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AUTHOR'S ABSTRACTS.

THE GEOLOGICAL SOCIETY OF AMERICA, CORDILLERAN SECTION.

FOURTH ANNUAL MEETING.

THE fourth annual meeting of the Cordilleran Section of the Geological Society of America, was held partly in the rooms of the Academy of Sciences, San Francisco, and partly in the rooms of the Department of Geology of the University of California, Berkeley, December 30 and 31, 1902. The officers elected for the ensuing year were H. W. Fairbanks, chairman; Andrew C. Lawson, secretary; and W. C. Knight, councilor. The following papers were read and discussed:

The Synthesis of Chalcocite and its Genesis at Butte, Mont. By HORACE V. WINCHELL, Butte, Mont.

IT was stated that chalcocite is the principal ore of copper at Butte, and that it is one of the latest minerals to be formed in the veins. It is believed that the mineral was formed by a chemical reaction between copper sulphate in solution in descending waters and the iron pyrites and other sulphides below. Some synthetical experiments were described to prove this. The active agent in the reduction of the copper salt to the cuprous state seems to have been sulphurous anhydride, SO_2, as the experiments showed that when pyrite was digested in a solution of copper sulphate containing SO_2, it became coated with a layer of chalcocite, while in the same solution without the SO_2 the pyrite remained just as bright and yellow as before immersion.

A Geological Reconnaissance of the Region of the Upper Main Walker River, Nevada. By D. T. SMITH, Yerington, Nev., presented by Andrew C. Lawson.

THIS region is in the western part of the state of Nevada, between latitudes 38° 50′ and 39° 10′. It comprises the greater portion of a valley of general north–south trend. Nearly ten miles of the eastern range and sixteen of the western have been mapped geologically.

The eastern range is made up of granitic rocks—andesite, rhyolite, and limestone. The western range is also made up of these, together with basalt, schists, garnetiferous rocks, and intrusives. In both ranges are some later Tertiary strata. The metamorphics are

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nearly transverse to the axis of the valley. In them are deposits of copper ore, and directly across the valley and having the same trend as the metamorphics are copper-bearing veins in the granitic rocks.

In several instances the genesis of the deposits has been ascertained. This came out through a study of the deposits and the country rock. In some places sufficient mining has been done to give helpful exposures of the deposits in depth.

The relation of the country rock, bearing the deposits, to the other rocks of the region was discussed in detail. Structural features, both general and local, were given special attention. It was hoped to correlate events with some other well-known part of the Sierras, but this was not entirely possible. No fossils from the limestone were found, nor have any been reported, so far as could be learned. The limestone however, is much plicated and petrographically borders closely on to marble. This would seem to suggest a relationship with that of the Sierra Nevada. The Tertiary strata are made up of material of all the rocks above mentioned, except the basalt, and perhaps an andesite, which seems to occur later than the ryolite, and is different from the andesite above mentioned. In the strata were found Pliocene vertebrates and a few triassic shells—presumably from the limestone.

The Correlation of the John Day and the Mascall. By JOHN C. MERRIAM and WM. J. SINCLAIR.

THE age of the John Day is commonly given in geological textbooks as Middle Miocene. A study of the large collection of vertebrate fossils from these beds made by the University of California, leads to a different view of the age of this formation.

The state of evolution of this fauna is practically identical with that of the Upper White River. Several genera occur in the Middle John Day which are found for the first time in the Protoceras beds. Associated with these are such persistent types as *Elotherium* and *Mesohippus*, which range far back into the Lower White River. But that the Middle John Day is not older than the Oreodon beds is shown by the total absence of Creodonts and Titanotheres, while it differs from the Oreodon beds in containing later introduced types, which are not known to range farther back than the Protoceras beds.

The Upper John Day contains several genera which have not been found in the Middle John Day (*Protomeryx*, *Protapirus*, *Promerycochœrus*). These seem to have entered Oregon as migrants from some

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of the eastern basins of accumulation. There are no related forms in the Middle John Day. With the exception of *Promerycochœrus*, and possibly some of the Rhinoceroses which have not yet been fully worked up, all the ungulate genera of the John Day are the same as those of the White River.

The Upper John Day has its closest affinities with the Middle John Day, and is probably in greater part Upper Oligocene, although it may overlap on the Lower Miocene. The Middle John Day is to be correlated with the Protoceus horizon of the White River Oligocene. The lower limit of the Upper John Day is determined by the downward range of *Promerycochœrus* in the beds.

This genus, which also occurs in the Mascall, and *Mylagaulodon angulatus*, gen. and sp. nv., and later types unite in a measure the gap between the Upper John Day and the Mascall faunas.

