

COLUMNAR SECTION

GENERALIZED SECTION OF SEDIMENTARY ROCKS OF THE PHILIPSBURG QUADRANGLE.
SCALE: 1 INCH=2000 FEET.

SYSTEM.	SERIES.	FORMATION.	SYMBOL.	SECTION.	THICKNESS IN FEET.	CHARACTER OF ROCKS.	CHARACTER OF TOPOGRAPHY.
QUATERNARY	RECENT	Alluvium.	Qal			Gravel, sand, and silt on flood plains and angular wash along bases of bedrock slopes.	Valley bottoms.
		Moraines.	Qm			Glacial deposits, largely of granite boulders, representing two or more stages of glaciation.	Ridges on valley sides and hillocks and untraced hollows.
		Later terrace gravels.	QTg			Gravel, sand, and angular wash.	Broad level benches on valley sides.
TERTIARY	PLIOCENE	Volcanic ash.	Tva		500	Buff to cream-colored unconsolidated ash.	Broad valleys.
		Andesitic extrusive rocks.	Ta		400-500	Pink and gray biotite-andesite flows and andesitic tuffs.	Rocky outcrops in valleys and rounded or flat-topped hills.
		Earlier gravels.	Teg		500±	Indurated gravel, well-rounded pebbles, with some volcanic ash.	Terraces and rounded hills.
CRETACEOUS	Eocene to Miocene (?)	UNCONFORMITY					
		Colorado formation. (Possibly includes part of Montana formation at top.)	Kc		1,500±	Upper part gray and olive-green sandstone, generally flaggy, locally pebbly near base, interbedded with dark blue-gray to light gray-green shales, largely sandy. Lower third black fissile shale with some sandy layers near top.	Depressions and slopes with knobs and ridges of sandstone.
CRETACEOUS	UPPER CRETACEOUS	UNCONFORMITY					
		Kootenai formation.	Kk		1,500±	Upper part calcareous shale and sandstone, dark shaly limestone, and gray fossiliferous limestone. Lower part mottled red and green shales, containing calcareous nodules, and thin-bedded sandstones, with some buff-weathering limestone interbedded near the base. Reddish to greenish quartzitic sandstone with pebbles of quartzite from the Quadrant at the base; the red shales are metamorphosed to green and chocolate-brown hornstones.	Smooth slopes as a rule, with prominent outcrops of the basal sandstone and ledges of fossiliferous limestones near the top, but where the formation is metamorphosed it forms cliffs.
JURASSIC	MIDDLE AND LOWER JURASSIC	UNCONFORMITY?					
		Ellis formation.	Je		400-480	Chiefly dark calcareous shales, olive-green sandstones, and thin-bedded impure gray to drab limestone. Conglomerate near the middle. Weathered surfaces commonly stained yellow.	Depressions between the Quadrant formation and the basal sandstone of the Kootenai.
CARBONIFEROUS	PENNSYLVANIAN	UNCONFORMITY?					
		Quadrant formation.	Cq		450-900	Upper half quartzites, generally separated into two divisions by impure cherty limestone. Lower half maroon to brick-red shales with ellipsoidal gray nodules interbedded with white, gray, and reddish magnesian limestones. Metamorphosed to greenish hornstones generally rich in diopside.	Generally forms ridges having parallel ledges of hard quartzite.
CARBONIFEROUS	MISSISSIPPIAN	UNCONFORMITY?					
		Madison limestone.	Cm		800-1,500	Nonmagnesian limestone, thick-bedded and mostly white in upper part, cherty and mostly dark blue-gray in middle part, and black, weathering gray and flaggy in lower part. Abundantly fossiliferous.	Largely forms rugged topography with cliffs. In part, gentle slopes.
DEVONIAN		Jefferson limestone.	Dj		1,000±	Pale-gray to dull-black, thick-bedded, somewhat magnesian limestone, locally flaggy near base. Metamorphosed to cream-white and blue-gray.	Rather steep slopes with prominent outcrops and some cliffs.
