Reviews

SUMMARIES OF PRE-CAMBRIAN LITERATURE FOR 1902–1903. I.

[*Continued from Vol. X, p. 913.*]

C. K. Leith.

Arthur Keith. "Description of the Cranberry Quadrangle of North Carolina and Tennessee." *Geologic Atlas of the U. S.*, Cranberry Folio, No. 90, U. S. Geological Survey, 1903, pp. 1–9.

Keith describes and maps the geology of the Cranberry quadrangle of North Carolina and Tennessee, along the junction of the Piedmont Plateau and Blue Ridge. Archæan, and doubtful Algonkian, rocks occupy all but the northwest corner of the area. The Archæan rocks are mapped and described under the heads: Carolina gneiss, Roan gneiss, soapstone, Cranberry granite, Blowing rock granite, and Beech granite. The Carolina gneiss is the oldest rock of the ridge and consists of interbedded mica-schist mica-gneiss, and fine granitoid layers. The Roan gneiss consists of hornblende-gneiss, hornblende-schist, diorite, with some interbedded mica-schist and gneiss, all cutting the Carolina gneiss. Soapstone, resulting from the alteration of peridotite and pyroxenite, occurs in bodies closely associated with the Roan gneiss and probably of the same age. The Cranberry granite is the most extensive formation in the district, occurring chiefly in the mountain districts. It consists of granite and of schist derived from granite, and cuts the Roan gneiss and Carolina gneiss. All of the before-named rocks are cut by the Blowing rock gneiss and the Beech granite, which are considered to be of the same age.

Four formations are classed as doubtful Algonkian. These are: Linville meta-diabase — an altered greenish diabase and gabbro; Montezuma schist — a blue and green epidotic schist, probably altered basal, and amygdaloidal basalt; Flattop schist, — a gray and black schist, probably altered andesitic rocks; meta-rhyolite — a grayish meta-rhyolite and rhyolite porphyry. The first of these appears to be the lower part of a surface flow, and the last three are of surface volcanic nature.

T. L. Watson. "Copper-bearing Rocks of Virgilina Copper District, Virginia and North Carolina." *Bulletin of the Geological Society of America*, Vol. XIII (1902), pp. 353–76.

Watson describes the copper-bearing rocks of the Virgilina copper district of Virginia and North Carolina and shows the adjacent rocks to be pre-Cambrian metamorphosed andesite associated with corresponding volcanic clastics. All are collectively referred to as greenstones, and are thought to be similar to greenstones described as occurring along the Atlantic coast region from eastern Canada to Georgia, and from Alabama to the Lake Superior region.

ARTHUR KEITH. "Geology of the Piedmont Plateau Area of the Washington Quadrangle." *Geologic Atlas of the U. S.*, Washington Folio, No. 70, U. S. Geological Survey, 1901, pp. 2, 3.

Keith describes and maps the geology of the Piedmont Plateau of the Washington quadrangles. Igneous rocks of Archæan age are mapped under the following headings; biotite-granite, soapstone and serpentine (altering from peridotite and pyroxenite), gabbro, meta-gabbro, diorite and meta-diorite (including granite, gneissoid granite and schistose granite), and Carolina gneiss (including mica-gneiss, mica-schist, and small bodies of granite, schistose granite, and diorite). In age these rocks rank in the order named, the Carolina gneiss being the oldest. Also the relative areas of the groups nearly correspond with their ages.

T. NELSON DALE. "Structural Details in the Green Mountain Region, and in Eastern New York." *Bulletin of the U. S. Geological Survey*, No. 195, 1902.

Dale sketches structural details in the Green Mountain district and in eastern New York, such as folds, cleavage, joints, and faults, some of them in the pre-Cambrian rocks.

F. J. H. MERRILL. "Metamorphic Crystalline Rocks of the New York Quadrangle. *Geologic Atlas of the U. S.*, New York City Folio, No. 83, U. S. Geological Survey, 1902, pp. 3–5.

