*GEOLOGIC ATLAS OF THE UNITED STATES (II.).*

FOLIO 11, JACKSON, CALIFORNIA, 1894.

THIS folio consists of 2 pages of text descriptive of the Gold Belt, concluding with a generalized section of the formations of the Gold Belt, 4 pages of text descriptive of the Jackson tract, signed by H. W. Turner, geologist, and G. F. Becker, geologist in charge; a topographic map of the Jackson tract (scale 1:125,000), a sheet showing the areal geology, and a third of structure sections.

The area covered by the folio embraces a portion of the foot hills of the Sierra Nevada, chiefly in the counties of Amador and Calaveras, California. The area is drained by the Mokelumne and Calaveras rivers. The region is one of great economic importance, and comprises a portion of the rich belt of gold-quartz mines known as the Mother Lode. One of these mines, the Utica, at Angels' Camp, is said to be paying about one million dollars yearly at the present time.

There are two distinct series of formations represented in this area. The Calaveras and Mariposa formations, of sedimentary origin, and the associated igneous rocks form an older, highly disturbed series, on which a later series rests with a marked unconformity. This later series represents the Tertiary and Pleistocene periods.

The Calaveras formation, of Carboniferous age, is composed of slates, quartzite, mica-schists and limestone lenses, and contains frequent gold-quartz veins. The Mariposa formation, of Jurassic age, is largely made up of clay slate. There are two main belts of this formation, and in the eastern one occur many of the gold-quartz mines of the Mother Lode.

The igneous rocks associated with the Calaveras and Mariposa formations are of considerable variety, but only three form areas of great extent. These are serpentine, granite and the porphyrites (old andesites) and their tuffs. The serpentine is undoubtedly an altered form of basic igneous rocks (pyroxenite and peridotite), and is intrusive. The granite is likewise intrusive, cutting through all the older rocks except the Mariposa formation, and there is little doubt that it is later than this formation also, and in adjoining districts it invades the Mariposa slates as well. The porphyrites are largely altered forms of surface lavas and tuffs, resembling andesite and in part basalt, and these rocks, have been folded and compressed along with the sediments of the Calaveras and Mariposa formations. The areas called amphibolite schists on the geological map are chiefly metamorphic forms of these porphyrite tuffs.

The formation of the later series, resting on these older rocks, that deserves most attention is called the Auriferous gravel formation. These gravels, which are found chiefly on the ridge tops, were deposited in Neocene time by rivers. These old streams, as may be seen by inspecting the map, united into one trunk a little to the north of the Bear Mountains, and there found an outlet into the gulf that then filled the San Joaquin Valley. At many localities these old river gravels have been profitably mined for gold. Forming a capping to the gravels are usually beds of volcanic material, chiefly andesite and rhyolite.

The Calaveras formation is of economic importance as containing frequent gold-quartz veins and lenses of limestone. Most of the latter are noted on the geological map.

The Mariposa formation affords a good roofing slate, but is chiefly remarkable as containing, in Amador county and in the north portion of Calaveras county, the quartz veins of the Mother Lode.

The amphibolite-schist belts contain copper deposits and gold-quartz veins. In the southern part of Calaveras county, at Angel's Camp, the Mother Lode lies to the

east of the Mariposa slates and intersects a belt of amphibolite schist.

In the granite of the West Point are a are numerous gold-quartz veins, the ores of which contain a larger per cent. of sulphurets than the ores of the Mother Lode mines, and such ores are called base.

The serpentine areas contain chrome-iron deposits at numerous points.

The tuffs overlying the gravels at Mokelumne Hill, Valley Springs and other points have been found to make good building stone. Sandstone quarries are marked in the foot hills in beds of Tertiary age, and the deposits of the same age near Ione afford large quantities of clay for pottery, and of coal.

FOLIO 12, ESTILLVILLE, KENTUCKY-VIRGINIA-TENNESSEE, 1894.

This folio consists of 5 pages of text by M. R. Campbell, geologist, a topographic map of the district (scale 1:125,000), a sheet showing the areal geology, another showing the economic geology, a third of structure sections, and a fourth giving a columnar section north of Clinch River and another south of that river.

The territory represented by the folio is located principally in southwestern Virginia, though the southern portion extends into Tennessee and the northwestern portion into Kentucky. Its area is 957 square miles, four-fifths of which is in the Appalachian Valley and one-fifth in the Cumberland coal basin.

The surface features are quite varied. In the Appalachian Valley they consist of a succession of narrow ridges separated by equally narrow valleys, trending in a northeast and southwest direction. In the coal basin the ridges are less regular, but higher, reaching in two cases an elevation of over 4,150 feet above the sea level.