SILURIAN?		Maywood formation.	Sm		250±	Thin-bedded gray and light-green to purple or red magnesian limestones and calcareous shale, commonly stained yellow. Some calcareous sandstone near the base. Greenish hornstone where metamorphosed.	Outcrops inconspicuous.
CAMBRIAN	MIDDLE AND UPPER	UNCONFORMITY?					
		Red Lion formation.	Cl		280	Chiefly limestone with thin wavy siliceous laminae, reddish purple, highly siliceous, and flaggy in the lower part. Black to olive-green shale, interstratified with thin-bedded magnesian limestones at base.	Prominent outcrops of siliceous banded limestone.
		Hasmark formation.	Ch		1,000	Chiefly magnesian limestone, with dark shale of varying thickness near the middle. Limestone above the shale mostly cream-white, that below mostly blue-gray.	Gentle slopes with cliffy limestone outcrops.
		Silver Hill formation.	Csh		100-600	Banded green and brown calcareous shale, interbedded with gray limestone having thin wavy dark siliceous laminae, and a little sandstone near the base.	Outcrops inconspicuous except where indurated by metamorphism.
ALGONKIAN BELT		Flathead quartzite.	Cf		0-200	Thick-bedded vitreous, white to pale-gray quartzite. Basal conglomerate in places.	Cliffs and ledges with coarse talus.
		UNCONFORMITY					
		Spokane formation.	As		9,000±	Deep-red shale and sandstone with subordinate green layers; metamorphosed equivalents green, rusty on weathered surfaces. Shale, somewhat sandy, predominates in the lower third, sandstone above. The shales are commonly ripple marked, sun-cracked, and rain pitted; the sandstones are commonly cross-bedded and contain mud fragments, and some have small well-rounded quartz pebbles.	Gently rounded hills and high knobs and ridges.
		Newland formation including Greyson (?) shale.	Anl		4,500	Chiefly light-greenish to dark bluish-gray calcareous shales and impure shaly limestones containing magnesium and iron carbonates and silica and weathering yellow to buff. A little cross-bedded calcareous quartzite occurs in thin beds. The shales in the uppermost part exhibit sun cracks. The beds are altered by contact metamorphism chiefly to hard flaggy pale-green hornstone.	Gently rounded hills, except where affected by contact metamorphism.
		Ravalli formation.	Ar		2,000	Lower part light-gray banded, thick-bedded fine-grained quartzite, somewhat sericitic; upper third light to dark gray quartzitic sandstones alternating with dark-bluish and greenish-gray shales. Contact metamorphism alters the shales to mica schist and produces knotted and gneissoid textures in the quartzites.	Rugged and steep-sided ridges with heavy talus.
		Prichard formation.	Ap		5,000±	Chiefly dark bluish-gray schists and gneisses derived from argillaceous sediments, interbedded, especially near the top and bottom, with a subordinate amount of quartzitic sandstone; deep reddish brown on weathered outcrops. Greatly altered by contact metamorphism.	Rugged mountains, some of the highest peaks in the area.
		Neilhart quartzite.	An		1,000±	White to pale-gray thick-bedded medium to coarse grained vitreous quartzite. Its purity decreases somewhat upward, and near the top thin beds of green and gray mica schist are intercalated. The quartz grains are elongated by pressure, producing a characteristic obscure lamination.	High summits with some steep cliffs.