Merrill describes the metamorphic crystalline rocks of the New York quadrangle. Of these only one, the Fordham gneiss, is of pre-Cambrian age. The petrography of this gneiss is described. No opinion is expressed as to its sedimentary or igneous origin or as to its Algonkian or Archæan age.

C. H. SMYTH, JR., AND D. H. NEWLAND. "Report on Progress Made During 1898, in Mapping the Crystalline Rocks of the Western Adirondack Region." Eighteenth Annual Report of State Geologist for 1898 published in *Fifty-second Annual Report of the New York State Museum* (for 1898), Vol. II, 1900, pp. 129–35.

Smyth and Newland report progress in the mapping of the crystalline rocks of the western Adirondack region. Inclusions of hornblende schists found in the more acid gneisses of the region are believed to afford important evidence as to the origin of the gneisses. Also light red granitoid gneiss has been found intrusive into a gray gneiss, indicating, as before held, that all the gneisses are not of the same age. Certain of the gneisses are found to be younger than, and intrusive into, certain schists associated with the limestones.

H. P. CUSHING. "Recent Geologic Work in Franklin and S. Lawrence Counties, N. Y." Nineteenth Annual Report of State Geologist for 1900, published in *Fifty-third Annual Report of the New York State Museum*, Vol. I, 1902, pp. 123–95.

Cushing discusses recent geological work in Franklin and St. Lawrence counties, N. Y., and concludes:

1. That the Adirondack anorthosite is cut intrusively by an augite syenite, which is therefore younger.

2. That, while the larger part of the augite syenite of the Adirondacks is in such situation with respect to the anorthosite as to render impossible any determinations of relative age, its general character is so uniform throughout that it is exceedingly probable that it is all of the same approximate age and consists of intrusions from the same source.

3. That at their borders these syenites pass over into granites, part of which at least cut the syenite eruptively, and are therefore younger.

4. That the syenite grades into granite on the one hand, and into gabbro diorite on the other, and apparently into anorthosite as well.

5. That the three together, anorthosite, syenite, and granite, form a great eruptive complex in the heart of the Adirondack region, and that all are younger than the (in part at least) sedimentary Grenville rocks.

H. P. CUSHING. "Pre-Cambrian Outlier at Little Falls, Herkimer Co., N. Y." Nineteenth Annual Report of State Geologist for 1900, published in *Fifty-third Annual Report of New York State Museum*, 1900, pp. 183–95.

Cushing describes a pre-Cambrian outlier at Little Falls, in Herkimer county, N. Y., and points of difference with the syenite of the Adirondacks.

A. W. G. WILSON. "The Laurentian Peneplain." JOURNAL OF GEOLOGY, Vol. XI (1903), pp. 615–69.

Wilson describes the Laurentian peneplain of the great pre-Cambrian shield of Canada and adjacent portions of the United States. The peneplain is an ancient one, which has undergone differential elevation, has been denuded, and subsequently slightly incised around the uplifted margin. At several places on the margin, as exposed today, the dissection may be regarded as submature. The date of the major development of the peneplain is not determined, but may be pre-Ordovician or Cretaceous. Around the southern margin between Montreal and Winnipeg there are traces of a peneplain (or probably more than one) of still earlier date, upon which paleozoic sediments were laid down, and which has been uncovered by processes of degradation and denundation since the differential uplift of the latest peneplain.

S. WEIDMAN. "The Pre-Potsdam Peneplain of the Pre-Cambrian of North-Central Wisconsin." JOURNAL OF GEOLOGY, Vol. XI (1903), pp. 289–313.

Weidman describes a pre-Potsdam peneplain of the pre-Cambrian of north-central Wisconsin and shows the same to slope gradually to the south, where it is covered by Paleozoic sediments. Several monadnocks stand above the pre-Potsdam peneplain. Extensive clay deposits near the contact of the Paleozoic and the pre-Cambrian are believed to have developed during the pre-Potsdam base-leveling.

