray chert nodules, fossiliferous (phosphatic brachiopods, *Orbiculoidea* sp.), weathers grayish orange and moderate yellowish brown with thin weathered rind, thick-bedded, forms ledge	1.8	6
Total thickness Bluebird Mountain Formation	30.9	102

Gradational contact.

Arco Hills Formation (Upper Mississippian):

7. Siltstone, dark-gray, noncalcareous, weathers dark gray, platy, forms slope	.6	2
6. Limestone, light-olive-gray, very fine grained, sandy (very fine grained quartz), common opaque iron oxide, platy, forms slope	.6	2
5. Siltstone, dark-reddish-brown, shaly, forms slope	1.8	6

SECTION 6.—*Reference section of the Arco Hills and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
4. Limestone, medium-gray, medium-grained, sandy (very fine grained quartz), common dark-yellowish-orange limonite specks, fossiliferous (brachiopods, bryozoan, pelmatazoan and trilobite debris, foraminifers), weathers medium gray, medium-bedded, forms slope. Foraminifera of F. Z. 19 include *Asteroarchaediscus* sp., *Eosigmoilina explicata* (one specimen), "*Eosigmoilina*" *rugosa*, *Neoarchaediscus* sp., and *Planospirodiscus* sp.	0.6	2
3. Mudstone and siltstone, dark gray, noncalcareous, weathers dark gray, shaly, forms slope	2.2	7
2. Limestone, medium-gray, fine-to medium-grained, sandy (very fine grained quartz), fossiliferous (brachiopods, pelmatazoan, bryozoan, and ostracod debris), graded bedding, medium bedded, forms low ledge on slope	1.5	5
1. Siltstone, mudstone, and sandy limestone as in units 2 through 7	35.4	116
Total thickness Arco Hills Formation	42.7	140

Abrupt contact with thick-bedded pure limestones of Surrett Canyon Formation (Upper Mississippian)

SECTION 7.—*Reference section of the Arco Hills and Bluebird Mountain Formations*

[Measured in the Blue Dome area of the southern Beaverhead Mountains (figs. 1 and 5, sec. 7), on the north side of Skull Canyon in NW¼NW¼ sec. 28 and NE¼NE¼ sec. 29, T. 10 N., R. 30 E., Clark County, Idaho, by Betty Skipp, Penny Patterson, and W. J. Sando in July 1976]

	Thickness in meters	feet
Snaky Canyon Formation, lower part (Lower Permian to Lower Pennsylvanian):		
45. Limestone, medium-light-gray, coarse grained, recrystallized, scattered medium-gray chert nodules, weathers medium light gray and yellowish brown, thick-bedded, forms cliff	6.1	20
44. Covered interval. One bed, 2 m (6 ft) thick in center of interval, is limestone, grayish-orange-pink, sandy, medium to coarse-grained, weathers light gray, forms ledge. Unit forms slope	20.1	66
Total thickness incomplete Snaky Canyon Formation	26.2	86
Gradational contact.		
Bluebird Mountain Formation (uppermost Mississippian):		
43. Sandstone, medium-gray, quartzose, calcareous, very fine grained, weathers pale yellowish brown, thick-bedded (1.2 m or 4 ft), forms cliff	2.4	8
42. Sandstone, grayish-orange-pink, quartzose, calcareous, very fine grained, weathers pale yellowish brown and moderate brown, thick-bedded, forms cliff	4.3	14

