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MINERAL INFORMATION SERVICE

STATE OF CALIFORNIA DIVISION OF MINES

Volume 12 Number 6

JUNE 1959

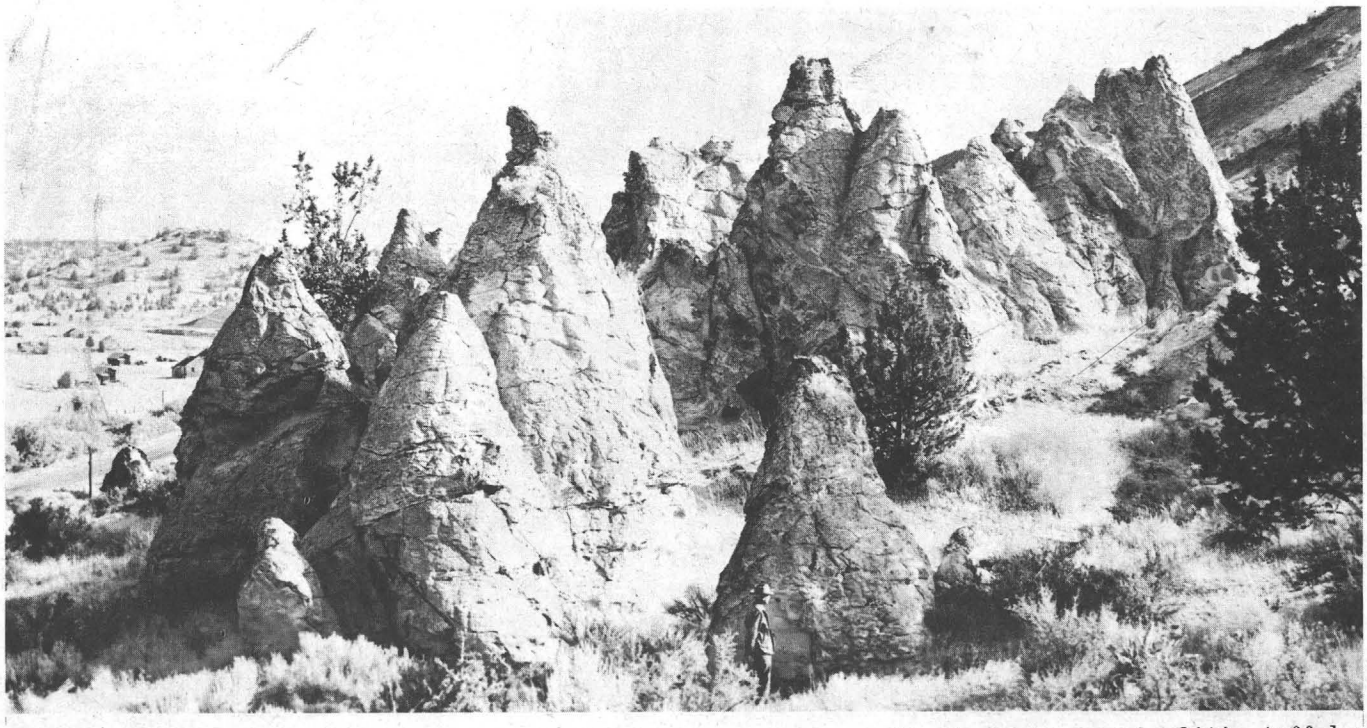
Geology of Northeastern California

The recently published Alturas sheet of the new Geologic Map of California shows the geology of a very interesting area in the northeastern corner of the State, at the scale of 1:250,000 (about four miles to the inch). A variety of Tertiary and Quaternary volcanic rocks, mainly olivine basalt flows and andesitic pyroclastic rocks, cover most of the area of the Alturas sheet. The only pre-Tertiary units are pre-Cretaceous metamorphic rocks, which occur only in the extreme southwest corner of the area; no unmetamorphosed marine sedimentary rocks or granitic intrusive rocks are known to crop out in the map area. The physiography of the area is dominated by two main features: (1) a series of prominent scarps of mid-Tertiary normal faults which bound the many north-trending fault-block mountains and ridges in the area, and (2) vast floods of Quaternary basaltic lava that overlapped the fault-blocks and have been relatively little deformed.

Because of the scarcity of geologic data for this area about three quarters of the Alturas sheet was mapped on a reconnaissance basis by Division of Mines geologists in 1957 and 1958. The new Alturas sheet, with the Explanatory Data Sheet which accompanies it, is therefore the first published account of much of the geology in the area.