Comment.—The peneplain described by Weidman is perhaps to be correlated with the pre-Paleozoic peneplain described by Wilson as appearing about the periphery of the great pre-Cambrian area of Canada, with a slope inclined to the great peneplain of the pre-Cambrian interior. It is of interest also to note that evidence of pre-Cambrian base-leveling has been described by Crosby near Manitou, Col., and that Crosby has called attention to the widespread occurrence of such a plain in North America.[1]

[1] W. O. CROSBY, "Archæan Cambrian Contact Near Manitou, Col." *Bulletin Geological Society of America*, Vol. X (1899), pp. 141–64.

REGINALD A. DALY. "Variolitic Pillow-Lava from Newfoundland." *American Geologist*, Vol. XXXII (1903), pp. 65–78.

Daly described variolitic pillow-lava from Newfoundland, and calls attention to the widespread occurrence of this or similar rocks, frequently called ellipsoidal greenstones, in Minnesota, New Brunswick, California, and Michigan.

R. W. ELLS. "The Progress of Geological Investigation in Nova Scotia." *Proceedings and Transactions of the Nova Scotian Institute of Science*, Vol. X, Part 4 (1901–1902), pp. 433–46.

Ells summarizes the progress of geological investigation in Nova Scotia.

L. C. GRATON. "On the Petrographical Relations of the Laurentian Limestones and the Granite in the Township of Glamorgan, Haliburton County, Ontario." *Canadian Record of Science*, Vol. IX (1903), pp. 1–38.

Graton describes in detail the petrographical relations of the Grenville limestones and granite in the township of Glamorgan, Haliburton county, Ontario. His conclusions are of importance as bearing on the relations of limestones and gneisses over other extensive areas in eastern Canada, the Adirondacks, and New Jersey. He summarizes his conclusions as follows:

The district exhibits a development of Grenville limestone pierced by intrusions of gneissic granite which contain masses of dioritic rock.

Considerable deformation took place during the intrusion.

Between the limestone and the granite is a highly brecciated zone, holding large amounts of lime-rich silicates which are eminently characteristic of contact metamorphism.

Diagenesis took place.

To a great extent, however, the elements, other than the lime necessary for the formation of these minerals, came from the intrusion and its accompanying exhalations.

The metamorphism, then, was largely also metasomatic.

In the gray gneisses and in the granite are dark basic masses which represent fragments broken off from the limestone series and floated away into the igneous mass. They have been still more highly metamorphosed than the rocks from which they came, and have been more or less dissolved and changed in character by the granite. In other words, they have been partially "granitized."

The gray gneisses, which have the composition of quartz diorites, may represent an intermediate phase of this "granitization"—between the inclusions and the granite. This theory may account for the large amount of plagioclase feldspar found in the granite itself.

R. W. ELLS. "Report on the Geology of Argenteuil, Ottawa and Part of Pontiac Counties, Province of Quebec, and Portions of Carleton, Russell and Prescott Counties, Province of Ontario." *Annual Report of Geological Survey of Canada*, Vol. XII (1899), New Series, pp. 1j–138j.

Ells maps and describes the geology of Argenteuil, Ottawa, and part of Pontiac counties, province of Quebec, and portions of Carleton, Russell, and Prescott counties, province of Ontario, covering most of what has long been known as the Original Laurentian district, and summarizes previous work in this district. Archæan rocks,

occupying most of the area north of the Ottawa River, are mapped as crystalline limestone, gneiss, quartzite, anorthosite, granite-gneiss and porphyry. In the text the limestones with the quartzites and gneisses associated with them are described as sedimentary and are classed as Grenville, and the underlying gneisses and granite-gneisses are described as of igneous origin and are called Fundamental complex — in this classification following previous writers. It is evident that the rocks of the Grenville series are decidedly newer than those of the Fundamental division. As for the numerous and often large area of red granite-gneiss, many of these are undoubtedly of more recent date than either of the others since they clearly cut both the gneiss and limestone. While in some points the newer granite-gneiss presents features similar to the Fundamental division, as in the foliation of certain portions, there is, over large areas, a marked difference in their aspect in the field.