PLATE I.—ANACONDA RANGE VIEWED NORTHEASTWARD ACROSS THE UPPER VALLEY OF TENMILE CREEK.
Shows rugged topography in sheared granodiorite and the broad, flat-bottomed glaciated canyon of Tenmile Creek.



PLATE II.—CONTACT OF GRANITE WITH DARK SCHIST OF PRICHARD FORMATION AT HEAD OF TENMILE CREEK.



PLATE III.—DETAIL OF CONTACT OF GRANODIORITE WITH SEDIMENTARY ROCKS AT STORM LAKE.
Shows variation of the igneous rock near contacts, apophyses extending into the sedimentary beds, and process of "stopping."

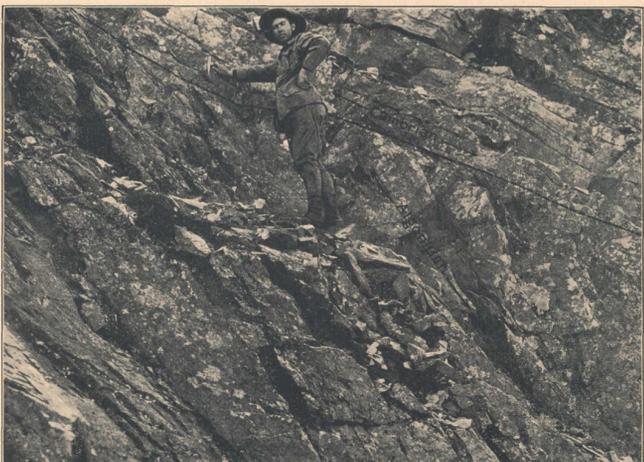


PLATE IV.—UNCONFORMABLE CONTACT OF CAMBRIAN WITH ALGONKIAN ROCKS ON EAST FORK OF ROCK CREEK, IN WESTERN PART OF ANACONDA RANGE.
The Spokane formation (Algonkian) dips 60° W.; the overlying Flathead quartzite (Cambrian) dips 25° W.



PLATE V.—SILICEOUS LAMINATED LIMESTONE OF RED LION FORMATION WEST OF GOLD COIN.
Irregular siliceous laminae are etched in relief by weathering.



PLATE VI.—CHERTY LIMESTONE OF MADISON FORMATION.
The dark cherty beds are characteristic of the middle of the formation.

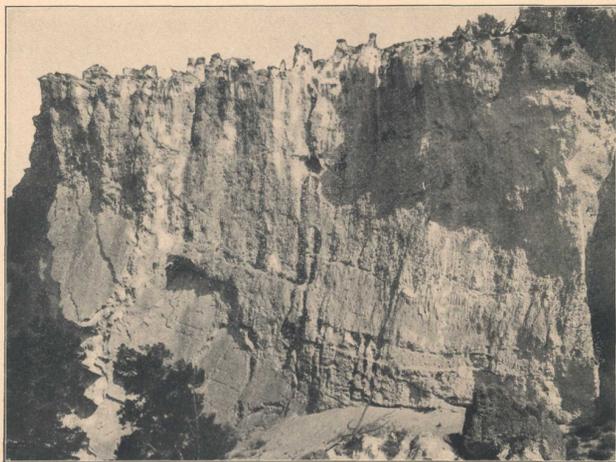


PLATE VII.—INDURATED GRAVELS OF EARLY TERTIARY AGE ALONG ROCK CREEK NEAR MOUTH OF SLUICE CREEK.
The gravels rest on an irregular floor of Newland formation, which slopes downward to the right in the cliff.



PLATE VIII.—FOLDED AND FAULTED PALEOZOIC LIMESTONES ON FOSTER CREEK NEAR SOUTH BOUNDARY OF GRANITE COUNTY.
The closely folded limestone in the cliff is Jefferson, brought into contact with Madison limestone by a fault along the ravine at the left.



PLATE IX.—MAGNESIAN LIMESTONE OF LOWER PART OF HASMARK FORMATION.
The roughness of the weathered surface is caused by projecting crystals of dolomite, which are less soluble than the calcite. The characteristic white tubular bodies are possibly fossil worm cases.



PLATE X.—MAGNETITE IN LIMESTONE OF HASMARK FORMATION IN CONTACT ZONE OF CABLE STOCK.
The light-colored mineral mixed with the magnetite is iron-poor olivine, partly serpentinized.



PLATE XI.—FOSSILS IN LOWER DOLOMITE OF HASMARK FORMATION.
Ellipsoidal sections of bodies having concentric structure; probably calcareous algae (Girvanella?).

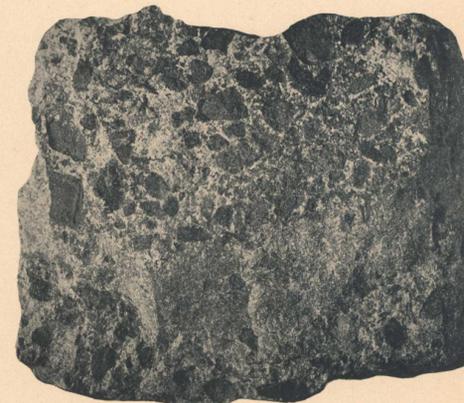


PLATE XII.—MUD FLAKES IN SPOKANE SANDSTONE.
Angular and rounded fragments of dark-red argillite inclosed as pebbles in the sandstone.