The region is almost entirely within the drainage basin of the Tennessee River. The principal tributaries of this stream are Holston, Clinch and Powell rivers, each of which is a stream of considerable importance. The Kentucky portion of the territory is drained by the headwaters of the Cumberland River.

The geologic structure of the region is complicated. In the Appalachian Valley the rocks have been squeezed, in a northwest and southeast direction, until they have been forced into great folds. These are generally overturned toward the northwest, and have in many cases been compressed to such an extent that they have broken, allowing one limb of the fold to be thrust over the other. These faults are of frequent occurrence in this region. Sixteen or seventeen can be counted on the geologic map. In the coal basin the folding is less severe, and the result is a broad basin in which dips are prevailingly light, and in many places the rocks are horizontal.

The intense folding of the strata has brought to the surface all of the geologic formations from the Carboniferous to the Cambrian. On lithologic grounds these are divided into twenty-two separate and distinct formations. As a result of the original folding and subsequent erosion, these formations show at the surface in long, narrow outcrops of limestone, shale or sandstone, which in the various folds are repeated over and over again. It is this repetition of the hard beds that gives rise to the numerous ridges which are such conspicuous features of Appalachian topography. In the coal basin the rocks are nearly horizontal, and hence they show in outcrop around the flanks of the mountains, or irregularly over the less rugged portions.

The mineral resources of this region are important, though at present but slightly developed. A belt of marble, varying considerably in composition and appearance, outcrops along the northern side of Clinch Mountain. Iron ore occurs in many parts

of this territory, both in the form of limonite and in that of hematite. Red fossil ore is found in the Rockwood formation in the northern part of the region, and it is mined on Wallen Ridge, south of Big Stone Gap. Coal is the principal mineral resource of this territory. It occurs in the structural basin north of Stone Mountain, and sparingly in the great arch of Powell Mountain, east of High Knob. The coal-bearing rocks are approximately 5,000 feet in thickness and include many seams of workable coal. In the vicinity of Big Stone Gap the Imboden seam is the most important. It has been traced over a large area on the Virginia side of the basin, where it varies from 3 to 16 feet in thickness. On this side there are a number of other seams of good quality, ranging from 3 to 7 feet in thickness, which could be easily worked. The Kentucky portion has also many workable seams, but at present, owing to lack of transportation, no mining has been done on a commercial scale.

FOLIO 13, FREDERICKSBURG, VIRGINIA-MARYLAND, 1894.

This folio consists of 5¼ pages of text, signed by N. H. Darton, geologist, and W J McGee, geologist in charge; a topographic map of the district (scale 1:125,000), and a sheet showing the areal geology.

The map represents an area of approximately 1,000 square miles of the Coastal Plain region of northeastern Virginia and the southwestern corner of Charles county, Maryland. It includes, in Virginia, King George and the greater part of Caroline and Stafford counties and adjoining portions of Spottsylvania, Essex and Westmoreland counties. The city of Fredericksburg is near the center of the western margin of the area. The Potomac River crosses the northeastern corner of the area, and the Rappahannock River extends diagonally across its center on a northwest and southeast line. The headwaters of the Mattapony River are in its southwestern corner. Along these river valleys there are wide, low terraces capped by the Columbia formation, of Pleistocene age. The intervening areas are plateau remnants capped by Lafayette deposits, of supposed Pliocene age. The underlying formations are the Potomac, Pamunkey and Chesapeake, which lie on an east-sloping floor of crystalline rocks. This floor rises to the surface and constitutes hills of considerable height in the northwestern corner of the tract; eastward it is deeply buried under the Mesozoic and Tertiary sediments. The Potomac formation, which is the basal member of these sediments, consists of a heterogeneous series of sands and sandstones with intercalated clays. Much of the sand is arkosic, and consists of detritus of crystalline rocks. The Pamunkey formation, which overlies the Potomac unconformably, is the representative of the Eocene in this region. It consists in greater part of glauconitic marls. These marls are important fertilizers, and in some portions of the region have been used with excellent results. They are overlain unconformably by the Chesapeake formation, which is of Miocene age. It is characterized by fine sands, marls and clays, portions of which consist largely of diatom remains. It is the same series that extends to Richmond, where its diatomaceous character was discovered many years ago, and to the northward through Maryland. It thickens rapidly eastward, and is nearly 1,000 feet thick in the lower Chesapeake Bay district.