Base map for the Alturas sheet is the recently published Army Map Service Alturas sheet, series V-502, with 200-foot contour interval, and 100-foot supplementary contours. The sheet extends from 41 to 42 degrees north latitude, and from 120 to 122 degrees west longitude, and includes about 7200 square miles. It is bounded by Oregon on the north and Nevada on the east, and includes all of Modoc County, and parts of Siskiyou, Shasta, and Lassen Counties.

A variety of landforms and physiographic features occurs in this part of northeastern California. Por-



Conical pinnacles, "chimney rocks", formed by wind and water erosion in pumiceous rhyolitic tuff low on the west flank of the Warner Range. Flat surface at left side is edge of Devils Garden plateau, surfaced with Pleistocene basalt flows.

MINERAL INFORMATION SERVICE

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MINERAL INFORMATION SERVICE is designed to inform the public on the geology and mineral resources of California and on the usefulness of minerals and rocks, and to serve as a news release on mineral discoveries, mining operations, markets, statistics, and new publications. It is issued monthly by the California Division of Mines. Subscription price, January through December, is $1.00.

Other publications of the Division of Mines include the Annual Report of the State Mineralogist, the Bulletin and Special Report series, county reports, and maps. A list of the Division's available publications will be sent upon request. Communications to the Division of Mines, including orders for publications, should be addressed to the headquarters office.

tions of four geomorphic provinces are represented, each characterized by distinctive surface features and a unique geological record. The four provinces represented are (1) the Basin-Ranges province; (2) the Modoc Plateau province; (3) the Cascade Range province; and (4) the Klamath Mountains province.

The easternmost part of the Alturas sheet area is part of the Basin-Ranges province, where the tilted Warner Range fault block has been uplifted some 5500 feet above the floor of the adjacent Surprise Valley fault block, with a spectacular range-front scarp marking the line of the Surprise Valley fault. Desert conditions prevail east of the Warner Range, with periodically desiccated alkali lakes, saltflats, and unusual wind-formed hummocks and migrating sand dunes present on the dry, sagebrush-covered portions of the floor of Surprise Valley. Around the margins of Surprise Valley are preserved remnants of shorelines and terraces, some as high as 550 feet above the valley floor, left there by Lake Surprise, which occupied the valley in Pleistocene time, and which was contemporaneous with Lake Lahontan, an extensive Pleistocene lake which occupied much of Nevada and Utah.