SECTION 7.—*Reference section of the Arco Hill and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
41. Limestone, dolomitic, medium-gray, medium to coarse-grained, recrystallized, silty, scattered medium-gray chert nodules, a few remnants of crinoidal and phosphatic brachiopod debris, weathers light gray and olive gray, one bed, forms cliff	1.8	6
40. Sandstone, light-olive-gray, quartzose, calcareous, very fine grained, weathers brownish gray, medium bedded, forms cliff	1.5	5
39. Sandstone, pale-reddish-brown and light olive-gray, quartzose, calcareous, very fine grained, weathers light olive gray and pale yellowish brown, thick bedded, forms steep slope	3.4	11
38. Sandstone, light-gray, quartzose, quartzitic, very fine grained, weathers light olive gray, forms steep slope	1.1	3.5
37. Limestone, light-brownish-gray and moderate yellowish-brown, coarse-grained, recrystallized, slightly silty, weathers medium light gray, medium bedded (0.5 m or 1.6 ft), forms steep slope	1.0	3.2
36. Sandstone, light-brown, light-olive-gray, medium-gray, quartzose, quartzitic, very fine grained, weathers mostly light brown and light olive gray, some laminations of medium-gray quartzitic sandstone with pink spots, medium- to thick-bedded (as much as 1 m or 3 ft), 80 percent exposed, forms steep slope with ledges	11.0	36
35. Limestone, light-olive-gray, medium-light gray, medium- to coarse-grained, recrystallized, very slightly sandy (very fine grained quartz), some crinoidal debris, weathers light gray and light olive gray, medium bedded, forms ledge	.9	2.8
34. Partly covered interval, 30 percent exposed. Sandstone, very fine grained, and siltstone, olive-gray, medium-dark gray, medium-gray, slightly calcareous in places, largely quartzitic, weathers olive gray and medium gray, medium bedded, forms steep slope with ledges	8.2	27
33. Sandstone, olive-gray, brownish-gray, mottled medium-gray and light brownish-gray, pale-reddish-brown, quartzose, largely quartzitic, very fine to medium-grained, some slightly calcareous, iron oxide present, minor light-gray chert nodules near base, weathers mostly moderate brown, minor crossbedding and laminations, medium-bedded (0.3–1.3 m or 1–4 ft), forms ledges	19.8	65
Total thickness Bluebird Mountain Formation	55.4	181.5

SECTION 7.—*Reference section of the Arco Hill and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
Gradational contact.		
Arco Hills Formation (Upper Mississippian):		
32. Mudstone, shaly, and siltstone, grayish-black, laminated with olive-gray streaks, noncalcareous, weathers to grayish black and dark-gray chips, forms slope	3.0	10.0
31. Limestone, medium-dark-gray, medium- to coarse-grained, sandy (very fine grained quartz), fossiliferous (brachiopods, some phosphatic, echinoderm debris, foraminifers), weathers medium gray and brownish gray, thin-bedded, forms small ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* sp., *Diaphragmus*? sp., *Inflatia* sp., and indeterminate orthotetids. Foraminifera of F. Z. 19 are ?"*Eosigmoilina*" *rugosa* and silicified *Pseudoglomospira* sp.	.2	0.5
30. Mudstone and siltstone, dark-yellowish brown, calcareous, mudstone is silty in upper part, thin siltstone at base, fossiliferous (productoid brachiopods), weathers into dark-gray chips, forms slope	1.7	5.7
29. Siltstone, medium-gray and light-olive-gray, noncalcareous, irregular laminations, organic material, weathers medium olive gray, medium gray, and grayish orange, forms ledge	1.0	3.4
28. Siltstone, dark-gray, noncalcareous, sheared, weathers dark gray, breaks into pencil-shaped chips, forms slope	1.6	5.1
27. Limestone, medium-gray, medium- to coarse grained, coquina in part, silty to sandy (very fine grained quartz), limonitic, fossiliferous (brachiopods, bryozoan and echinoderm debris, Foraminifera), weathers with subdued medium-dark-gray and moderate-yellowish brown mottling, thick-bedded (1–1.3 m or 3–4 ft), forms ledge. Brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Antiquatonia*? sp., and *Inflatia* sp. Foraminifera (F. Z. 19) include *Archaediscus* sp., *Asteroarchaediscus* sp., "*Eosigmoilina*" *rugosa*, and *Neoarchaediscus* sp.	2.2	7.1
26. Mudstone and argillaceous limestone. Argillaceous limestone in upper part, medium-gray, fine-grained, fossiliferous (brachiopods, see unit 25), thin-bedded, forms low ledge. Mudstone in lower part, brownish-gray, calcareous, laminated with limonitic zones, shaly, weathers into tiny grayish-black shale chips, forms slope	2.1	7.0