The crystalline rocks consist mainly of granites and gneiss and an infolded belt of slates, to which the name Quantico slates has been given. They are not of value for roofing slates, so far as is now known. They appear to be a continuation of the slates in the belts west of Richmond in which lower Silurian fossils were discovered some time

ago, but no fossils have been found in the area of the Fredericksburg sheet.

FOLIO 14, STAUNTON, VIRGINIA-WEST VIRGINIA, 1894.

This folio consists of 4 pages of text, signed by N. H. Darton, geologist, and closing with a columnar section of the area; a topographic map (scale 1:125,000), a sheet showing the areal geology of the district, another showing the economic geology and a third exhibiting structure sections.

The area represented is about 1,000 square miles of central Appalachian Virginia. It comprises central and western Augusta county and portions of several adjacent counties. Staunton lies near the center of the eastern margin of the tract. About a third of the area is in the Great Valley of Virginia, and the remainder stretches halfway across to the Alleghany Mountains.

The geologic formations comprise members from the Shenandoah limestone of the Great Valley to the Pocono sandstone of Lower Carboniferous age. There are also some small dikes of diabase in the northwestern corner of the area. The region is one in which relatively gentle folds predominate. There is an overthurst fault which extends along the western side of the Great Valley for some distance, and several other faults traverse the Shenandoah limestone.

The geological classification does not differ materially from that outlined by W. B. Rogers, but geographic names have been applied to the formations. The name Shenandoah limestone has been selected for the great series of limestones of the valley. This series comprises several subdivisions, but in the Staunton region they merge so gradually that no attempt has been made to differentiate them on the map. The upper member contains a Trenton fauna, and it is thought that the basal beds of the series extends into the Cambrian, although no fossils have been discovered in them. Next, there is the representative of the Utica and Hudson shales, which has been designated the Martinsburg shale. It is overlain by the Massanutten sandstones, which comprise the Oneida and Medina in terms of the New York series. Next, there are the Rockwood formation and the Lewistown limestone, which include the formations between the Clinton and Lower Helderberg. The Oriskany and associated sediments are here represented by a stratigraphic unit to which the name Monterey sandstone has been given. The great series of Devonian strata lying above the Monterey has been divided into the Romney shale, Jennings formation and Hampshire formation. As they are not sharply separated from each other the patterns by which they are represented on the map are merged over a narrow zone along their boundaries. Only a portion of the Pocono formation is included in the stratigraphic column in this region.

The principal economic resources are iron ores, which lie on a local unconformity between the Monterey sandstone and the Romney shale, and limestone for flux. Some of the limestones are suitable for marbles, and at many points lime is burned for local use. There are several thin, irregular beds of coal in the Pocono sandstone, but they are not of economic importance. Brick and pottery clays in the Great Valley complete the list of economic resources.

FOLIO 15, LASSEN PEAK, CALIFORNIA, 1895.

This folio consists of 2 pages of text by J. S. Diller, geologist, descriptive of the Lassen Peak district, supplemented by two pages, with illustrations (9 figures), devoted to recent volcanic activity; a topographic map of the district, a sheet showing the areal geology and another showing the economic geology.

The Lassen Peak district is situated in

northern California, between the Sacramento Valley and the Great Basin, and adjoins the northern end of the Sierra Nevada. It is bounded by the 121st and 122d meridians and the 40th and 41st parallels, and contains an area of 3,634.4 square miles.

Within the district there are three distinct topographic features. Beginning at the west, it includes (1) a small portion of the eastern border of the Sacramento Valley, (2) the Lassen Peak volcanic ridge, and (3), upon the east, a portion of the Great Basin platform.

Twenty-two geological formations are shown upon the map. Thirteen of these were deposited by water as sedimentary rocks. The remaining nine are of igneous origin, and were erupted from the interior of the earth in a molten condition. Some of the sedimentary rocks, especially the younger ones, have not been materially changed since they were deposited, but others, such as the Auriferous slates, have been greatly altered or metamorphosed, and contain veins of quartz and metalliferous deposits.

By far the most abundant rocks of the Lassen Peak district are those of igneous origin. The numerous volcanoes of the district have furnished a great variety of such rocks.

Beds of unaltered stratified rocks, none of which are older than the Cretaceous, are still nearly horizontal; although uplifted, they have not been compressed enough to produce folds. On the other hand, the Auriferous slates have been thrown into a series of anticlines and synclines and so greatly compressed as not only to close the folds, leaving the strata in many cases approximately vertical, but also to break and displace them along a series of thrust faults during the earth movements by which the mountains were produced.