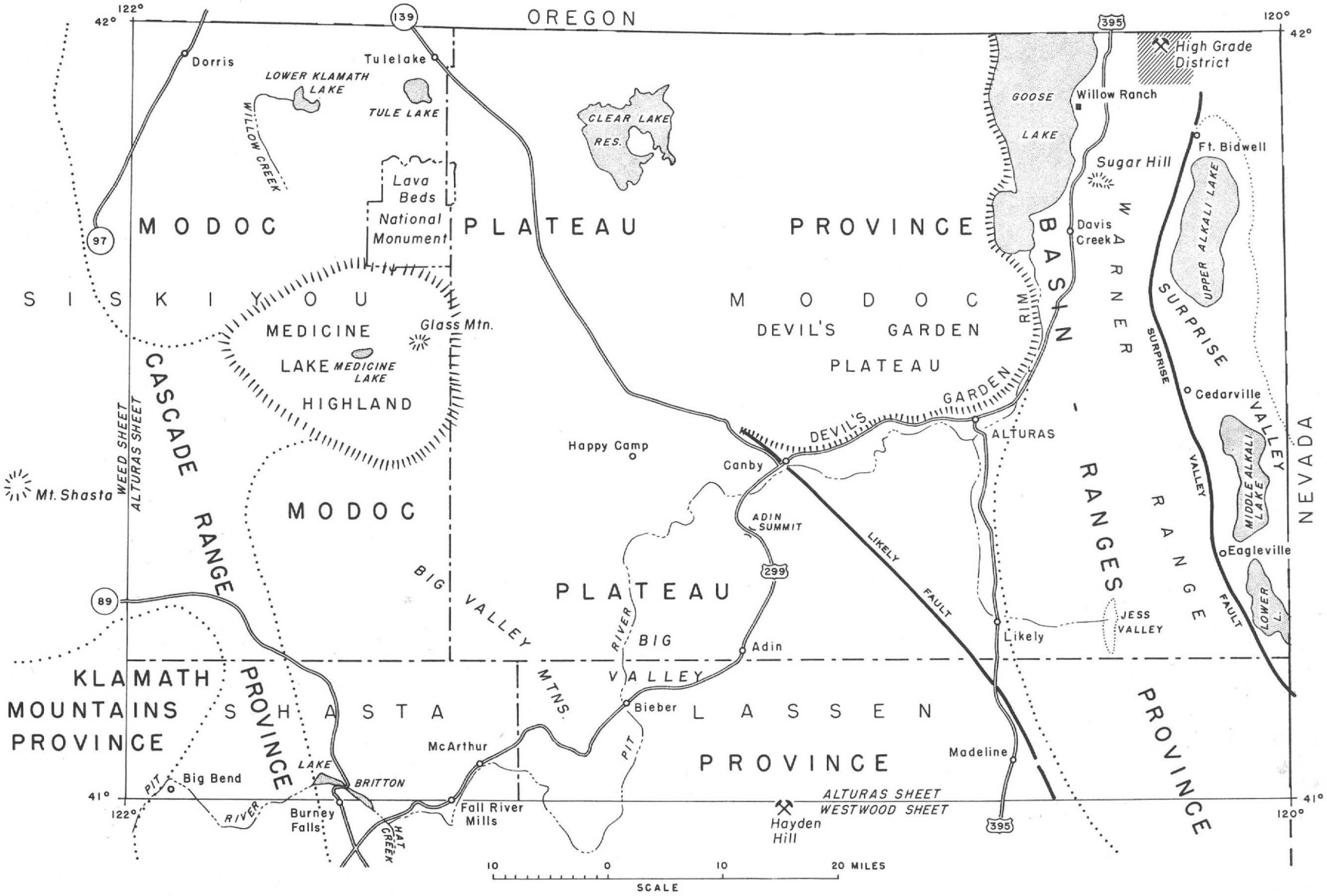
The uplifted Warner Range block, with its highest peaks only slightly less than ten thousand feet in elevation, is the most prominent feature in the eastern part of the Alturas sheet area. Its snow-clad crest in winter, and its wooded scenery with scattered meadows, glacial lakes, and incised streams in summer, make the Warner Range an attractive feature in this otherwise rather arid corner of California. High in the central part of the range is the South Warner Wild Area, in which the flora, wildlife, and alpine scenery are preserved in their original natural state. Large herds of mule deer and dense evergreen forests are found in the higher reaches of the west side, and near the crest of the range; by contrast, much of the steep, rocky east side of the range appears almost barren.

The range consists mainly of layered andesitic pyroclastic rocks--tuff, tuff-breccias, agglomerates--with intermingled andesitic flows. These rocks, which have been termed the Cedarville series, include Oligocene and Miocene units, and are the oldest known rocks in the Alturas sheet, except for a small area of Mesozoic and Eocene rocks in the southwest corner of the sheet. In the northern end of the range, near the Oregon border, a series of rhyolitic rocks is present as flows and shallow intrusions into the andesites; masses of obsidian and perlite also are present. In the southern portion of the Warner Range, and on its western flank, basaltic and andesitic flow rocks were poured forth in late Tertiary and Pleistocene time to cover large areas of the Cedarville rocks. Uplift of the Warner Range apparently began in mid-Tertiary time with a combination of arching, tilting, and uplifting forces. Although faults bound the Warner Range on both sides, like the Sierra Nevada, the east scarp is conspicuously abrupt, whereas the western flank of the southern part of the range slopes relatively gradually. Near the south border of the Alturas sheet, decreased uplift of the Warner Range causes it to blend gradually with an irregular terrane of Pliocene shield volcanoes and intervening flat plains once filled with large Quaternary lakes, which extend for many miles south of the Alturas sheet.

The central portion of the Alturas sheet, which comprises about two-thirds of its area, is in the Modoc Plateau province, characterized by extensive Tertiary and Quaternary basaltic lava flows, volcanoes, and cinder cones. The principal plateau district, known as the Devils Garden, occupies nearly 1000 square miles in the north central part of the area. Here, floods of olivine basalt formed a veneer from several tens to several hundreds of feet thick over the diatomaceous and ash-rich lake- and stream-laid sediments that are known as the Alturas formation.

Much of the Devils Garden plateau is bordered by an abrupt cliff several hundred feet high, where the soft underlying Alturas sediments have been eroded away, leaving a broad valley. The edges of the basalt flows that cover the plateau surface form a conspicuous dark-colored rimrock at the top of the plateau-bordering cliffs. Diatoms and vertebrate fossils (mainly mouse teeth) found just below the rimrock indicate a late Pliocene to early Pleistocene age for these sediments; the overlying basalt flows are considered to be Pleistocene. In this relatively arid part of the Alturas sheet area, the youthful lava plateau surface supports only a sparse vegetation, mainly of juniper trees and sagebrush. Parts of the plateau are covered with clusters of conspicuous circular soil mounds, from 4 to 5 feet high and from 30 to 40 feet in diameter. The mode of origin of these mounds is undetermined, but they are suspected of being at least in part caused by accumulation of wind-blown, ash-rich silt around clumps of vegetation. Elsewhere on the plateau, somewhat older, and more deeply weathered Tertiary basalts are covered by deep soils and merchantable pine forests. Pronghorn antelope, only a few herds of which remain in North America, are occasionally glimpsed on the Devils Garden plateau.