SECTION 7.—*Reference section of the Arco Hill and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
25. Mudstone, dark-gray, silty, calcareous, platy, breaks into flat chips about 1 cm (0.5 in.) in diameter, forms slope. Brachiopods collected from float derived from limestone of units 26 and 27 include *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Flexaria*? sp., *Inflatia*? sp., and orthotetid fragments (identified by J. T. Dutro, Jr., written commun., 1978)	3.7	12.0
24. Limestone, medium-dark-gray, fine- to medium-grained, matrix recrystallized, slightly silty or sandy (very fine grained quartz), limonitic, very fossiliferous (brachiopods, some phosphatic, see unit 23, echinoderm, bryozoan, and trilobite debris), weathers medium gray and moderate yellowish brown, one bed, forms ledge	.6	2.1
23. Mudstone, brownish-gray, silty, upper beds calcareous, fossiliferous (brachiopods weather white), weathers to small (less than 0.6 cm, 0.25 in.) grayish-black to dark-gray chips, forms slope. Indigenous brachiopod fauna is composed largely of *Composita* sp. Float collection derived from overlying limestone of unit 24 contains the following brachiopods identified by J. T. Dutro, Jr., (written commun., 1978) *Anthracospirifer* sp., *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Composita* sp., *Composita* cf. *C. poposiensis* Gordon, *Diaphragmus*? sp., *Inflatia* sp., and orthotetid and terebratuloid forms	4.6	15.0
22. Limestone, medium-gray to dark-gray, fine grained, silty in upper part, fossiliferous (brachiopods) in lower part, weathers medium dark gray and light olive gray, thin-bedded (0.1 m or 4 in.), forms ledge. Brachiopods from lower part identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* sp., *Carlinia*? sp., *Composita* sp., *Inflatia* sp., *Ovatia* sp., and orthotetid forms	.9	3.1
21. Mudstone, light-brownish-gray, silty, calcareous, fossiliferous (brachiopods weather white), weathers to small chips as unit 23, forms slope	1.8	6.0
20. Limestone, medium-gray and dark-gray, fine to coarse grained, silty bands, sheared, limonitic in places, some richly fossiliferous zones (brachiopods, some phosphatic, echinoderm debris, sparse Foraminifera), weathers medium gray, dark yellowish orange, and grayish orange in irregular bands, medium-bedded (0.6–0.9 m or 2–3 ft), forms steplike ledges. Brachiopods from the base identified by J. T. Dutro, Jr., (written commun., 1978) include *Anthracospirifer* sp., *Carlinia*? sp., *Cleiothyridina* sp., *Composita* sp., and orthotetid forms. The foraminifer *Asteroarchaediscus* sp. of Late Mississippian age also is present at the base	5.2	17

SECTION 7.—*Reference section of the Arco Hill and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
19. Mudstone. Upper part, light olive gray and pale yellowish brown, noncalcareous, weathers medium gray. Lower part, grayish black and brownish gray, silty, calcareous, weathers grayish black and brownish gray, forms slope	1.8	6
18. Siltstone, medium-dark-gray, calcareous, sheared, weathers pale yellowish brown, forms low ledge between mudstones	1.7	5.5
17. Mudstone, mostly brownish-gray and yellowish brown, calcareous. Grayish-black silty noncalcareous mudstone at base. Unit forms slope	1.5	5.0
16. Siltstone, medium-dark-gray, calcareous, laminated, weathers light brown and moderate yellowish brown, medium bedded (0.3–1 m or 1–3 ft) forms small ledge	0.9	3.0
15. Limestone, silty, and calcareous siltstone, dark-gray and brownish-gray, slightly fossiliferous (brachiopods and sponge spicules) weathers medium gray and pale yellowish brown, thick-bedded (0.6–2.0 m or 2–6 ft), forms ledge	5.5	18.0
14. Limestone, grayish-black (base) to brownish-gray (upper part), fine grained, silty, sheared, fossiliferous (brachiopods), weathers medium dark gray, medium-bedded (0.2–0.6 m or 8 in.–2 ft), forms low ledge, 75 percent exposed. Brachiopods from the middle include *Eolissochonetes pseudoliratus* (Easton), and *Anthracospirifer* sp. identified by J. T. Dutro, Jr., (written commun., 1978)	7.3	24.0
13. Mudstone, brownish-gray, moderate yellowish-brown, noncalcareous, much limonite, weathers moderate yellowish brown, forms slope	2.0	6.5
12. Mudstone, grayish-black, noncalcareous, silty, weathers dark gray and pale yellowish brown, breaks into thin pencillike fragments, forms slope	1.2	4.0
11. Siltstone, brownish-gray, medium-dark gray, yellowish-brown, largely noncalcareous, weathers light brown and yellowish brown, shaly to thin bedded, breaks into equidimensional fragments, forms low ledge	1.7	5.8
10. Mudstone as in unit 12	3.6	12.0
9. Mudstone, dark-gray, slightly calcareous, laminated, weathers dark gray and reddish brown (iron staining), thin bedded (8–10 cm or 3–4 in.), forms slope	.8	2.8
8. Mudstone and limestone. Mudstone, grayish black, silty, weathers grayish black and pale yellowish brown, breaks into pencillike fragments. Thin bed (7.5 cm or 3 in.) of grayish-black argillaceous limestone in middle of unit. Unit forms slope	1.5	5.0
7. Limestone, medium-gray to medium-dark-gray, fine-grained, slightly silty and sandy (very fine grained		