A. OSANN. "Notes on Certain Archæan Rocks of the Ottawa Valley." *Annual Report of the Geological Survey of Canada*, Vol. XII (1899), New Series, pp. 10–840.

Osann makes a detailed petrographic description of the crystalline rocks in the Original Laurentian area of the Ottawa Valley.

WILLET G. MILLER. "Lake Temiscaming to the Height of Land." *Report of the Bureau of Mines*, Ontario, 1902, pp. 214–30.

Miller publishes geological notes taken on a canoe trip from Lake Temiscaming northward to the height of land. Special attention was paid to occurrence of minerals of commercial value, and no mapping was attempted. He finds various kinds of igneous rocks, both plutonic and volcanic, such as granite, syenite, diorite, olivine diabase, quartz-porphyry, and others of less importance. In addition to these, most of the metamorphic fragmental rocks characteristic of the Huronian occur, among which may be mentioned quartzite, slate graywacke, and different varieties of the pyroclastic series, ash rocks, and agglomerates. The popular belief that the height of land in this district represents the highest point of the surface from which sediment was derived for the formation of deposits of later age which lie to the southward is scarcely based on fact. He found what appear to be thick deposits of Huronian conglomerate and other water-formed material resting on the surface close to the height of land. It is evident from this that the surface level must have changed considerably since Huronian times, and that what is now the height of land may have once been a comparatively low-lying area.

L. L. BOLTON. "Round Lake to Abitibi River." *Report of the Bureau of Mines*, Ontario, 1903, pp. 173–90.

Bolton reports on the geological reconnaissance from Round Lake north to the Abitibi River in the district of Nipissing. Laurentian granite was seen near both the southeastern and southwestern corners of Eby. Elsewhere Huronian rocks are exposed. Of these there is a considerable variety, many of which are of fragmental origin. The following types were seen: diorite, diabase, brecciated conglomerate, slate, graywacke, hornblende schist, etc. As the rock outcrops of the district explored are, as a rule, separated by areas of sand, swampy, or clayey soil, the relations of the different types could seldom be worked out.

A. P. COLEMAN. "The Sudbury Nickel Deposits." *Report of the Bureau of Mines*, Ontario, 1903, pp. 235–303.

Coleman describes and maps the nickel deposits near Sudbury, Ontario, and incidentally discusses the geology of the region. The probable succession and age of the rocks of the district is as follows, in ascending order:

Keweenawan (?) { Dikes of diabase. / Younger Granite. / Nickel-bearing eruptive; norite; micropegmatite; granite.

Animikie (?) or Upper Huronian (?) — Oval area of tuffs, sandstones, and slates overlying the preceding.

Laurentian.—Granitoid gneiss.

Upper Huronian { Green schists and greenstones. / Arkoses, quartzites, and graywackes.

It can hardly be said that the precise age of any of these groups of rocks is known, though they probably range from the base of the Upper Huronian to the Keweenawan, including the Laurentian as later than the Upper Huronian. No rocks undoubtedly of Lower Huronian age are known from the nickel district proper; though the ranges of banded silica and magnetite extending through Hutton and Wisner townships to the north of the nickel area evidently belong to the Lower Huronian.[1] The latter rocks occur entirely inclosed, so far as known, in granites and gneisses, generally considered Laurentian, and have not been found in direct connection with the rocks here described.

The fact has been brought out that all of the nickel deposits are either on the basic edge of a great eruptive band, which at the opposite edge becomes a quartz syenite or granite, or in dike-like offshoots, often, however, interrupted by other rocks projecting from the southeastern basic edge of the great gabbro band. This band has been found to outcrop in a great oval, the north and south sides of which have been known respectively as the North and South nickel ranges. The structure is synclinal, and the center is occupied by Animikie or Upper Huronian rocks.