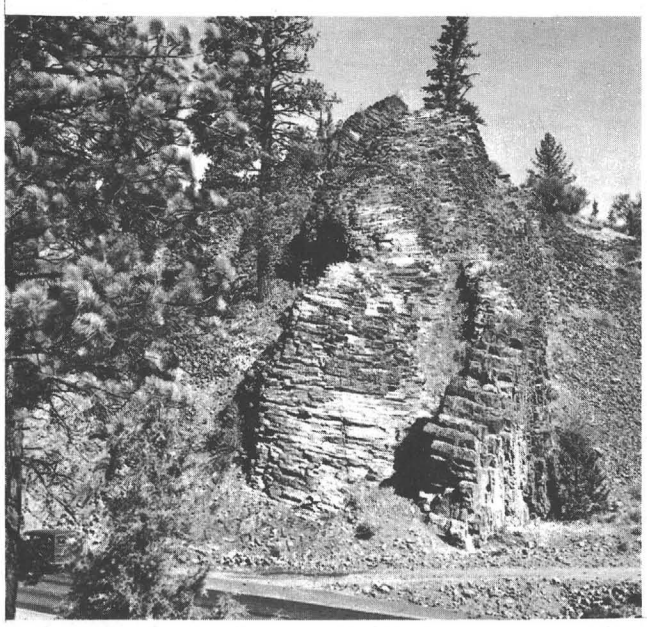
The south-central portion of the Alturas sheet, although generally included with the Modoc Plateau province, is a terrane of Tertiary basaltic and pyro-



Outline of the newly published Alturas sheet of the State Geologic Map, showing geomorphic provinces and some of the principal features in the area.

clastic rocks, broken by normal faults into northwest-trending fault-block mountain ridges with large alluviated valleys intervening. Pleistocene stream and lakebed sediments as much as 1000 feet thick occur in these broad valleys, and are covered in turn by a veneer of Quaternary lakebed sediments. The fault-block ridges consist primarily of Miocene basaltic flow and pyroclastic rocks, in which diatomaceous lake-laid sediments are locally abundant. An extensive series of Recent and Pleistocene basalt flows, that are more typical of the Modoc lava plateau, separate this fault-block area from the Medicine Lake Highland and Cascade Range area to the northwest and west. In the northwest corner of the Alturas sheet the Modoc Plateau surface is modified by northwest- and north-trending normal faults that divide the Tertiary and Quaternary lava surface into elongated blocks, with broad sediment-filled lake basins between.

Near the western edge of the Alturas sheet, and ordinarily included with the Cascade Range province, is the isolated mountainous mass known as the Medicine Lake Highland, named after Medicine Lake, which occupies a central depression in the Highland. This prominent region was apparently a shield volcano built up of andesitic lava flows in Pliocene time. Late Tertiary violent eruptive activity in the area was followed by a collapse of the central part of the mass, to form a caldera. Abundant eruptions of andesitic, basaltic, dacitic, and rhyolitic lava flows and cones around the rim of the caldera in Pleistocene and Recent time accentuated the central depression, and, with minor modification by Pleistocene glaciers, are responsible for the present configuration of the Highland. Among the interesting rocks that are exposed in the Highland, are extensive masses of pumice, scoria, and obsidian. Perhaps the most spectacular body of obsidian in California is Glass Mountain at the northeast edge of the Highland,



Columnar "cordwood" jointing in a basalt dike, about 10 miles south of Adin. Dikes such as this are thought to be feeders for the lava flows which cover extensive areas of the Alturas sheet.

a Recent flow of glassy gray to black rhyolitic obsidian, about a thousand years old. The flow is about a mile long, more than half a mile wide, and more than 150 feet thick at its snout. The toe of this tremendous mass of volcanic glass is an irregular heap of angular fragments, the larger of which weigh several tons. Several smaller "mountains" of obsidian occur in the central and western part of the Highland. More than 50 Recent volcanic cinder cones that range from barely perceptible mounds to perfectly formed cones nearly a thousand feet high are scattered around the top and flanks of the Highland. Most of the cones consist of reddish to black Recent basaltic cinders and scoria, but a few, like Pumice Stone Mountain, are mantled with a white blanket of fragmental pumice and pumicite that was apparently explosively blown out of volcanic vents on the Highland, and settled over much of the adjacent landscape.