SECTION 7.—*Reference section of the Arco Hill and Bluebird Mountain Formations*—Continued

	Thickness in meters	feet
quartz), fossiliferous (brachiopods, bryozoans, sponge spicules, echinoderm debris, sparse Foraminifera), weathers with alternating bands of medium gray and moderate yellowish brown, thick-bedded (1-1.6 m or 3-5 ft), forms cliff. Brachiopods from the upper and lower parts identified by J. T. Dutro, Jr., (written commun., 1978) include: upper part, *Anthracospirifer* aff. *A. occiduus* (Sadlick), *Anthracospirifer* cf. *A. shawi* Gordon, *Carlinia*? sp., *Composita* sp.; lower part, *Carlinia*? sp. and *Inflatia* spp. Foraminifera (F. Z. 19) from the middle part are *Earlandia* sp., *Eosigmoilina* aff. *E. explicata*, (see also unit 6)	5.5	18.0
6. Limestone, medium-gray, fine-grained, slightly silty and sandy (very fine grained quartz), sheared, limonitic in part, fossiliferous (brachiopods, ostracods, and sponge spicules), weathers medium gray and light olive gray, thick-bedded, forms slope, 50 percent exposed. Brachiopods collected from float represent debris from unit 7 and include *Anthracospirifer* sp. (large), *Anthracospirifer* cf., *A. shawi* Gordon, *Composita* sp., *Inflatia* sp., *Orbiculoidea* sp., orthotetid forms, and *Ovatia?* sp., identified by J. T. Dutro, Jr., (written commun., 1978)	2.4	8.0
5. Limestone, dark-gray, fine-grained, partly dolomitized, limonitic, sheared, fossiliferous (brachiopods, bryozoans, sponge spicules, and Foraminifera), weathers yellowish orange and medium gray, thick-bedded (0.45-1.2 m or 1.5-3.5 ft), forms ledge. Foraminifera (F. Z. 19) include: *Eosigmoilina explicata*, *Planospirodiscus* sp.	1.5	5.0
4. Limestone, dark-gray, argillaceous, fossiliferous (a few orbiculoid brachiopods), weathers dark gray and light olive gray, thin-bedded (10-30 cm or 2-6 in.), forms slope	1.8	6.0
3. Mudstone, dark-yellowish-brown, calcareous, silty and limonitic in lower part, weathers dark yellowish brown, forms slope	4.0	13.0
2. Mudstone, silty, and argillaceous siltstone, medium-dark-gray, mostly noncalcareous, weathers dark gray and olive gray, breaks into pencillike fragments, forms slope	3.6	11.0
1. Sandstone, medium-gray, quartzose, calcareous, very fine grained, cleaved, contains moderate-brown limonite nodules 1 to 2 cm in diameter, weathers dark yellow brown, thin-bedded (0.2-0.3 m or 0.7-1 ft), forms low ledge	1.2	4.0
0. Covered interval. Thickness estimated	15.2	50.0
Total thickness Arco Hills Formation	93.3	306.6

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