Upon the economic map special attention is called to the distribution of auriferous slates, in which alone there is any probability of discovering valuable deposits of precious metals. These rocks are exposed in the southeastern and northwestern portions of the area mapped, and extend through under the lavas of the Lassen Peak district from the Sierra Nevada to the Klamath Mountains of the Coast Range. The broad stretch of unaltered lavas about Lassen Peak does not contain any appreciable amount of precious metals, and may be wholly neglected by the prospector.

Among the auriferous slates seven formations have been distinguished, ranging in age from the Silurian to the Jurassic, inclusive. Of these the Cedar formation, of Triassic age, has been the most productive. By its disintegration it has furnished the gold for the placer mines of Indian Creek below Shoo Fly, of Soda Creek, Rush Creek, the north fork of Feather River and Dutch Hill. The Savercool mine, by the north fork of Feather River, is on this belt, and active prospecting is going on at a number of points. Numerous copper deposits have been discovered in the Pit River region.

Intermingled with the auriferous slates, there are eruptive rocks, such as diabase, porphyrite, peridotite and diorite, which have much to do in determining the distribution of certain classes of ore bodies. The areas of eruptive rocks have been outlined, and it has been found that the most promising prospects of that region are located near the borders of these eruptive masses. The ore deposits may be in the auriferous slates or the eruptive rock, but in either case they are not far from the contact.

Traces of coal have been discovered in the Chico and Ione formations, but no deposits of considerable value are yet known in the region of Lassen Peak. The Tuscan tuff has furnished some excellent material for chimneys, hearths and water coolers. The large deposit of diatom earth on Pit River, having a thickness of over 100 feet

and a length of several miles, is of economic importance for polishing, packing, making explosives and other purposes.

FOLIO 17, MARYSVILLE, CALIFORNIA, 1895.

This folio consists of 2 pages of text descriptive of the Marysville tract, signed by Waldemar Lindgren and H. W. Turner, geologists, and G. F. Becker, geologist in charge; a topographic map (scale 1:125,000) of the tract, a sheet showing the areal geology, another showing the economic geology and a third exhibiting structure sections.

The Marysville tract includes the territory between the meridians 121°30′ and 122° and the parallels 39° and 39°30′, and contains 925 square miles. The tract is located near the center of the Sacramento Valley. The larger part of it is occupied by the alluvial plains of the Sacramento and Feather rivers. The extreme northeastern corner includes the first rolling foot hills of the Sierra Nevada. In the center of the tract rises the isolated mountain group of the Marysville Buttes.

The alluvial lands consist of sands, clays and gravels, deposited by the shifting currents of the streams. The foot-hill region of the northeastern corner is principally occupied by the gravels of Pleistocene and Neocene age. The area composed of the bed-rock series of the Sierra Nevada is small and consists of diabase and porphyrite. The mountain group of the Marysville Buttes is an extinct volcano of probably late Neocene age, the internal structure of which is to a certain extent laid bare by erosion. The eruptive rocks of the buttes are andesites and rhyolites. In describing the structure of the group three parts may be distinguished: First, the central core of massive andesite and rhyolite; second, the upturned sedimentary rocks surrounding the massive core, evidently brought into their present position by the force of the ascending lavas; the sediments are of Eocene and Neocene age; third, the external ring of tuffs and breccias. The feature of greatest interest in connection with the Marysville Buttes is doubtless the presence of upturned sediments around the central core.

The shore gravels in the northeastern corner contain some gold and have been washed superficially. Somewhat auriferous gravels are also found in the upturned sediments of the Marysville Buttes. Coal and natural gas have been found in small amounts in the Marysville Buttes.

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*A GLACIER IN THE MONTANA ROCKIES.*

The section of the Rocky Mountains lying between the Great Northern Railway and the international boundary has thus far been but little explored. Until the advent of the railway there was such difficulty in reaching these mountains that only an occasional prospector or trapper penetrated their fastness. As access has become easier it has been growingly evident that it is a region of remarkable scenic and geological interest. Thus far it has been reached largely from the eastern side, but this has been troublesome from the fact that skirting the eastern slope of the mountains is the great Blackfoot Indian reservation, over which it is impossible to travel without much annoyance.

Several glaciers have been known to exist in these mountains and two are located upon the military maps of the department of Dakota. The largest of these is known as the Grinnell glacier from Mr. George Bird Grinnell, who has made a number of expeditions into the region and has done more than anyone else to attract attention to it. The Grinnell glacier is not easily accessible and for some time efforts have been made to discover others which could be more easily reached by the ordinary tourist. About a year and a half ago Dr.