Just north of Medicine Lake Highland in the western extremity of the Modoc Plateau province, is Lava Beds National Monument, which comprises about 73 square miles of interesting and unusual features in the Quaternary basaltic lava flows ("Modoc basalt") that cover this region. The general Lava Beds surface slopes gently down to the northward, with local irregularities where cinder cones, explosion craters, chimneys, fault scarps, and individual lava flows are present. The Modoc basalt is generally a dark-colored, extremely rough-surfaced flow rock on which little or no soil or vegetation has formed. Some of the most recent flows appear to be less than a thousand years old. At least 12 prominent cinder cone buttes, that range from 50 to 700 feet high, are in the Monument; Mammoth Crater, the most spectacular of the several funnel-shaped explosion craters in the area, extends to 375 feet below the surrounding surface. Among the most recent features are the several groups of spatter cones, or chimneys, that were formed by the gradual accumulation of semi-molten lumps and clots of frothy lava around fumarole vents. These chimneys range from 2 to more than 50 feet in height, and from one to more than a hundred feet in diameter. Sinuous, log-like ridges which extend as far as several hundred feet from the bases of some of the chimneys, have hollow interiors and are in effect, miniature lava tubes formed on the surface. Small domes of lava, which range in diameter from 2 to about 20 feet, and which are believed to have formed as blister-like gas bubbles, occur at many places on the surface of the basalt flows.

Perhaps the most spectacular features of the Monument are the many caverns, or lava-tubes, 293 of which are said to be present in the Monument, and 130 of which have been explored. Only where a tube, or tube-system, has a collapsed place in the roof is it accessible; two or more open caverns commonly are present in a tube. A wide variety of dimensions, forms, wall and floor detail, and other features are present in the various caves. Seemingly permanent ice beds occur in several of the caves; fossil remains of a mastodon and prehistoric camel were found in another. An astonishing variety of stalactitic forms ("lavacicles") occur on the walls and ceilings of many of the caves. Pictographs, stone artifacts, obsidian weapons, bones, and human skeletons are evidence of Indian occupation of some of the caves; during the Modoc Indian War, in 1872-73, several caves were used as Indian retreats.

Pumice quarry at the foot of Glass Mountain, a flow of obsidian on the margin of Medicine Lake Highland. Pumice obtained from this mantle-like deposit, which is as much as 60 feet deep over older basalt flows, is used as aggregate.

The western edge of the Alturas sheet area, which lies in the Cascade Range province, consists mainly of the volcanic mountains that form the east flank of the Cascade Range. Mt. Shasta, the most prominent peak in the southern portion of the Cascade Range, is less than 10 miles west of the Alturas sheet border. The generally conical peaks of this region are made up mainly of Pliocene andesitic rocks, although Pleistocene basaltic lavas occur at lower elevations. Mt. Shasta was the central point for the extensive Pleistocene glaciation that occurred in this region, and still retains permanent ice fields near its summit. The more prominent of the subordinate peaks east of Mt. Shasta have been affected by glacial action; glacially carved U-shaped valleys, and deposits of glacial outwash debris are present near the west edge of the Alturas sheet.

The fourth geomorphic province in the Alturas sheet area is the Klamath Mountains province, limited to the extreme southwestern corner of the sheet. This is a rugged, deeply dissected region, dominated by the precipitous canyons of the Pit River drainage system. The rocks of this region are by far the oldest in the Alturas sheet area, and include Triassic and Jurassic metasedimentary and metavolcanic rocks; Paleozoic metamorphic rocks are known to underlie these units a few miles southwest, just off the Alturas sheet. In contrast to the generally flat-lying Tertiary and Quaternary rocks that cover the rest of the Alturas sheet, the Mesozoic units have been folded and tilted to create the generally steeply dipping attitudes that can now be observed.