There are two different types of deposits represented in the mines of the district: those along the southeastern margin of the main range, often crowded into bay-like indentations of the adjoining rock; and those strung out along the narrow off-shoots from the main range, as Peters suggests, "like sausages on a string, but with a long piece of string between the sausages."[2] Among the former class are the Creighton, Gertrude, Elsie, Murray, and Blezard mines; among the latter, the Copper Cliff, Evans, Frood and Stobie, and the Victoria and Worthington mines. Perhaps a third variety should be distinguished for the Vermilion mine, which contains rich nickel and copper ores, but has no visible association with a band of gabbro, having, however, been formed probably by hot circulating fluids proceeding from such a band.

The final impression left is that the marginal type of deposit is in the main of plutonic origin, aqueous work being relatively unimportant; that in the offset type plutonic is generally more important than aqueous action, though one example, that of the Worthington, suggests more complete rearrangement of the materials by circulating water; thus forming a transition to ordinary vein deposits wholly due to water action, as at the Vermilion mine.

[1] *Report of the Bureau of Mines*, 1901, p. 186.

[2] *Mineral Resources of Ontario*, p. 104.

C. K. LEITH. "Moose Mountain Iron Range." *Report of the Bureau of Mines*, 1903, pp. 318–21.

Leith describes the Moose Mountain iron range in the township of Hutton and district of Nipissing. Iron formation consisting of magnetite, of banded magnetite and quartz, and of magnetite, associated with amphibole and epidote, occurs in bands and lenses in a complex of basic igneous rocks characterized by uniform abundance of amphiboles. Some of the greenstones are basal and some intrusive into the iron-bearing bands. Intrusive into the greenstone and probably into the iron formation are granite masses. Closely associated with the iron formation, but with relations unknown, is a pyritiferous graywacke. The ores and associated rock as a whole are in general similar lithologically to the Vermilion iron-bearing district of Minnesota, although showing many points of difference.

Comment.—Further field work in 1903 in adjacent areas indicates that a great graywacke and conglomerate series rests unconformably against the rocks of the iron range, thus adding another point of similarity of this range to the Vermilion iron range of Minnesota.

L. C. GRATON. "Up and Down the Mississaga." *Report of the Bureau of Mines*, Ontario, 1903, pp. 157–72.

Graton reports on a geological reconnaissance along the Mississaga River and east and west along Niven's baseline in the district of Algoma. Laurentian granites occupy all of the area north of township 188, where was found a greenish slate conglomerate belonging to the Huronian.

W. G. MILLER. "Iron Ranges of Northern Ontario." *Report of the Bureau of Mines*, Ontario, 1903, pp. 304–17.

Miller gives a résumé of the occurrence of iron ore in northern Ontario, and incidentally discusses their geological relations.

A. P. COLEMAN. "Iron Ranges of Northwestern Ontario." *Report of the Bureau of Mines*, Ontario, 1902, pp. 128–51.

Coleman gives results of an examination of the iron ranges of northwestern Ontario, principally the Mattawan, Atikokan, Steep Rock Lake, and other districts along the Canadian Northern Railway, the Slate Islands in Lake Superior, and near Dryden on the Canadian Pacific. The description of the details of the districts contains but few references to general stratigraphy and correlation, but at the end a general classification of the iron ores of Canada is given. To the upper part of the Lower Huronian (Archæan of the U. S. Geological Survey) are referred the siliceous and sideritic iron ranges occurring in practically every iron-bearing area in Ontario, but being mined at only one place, at the Helen mine in the Michipicoten district. To the lower part of the Lower Huronian are referred the magnetite lenses in green schists of the Atikokan district and the titaniferous magnetite, occurring as segregations in basic eruptives, especially gabbro. To the Grenville series "probably Huronian" are referred the magnetite and hematite ores associated with bands of crystalline limestone and gneiss of eastern Ontario. To the Animikie or Lower Huronian (Upper Huronian of the U. S. Geological Survey) are referred impure siderite and hematite occurring in the neighborhood of Thunder Bay and also near Algoma. To the Pleistocene are referred the bog and lake ores and postglacial magnetic sands occurring widely in Ontario and especially in the eastern part.