The structural features present in the Alturas sheet are nearly all related to the north- to northwest-trending normal faults that may be traced through nearly all units that are older than Quaternary. Lack of precise stratigraphic control prevents accurate determination of the net displacement of any fault, but some idea of the probable magnitude of displacement is estimated from physiographic evidence, such as the height of the spectacular scarps that disrupt the lava surfaces and bound most of the fault blocks. The greatest visible displacement is the more than 5500 feet of throw of the Surprise Valley fault; the fault-block mountains in the south central part of the sheet have scarps that indicate minimum vertical displacements of 500 to 2000 feet. A number of sag-ponds and disrupted topographic features mark the position of the Likely fault, which trends northwest for about 40 miles from the south border of the sheet east of Madeline to the vicinity of Canby, and along which there has been major horizontal displacement, apparently in a right-lateral sense. The Likely fault is named after the small town of Likely in the southeasterly part of the area. Whether the Likely fault, or the abundant normal faults, continue northwestward beneath the Quaternary volcanic cover of the Devils Garden area is undetermined. The tilting of some of the fault block ridges down to the southwest is suggested by the slope of land surfaces, and the dip of layered rocks. Although dips as high as 30 degrees are not uncommon among the Miocene units, younger strata tend to be progressively less disturbed. Few folded structures have been recognized in the Alturas sheet area. A broad but gently folded anticline, which formed prior to the mid-Tertiary block faulting in the Warner Range, trends north-northwest across the northern part of the range. Late Tertiary and younger strata partially conceal a parallel broad synclinal fold that lies adjacent southwest of this anticline.

Among the more interesting features of the Alturas sheet area are the extensive deposits of diatomaceous earth that formed in Miocene and Pliocene time. Conspicuous white outcrops of diatomite, in bedded layers, locally as thick as 25 feet, are seen along Highway 299. One of the most striking outcrops is at the Highway 299 crossing of Hat Creek, several miles south of the Alturas sheet. Pliocene diatomite of undetermined thickness and purity extends from this locality beneath a capping of Pleistocene basalt around the shores of Lake Britton. This diatomite unit may also be traced to the thin layers of diatomite exposed on the undercut cliff face of scenic Burney Falls in Burney Falls State Park, which is just south of the south boundary of the sheet. Pliocene diatomaceous beds, also of undetermined thickness or purity, occupy about 20 square miles along Willow Creek valley near the northwest corner of the sheet; here, too, the diatomite is capped by Pleistocene basalt flows. Miocene diatomite beds are extensively exposed west of Big Valley in the northern

Blocks of banded obsidian from talus piles along margins of Glass Mountain, in Medicine Lake Highland. Mirrors for use in telescopes and other specialized optical instruments have been made from this obsidian. Scale is 6 inches long.

View west from Medicine Lake Highland. Light gray mass in foreground is Little Glass Mountain, which consists of two flows of obsidian separated by an escarpment. Pressure ridges that formed as the flows advanced show on left side; mounds which represent collapsed spines dot the surface of both flows. The white-capped, rounded mounds are cinder cones covered by a thin veneer of pumice fragments. Mt. Shasta on skyline.

Big Valley Mountains, and at various places in the mountains northeast of Big Valley, as well as at scattered localities elsewhere in the area. Although prospect pits have been dug and samples from several localities have been analyzed, diatomite has not been produced commercially in this area.

Striking and unusual erosional forms, locally called "chimney rocks", are present in the tuffaceous beds of the Alturas formation and the Cedarville series in the eastern part of the Alturas sheet area. The chimney rocks, which have been noted in groups of three to a score or more in widely scattered localities, consist of remarkably regular conical mounds, reminiscent of beehive coke ovens, from 5 to 20 feet in diameter at the base, and 10 to 30 feet tall. They form only from massive, essentially homogeneous, flat-lying pumice lapilli tuff, or coarser pumice tuff-breccia, apparently as a result of wind and water erosion. Siliceous cementing material acts to harden the surface of these otherwise soft rocks; where this surface is breached, the wind scours deep hollows in the uncemented interior of the rock mass.

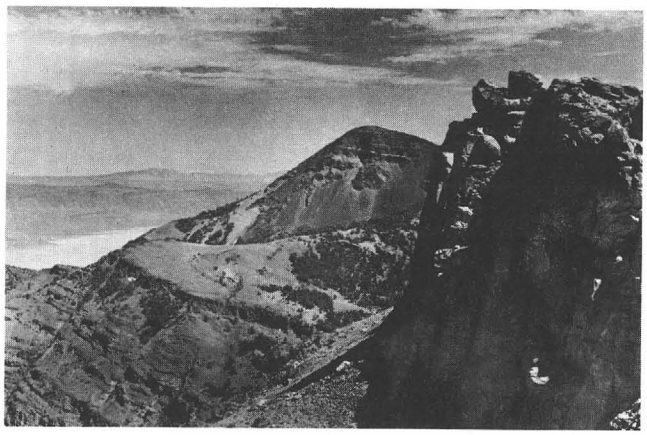
A variety of plant and animal fossil remains has been found in different parts of the Alturas sheet area. The smallest fossils are the microscopic diatom tests that comprise the Miocene, Pliocene, and Pleistocene diatomite beds which are exposed in scores of localities scattered throughout the area. The largest animal fossil is the skull of a Pleistocene bison with horns which measured more than six and a half feet between tips that was found in a gravel deposit near McArthur. Other vertebrate fossils include a rhinoceros jaw of probable lower Miocene age found near Cedarville; mouse teeth of upper Pliocene or lower Pleistocene age found near Alturas; remains of camel, fox, peccary, horse, rhinoceros, unidentified carnivore, and mastodon types from the Pliocene Alturas formation near Alturas; and mastodon remains near Fall River Mills. Determinable leaf fossils include am Eocene flora from carbonaceous beds north of Big Bend; an abundant middle Oligocene flora from beds of the Lower Cedarville near Cedarville; middle Miocene flora from three localities between Adin and Canby; and a middle Pliocene flora from the Alturas formation near Alturas. Gastropods of upper Pliocene age have been found near Alturas and near Dorris. Petrified wood is widespread in the Oligocene and Miocene rocks exposed on the east face of the Warner Range; fragments of petrified logs, stumps, and roots are especially abundant about two miles east of the range crest northwest of Eagleville. The state of preservation of many of the fossils found in this area is excellent, and from the abundance of types found, and ages represented, it appears possible that further work may yield a rather complete record of Tertiary life in this area.

Economic mineral materials that have been mined in the Alturas sheet area include gold and silver, and a variety of nonmetallic mineral products. The principal gold mines are in the High Grade district, at the crest of the Warner Range near the Oregon line, where rich but narrow and spotty quartz veins cut rhyolitic and andesitic rocks; this district has been essentially inactive since World War I, except for token activity in depression years. Just south of the southern boundary of the Alturas sheet is the once-productive Hayden Hill district, where gold was recovered from quartz veins in brecciated rhyolite tuff. Minor amounts of gold were mined at the long-idle Hess mine, near Adin summit. Copper has been found in minor showings in the Warner Range, near Happy Camp, and near Big Bend, but none has been produced. Cinnabar has been recovered from a small,

Spatter cone on Recent basalt flow in Lava Beds National Monument. Such cones are formed by forceful emissions of hot volcanic gas which eject semi-molten clots of lava, so they accumulate in mounds around the vent. Schonchin Butte, a cinder cone 500 feet high, is in left foreground.

long-idle deposit in the Warner Range near Willow Ranch; remains of two old retorts still stand on the property.

Of the nonmetallic minerals, salt was among the first to be produced, from brines of Middle alkali Lake in Surprise Valley, for local consumption in its crude state. The extensive deposits of diatomite, from which no production has yet come, have been noted above. The only peat moss that is commercially produced in California is obtained from drained Quaternary lakebed deposits in Jess Valley, and shipped widely for agricultural purposes. Most of the remaining mineral products of the area are forms of the volcanic rocks common to the area: volcanic cinders, dimension stone, obsidian, perlite, pumice, and sand and gravel. The several deposits from which volcanic cinders, pumice, and pumicite are obtained for use in building blocks, as lightweight aggregate, railroad ballast, and road material, are described in Division of Mines Bulletin 174 ("Pumice, Pumicite, and Volcanic Cinders in California", 1956). Several quarries near Alturas have yielded dimension stone for local construction projects from resistant layers of partly welded pumice tuff-breccia in the Alturas formation, called the "building stone". Obsidian, in addition to its wide usage for Indian points and tools, has been widely sought by collectors of ornamental stone in recent years. Particularly attractive are the chatoyant and red-streaked varieties found in the Warner Range. Selected pieces of Glass Mountain obsidian have been cut and ground to optical specifications for use as telescope mirrors. Perlite from the Sugar Hill area, in the west flank of the Warner Range, was the first to be expanded for lightweight aggregate in California. Approximately a thousand tons were successfully processed in the mid-1940's before other deposits closer to industrial centers captured the market. Sand and gravel is obtained from Quaternary terrace and streamwash deposits near population centers in the area for use as aggregate in highway and other construction projects. Where sand and gravel is not available, various types of volcanic rocks are crushed for aggregate.



View southeast along relatively barren steep east side of Warner Range. Light-colored playa surface of Surprise Valley at left, middleground; barren front of Hays Canyon Range, Nevada, in background. Photo by Eastman Studios.

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MINERAL MARKETS

The following quotations are taken from E & M J Metal and Mineral Markets, published weekly by McGraw Hill Publishing Company.