A. P. COLEMAN. "Nepheline and Other Syenites Near Port Coldwell," Ontario. *American Journal of Science*, Vol. CLXIV (1902), pp. 147–55. See also *Report of Ontario Bureau of Mines* for (1902), pp. 208–13.

Coleman describes nepheline and other syenites near Port Coldwell, Ontario, and calls attention to their widespread distribution in Ontario and the United States.

W. G. MILLER. "Nepheline Syenite in Western Ontario," *American Geologist*, Vol. XXXII (1903), pp. 182–85.

Miller describes bowlders of nepheline syenite near Sturgeon Lake, northwest of Lake Superior, indicating the occurrence of rocks of this character in the pre-Cambrian rocks farther north.

R. G. MCCONNELL. "Note on the So-called Basal Granite of the Yukon Valley." *American Geologist*, Vol. XXX (1902), pp. 55–62.

McConnell describes the granite gneiss of the upper part of the Yukon Valley, extending from the Nordenskiold River in a northwesterly direction across the White River valley to the Tanana, and down this stream to near the mouth of the Delta River — a total distance of about 380 miles — and concludes that a part of the gneisses at least must be regarded as intrusive through, and therefore younger than, the clastic schists associated with them. It is still possible, however, as the work done so far has been largely of an exploratory character, that older gneisses may be present in the district, but no evidence of this was obtained in the course of the investigation.

O. H. HERSHEY. "Structure of the Southern Portion of the Klamath Mountains, California." *American Geologist*, Vol. XXXII (1903), pp. 231–45.

Hershey discusses the structure of the southern portion of the Klamath Mountains, of California. The oldest rocks in the mountains west of the Sacramento River are the Abrams mica-schists, 1,000 feet thick, and overlying it the Salmon hornblende-schist, known to be at least 2,500 feet thick, both of them supposed to be of pre-Cambrian age, probably Algonkian, and possibly Archæan. The Abrams mica-schist is a sedimentary rock, and the Salmon hornblende-schist is a metamorphosed volcanic ash. The Klamath schists form the central ridge of the Klamath region. They are bordered on the west by a great, unsymmetrical geosyncline, and on the east by the western limb of another great geosyncline. The first geosyncline is limited on the west by another belt of schist, chiefly the Abrams mica-schist, which forms the South Fork Mountain and is prolonged northwestward to and probably across the Klamath River near Wichiper. The sandstones of the Coast Range region adjoin this schist belt on the west. According to Mr. Diller, toward the north, approaching the Klamath River, long narrow belts of schist alternate with narrow belts of sandstone, the latter dipping eastward as though going under the schists. This apparent anomaly is evidently due to a series of faults. It is further evident that the Coast Range formations have buried the western portion of the schist belt which may extend, immediately under the sandstone, far toward the coast.

The eastern schist belt emerges from beneath the Cretaceous sandstones and shales in the Sacramento valley west of Ono, with a width of eight miles and

gradually increases as it advances northward to a maximum of about twelve miles west of Scott Valley. Southward from the Trinity River, the pre-Paleozoic area is occupied chiefly by the Abrams mica-schist, the hornblende-schist being confined to narrow strips, but northward from the Trinity River the hornblende-schist spreads out and finally nearly excludes the mica-schist as in the valley of the South Fork of the Salmon River. Still farther north, in the mountains west of Scott Valley, the mica-schist has again asserted its supremacy.

O H. HERSHEY. "Some Crystalline Rocks of Southern California." *American Geologist*, Vol. XXIX (1902), pp. 273–90.