Metals—May 7, 1959

COPPER, electrolytic, 31.165¢ per pound, domestic refinery.

LEAD, refined, 11.3¢ per pound, [St. Louis]; 11.5¢ per pound, [New York].

ZINC, prime Western, 11.0¢ per pound, [East St. Louis].

Metallic Ores—May 7, 1959

CHROME ore, per long ton, dry basis, subject to penalties if guarantees are not met, f.o.b. cars, Atlantic ports: Turkish ore 48% Cr_2O_3, 3 to 1 chromium to iron ratio, $44 to $46, nominal.

MANGANESE ore, quotations on Indian ore, basis 46% to 48% Mn, export duty included, nominal at 87¢ to 90¢ per long ton unit, c.i.f. U.S. ports, import duty extra.

TUNGSTEN ore, U.S. scheelite, f.o.b. mine or mill, $19 to $22 per short ton unit, 65% WO_3, nominal.

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CALIFORNIA MARKET QUOTATIONS

The following quotations are from San Francisco and Los Angeles area processors and dealers, and were those in effect May 11, 1959.

MANGANESE ore, delivered to railhead for G.S.A. stockpile, carload lots, 48% Mn, 6% Fe, 11% SiO_2+ Al_2O_3, $2.30 per long ton unit; premiums for better grades, penalties for poorer grades.

QUICKSILVER, per flask of 76 pounds prime virgin, price paid to miner about $237, [San Francisco], in small lots; [New York], $245 to $249 per flask.

INDUSTRIAL MINERALS

(Crude unless otherwise stated). Prices depend upon chemical analysis, color, impurities, and physical properties. Market is generally limited.

BARITE, 90% to 98% $BaSO_4$, crude, $16 per short ton, [San Francisco area]; ground, bulk, $30 per short ton [Los Angeles].

BENTONITE [Wyoming type] carload lots, pulverized 200 mesh, $33.00 per short ton, [San Francisco area]. [California type-absorbent] insecticide, $30 per short ton, f.o.b. carlots, [Olancha].

FIRE CLAY, crude, $4.40-$7.50 per short ton depending on quality, [San Francisco and Los Angeles].

LIMESTONE, white, 97% $CaCO_3$, $7 per short ton [San Francisco].

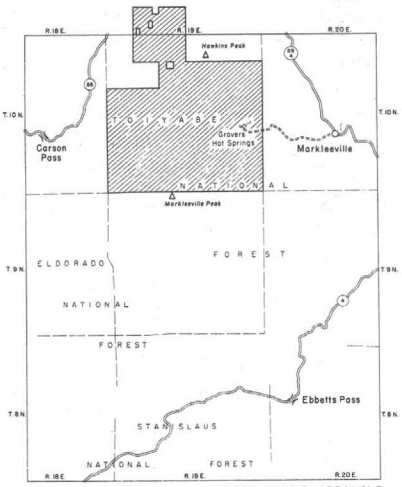
TALC, crude, $20 per short ton, [San Francisco area]. Soapstone, crude, $7 per short ton, [San Francisco areas].

PERLITE, crude, $9-$11 per short ton [Los Angeles area]; processed, 73¢ per sack of 4 cubic feet, f.o.b. [Los Angeles].

HUBERT O. JENKINS

Dr. Hubert O. Jenkins of Sacramento, long a prominent figure in nature conservation activities in California, passed away a few days ago at Sacramento. He was 74 and death came after a very short illness. He was the brother of Dr. Olaf P. Jenkins, recently retired chief of the Division of Mines.

LAND REOPENED



EBBETTS PASS QUADRANGLE
N3830-W11945/15

At 10:00 a.m. on April 24, 1959, the area of Alpine County shown in the sketch map was reopened, after having been withdrawn for reclamation purposes in 1913 in connection with the Truckee-Carson project.

The area comprises 20,439 acres, including 17,128 acres of National Forest land, and is located a few miles east of Markleeville. Roughly, it is bounded on the north by Hawkins Peak, on the south by Markleeville Peak, on the west by the West Fork of the Carson River, and on the east by Grovers Hot Springs.

As announced in the Federal Register, Vol. 24, no. 59, dated March 26, 1959, "...The National Forest lands shall be opened, subject to valid existing rights and the requirements of applicable law, to such applications, selections and locations as are permitted on such lands. They have been open to applications and offers under the mineral-leasing laws." Inquiries should be addressed to the Manager, Land Office, U.S. Bureau of Land Management, California Fruit Building, 4th and J Street, Sacramento.

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