Hershey describes the results of a brief examination of the Fraser Mountain and Sierra Pelona regions, and portions of the Tehachapai, Sierra Madre, and San Bernardino ranges, together with quite an extended section of Mohave desert, all comprised in the counties of Los Angeles, Ventura, Kern, and San Bernardino of California. The crystalline rocks are discriminated under the following heads: (1) "The Pelona Schist Series;" (2) "The Gneiss Series;" (3) "The Rocks of Fraser Mountain and Vicinity;" (4) "The Mesozoic Granites;" (5) "The Ravenna Plutonic Series;" (6) "The Gneiss Near Barstow;" (7) "The Quartzite-Limestone Series of Oro Grande;" (8) "The Schists in Cajon Pass."

The Pelona schist series and the adjacent gneisses, the rocks of Fraser Mountain and vicinity, and the gneiss near Barstow are tentatively correlated with the Abrams schist of the Klamath region in a general way, and are considered pre-Paleozoic, perhaps in part Archæan and in part Algonkian.

W. LINDGREN "The Gold Belt of the Blue Mountains of Oregon." *Twenty-second Annual Report of the U. S. Geological Survey*, Part II, 1900–1901, pp. 551–776.

Lindgren describes and maps the geology of the gold belt of the Blue Mountains of Oregon. Gneiss, referred to the Archæan, occurs northwest of Blue Mountain above La Belleview mine.

BAILEY WILLIS. "Stratigraphy and Structure, Lewis and Livingston Ranges, Montana." *Bulletin of the Geological Society of America*, Vol. XIII (1902), pp. 305–52.

Willis describes and maps the stratigraphy and structure ot the Lewis and Livingston Ranges of the Front Range of the Northern Rocky Mountains of Montana and Alberta. Lewis and Livingston Ranges consist of stratified rocks of Algonkian age, as determined on fossils which were found by Weller in the lowest limestone of the series, and identified by Walcott as probably being Beltina danai, the species of crustacean discovered in the Grayson shales of the Belt Mountains. The Algonkian series consists of limestone, argillite, and quartzite, classified in five formations, and aggregating about 12,500 feet in thickness. The formations are the Kintla argillite, Sheppard quartzite, Siyeh limestone, Grinnell argillite, and Appekunny argillite. There is apparent conformity throughout. The series is so situated with reference to other rocks that no lower or upper stratigraphic limit could be determined. Dr. G. M. Dawson classified with strata as Cambrian, Carboniferous, and Triassic, but it is believed that he mistook certain local overthrust faults for unconformities, and was misled by lithologic resemblances.

Igneous rocks occur sparingly in the Algonkian series. An intrusive sheet of diorite is extensive in the upper limestone formation and an extrusive flow of diabase caps it.

The Algonkian strata form a syncline whose axis trends west of north. Southwestern dips vary from 5° to 30°. Northeastern dips are generally 30° to 40°, and locally approach or pass verticality. Minor flexures within the syncline are very broad and low. The northeastern limit of the fold is an eroded margin; the southwestern is an anticlinal axis whose western limb is in part eroded, in part thrown down by a normal fault along North Fork Valley. Syncline and anticlines are closely related to valley and ridge respectively, and this relation extends to heights of peaks.

Along its eastern margin the oldest Algonkian formation rests upon Cretaceous rocks. The outcrop of this abnormal contact is deeply sinuous throughout the stretch from Saint Mary Lake to Waterton Lake. The structure is described as an overthrust fault, on which the Algonkian series has moved northeastward relatively over the Cretaceous rocks. The displacement on the thrust surface is 7 miles or more, and the vertical throw is estimated at 3,400 feet or more. The thrust surface dips from 0° to 10° southwestward, and strikes variously from north to north 60° west. Thus it is warped, and this warping is found to determine the general outline of the eastern face of the Rocky Mountains, particularly the prominence of Chief Mountain, and the relative position of the Lewis Range, en echelon to the Livingston.

W. H. WEED. "Geology and Ore Deposits of the Elkhorn Mining District, Jefferson County, Montana." *Twenty-second Annual Report of the U. S. Geological Survey*, Part II, 1900–1901, pp. 399–549.

Weed describes and maps the geology of the Elkhorn mining district of Montana. Doubtfully referred to the Algonkian are the Turnley hornstones. The lower division is 200 feet thick and consists of shale metamorphosed to a very dense hornstone composed of light brown biotite and quartz. A bed of impure iron ore 20 to 30 feet thick occurs in the middle lower part of the formation. The quartzitic hornstones overlie the basal beds just noted and are 200 feet thick. The rocks, though well bedded, are very dense and hard, and are of a gray-black color, so that they closely resemble the andesites. In color, composition, and relation to the overlying quartzite the rocks correspond to the red Spokane shale of the Belt terrane seen at Whitehall, 20 miles south, at Townsend to the east, and at Helena on the north.

W. S. TANGIER SMITH. "Geology of the Hartville Quadrangle of Wyoming." *Geologic Atlas of the U. S.*, Hartville Folio, No. 91, U. S. Geological Survey, 1903, pp. 1–6.

Smith (W. S. Tangier) describes the geology of the Hartville quadrangle of Wyoming. The Whalen group, assigned to the Algonkian, consists of gneisses, schists, quartzites, and limestones, all very schistose, the schistosity standing nearly vertical. These rocks occur principally in the northeastern part of the quadrangle. Quartzites and micaceous schists form the greater part of the exposed rocks of the Whalen group, and in places they grade into each other, so that no definite separation can be made. Some of the quartzites are more or less calcareous. Iron ore occurs within and near the contact of the limestones and schists of the Whalen group on the west side of Whalen Canyon. Information at hand is not sufficient to decide whether there are several ore-bearing horizons or a single horizon repeated by folding. Ore is being mined at Sunrise.

F. L. RANSOME. "Ore Deposits of the Rico Mountains, Colorado. *Twenty-second Annual Report of the U. S. Geological Survey*, Part II, 1900–1901, pp. 229–397.

Ransome describes the ore deposits of the Rico Mountains, Colorado, and incidentally summarizes the geology of the area, referring the reader to a previous paper by Cross and Spencer[1] for further details. The Algonkian rocks consist of quartzites and schists, exposed just north of Rico and in the canyon of Silver Creek. They appear as fault blocks, in the heart of the dome, thrust up from below into the later beds.

WHITMAN CROSS. "Geology of the Silverton Quadrangle, Colorado." From *Bulletin No. 182, U. S. Geological Survey*, 1901, by F. L. RANSOME.

Cross summarizes the geology of the Silverton quadrangle, Colorado, for Ransome's bulletin on the economic geology of this quadrangle. Algonkian quartzites and schists appear beneath the volcanics where the Animas River and the Uncompahgre River and its tributaries cut through the volcanics.

Irrigation. By F. H. NEWELL. New York: T. Y. Crowell & Co.

MR. NEWELL'S book is written from the economic and social point of view, and emphasizes the importance of irrigation as a national problem. For this reason the general reader, as well as the person directly concerned in home-making in the arid West, will read the work with interest. Guided by his extensive experience with problems of irrigation, the author contrasts the present scanty occupation of the western two-fifths of the United States with the possibilities for home-making when the present water supply shall have been properly conserved.

At the present time 7,300,000 acres are under irrigation, while the natural water supply is sufficient for ten times that acreage. The success already attained in this small fraction of the area abundantly justifies the national expense already incurred, and becomes the basis for urging national aid in bringing greater areas under irrigation. Certainly the addition of 60,000,000 acres, equivalent to two states the size of Pennsylvania, to the present productive area of the public domain is an expansion in the right direction. The fact that these lands capable of irrigation are distributed, oasis like, through regions which must always yield but scanty returns, and that these areas have a calculable productivity equal to the best land in humid states, are

[1] WHITMAN CROSS AND A. C. SPENCER, "Geology of the Rico Mountains, Colorado," *Twenty-first Annual Report of the U. S. Geological Survey*, Part II, 1899–1900, pp. 1–165; summarized in JOURNAL OF GEOLOGY, Vol. X (1902), p. 910.