The presence of *Desmatippus crenidens* in the Mascall serves to correlate this formation with the Deep River beds. The flora preserved in the lower levels of the Mascall formation determines its age very definitely as Upper Miocene.

The Columbia lava represents in the stratigraphic series an erosion interval between the Upper White River and the Loup Fork in the plains region.

The Valley of Southern California. By E. W. HILGARD, Berkeley, Calif.

THIS paper treats of the orographic relations and post-Tertiary formations of the valley region extending from Los Angeles to Redlands, showing it to have been a topographic unit anterior to the subdivision of the drainage into the San Gabriel and Santa Ana systems by the extraordinary development of débris fans which now form the sources of artesian waters.

The Potter Creek Quaternary Bone Case. By WM. J. SINCLAIR; presented by J. C. Merriam.

THE case, which is situated near Baird, Shasta county, Calif., contains a thick deposit of alternating layers of clay, case breccia, and stalagmite resting in part on a stratum of volcanic ash. The ash reposes, either directly or with the intervention of some clay, on a floor of cemented case breccia known to be in part about a foot and a

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half thick. Excavation has not yet been prosecuted beneath this floor. The volcanic material is composed of fine fragments of glass.

Bones, in an excellent state of preservation, recur in all the deposits except the ash. They represent an *Equus* fauna of plains and forest type combined, much richer in species than any Quaternary fauna known from this coast. Among the larger forms represented are *Elephas*, *Mastodon*, *Megalonyx?*, *Rhinoceros*, *Equus*, and *Arctotherium*. Many smaller carnivora are present, many of them of extinct species. Among the rodents there is a new rabbit, a new squirrel, a new *Teanoma*, etc. Two species of deer are represented by numerous specimens.

At the time of the accumulation of the case deposit, the topography of the adjacent region had not assumed its present rugged character. The case was formed by percolating waters during the cutting of the McCloud river canyon. Infilling does not seem to have been contemporaneous with the excavation of the case. It is possible that much of the accumulation in the case antedates the Red Bluff epoch.

Further study will be required before the exact position of this fauna in the Quaternary case can be stated.

The Physiography of Southern Arizona and New Mexico. By H. W. FAIRBANKS.

THE great plain-like valleys of southern Arizona and New Mexico are extremely interesting. They stretch eastward from Yuma, where they are but slightly elevated above the sea, toward the continental divide, where they attain an elevation of 5,000 feet. From this point they gradually descend to 4,000 feet at El Paso, and are known to reach still farther eastward toward the Gulf of Mexico.

The plains are dotted with mountain ranges, which in southwestern Arizona are completely isolated and rise very abruptly, but toward the east the mountains break up the plain to such an extent as to form nearly inclosed basins.

A discussion of the origin of the nearly level surfaces of the broad valleys of the southern portion of the Great Basin and those adjacent to the lower Colorado led to the conclusion that three distinct types are to be distinguished: (1) those produced by erosion, as in the Mohave desert north of Kramer; (2) those of stream accumulation in old valleys, formed by the coalescing of débris fans; (3) those of accumulation in bodies of water.

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The delta accumulations of a large stream like the Colorado are very different in nature of material and manner of arrangement from those constituting the waste slopes or débris fans; and besides, at the time the great valleys of Arizona were filled to their present level there is no reason to suppose that there was such a river as the Colorado in this region.

As a result of the attempt to discriminate the origin of the nearly level surfaces of the plain-like valleys of the Southwest, the conclusion was reached that those of southern Arizona, as typically represented in the region about Tucson, are the result of accumulation under a body of water, and that this water could have been none other than the northern and eastern extension of the Gulf of California. At Tucson the plain has an elevation of about 2,200 feet.

Professor Blake has described the extension of the beds of this plain into southeastern Arizona, where in the San Pedro valley they attain an elevation of 4,000 feet. In the lower end of the valley he has found beds of diatomaceous earth which are thought to be of marine origin.

The floors of these plain-like valleys appear dissected as they rise toward the continental divide, and upon the middle Gila river are exposed in cliffs several hundred feet high and capped by flows of basalt. Basalt also forms a portion of the floor of the plain between Yuma and Tucson. The beds appear nowhere to have undergone other disturbance than simple uplift. Their materials are but slightly consolidated, and the writer believes with Professor Blake that they probably belong in the late Tertiary or early Pleistocene.

Valleys filled with similar well-stratified material extend across the continental divide, but their surfaces are in places modified by débris fans and in others dissected by erosion.

At El Paso well-stratified beds of fine detrital material have been cut through by the Rio Grande. There can be no question about their belonging with those farther west. They extend many miles east of the city, but just how far the writer does not know from personal observation. The presumption is that they reach the Gulf of Mexico.

From the facts presented it is legitimate to draw the conclusion that during the late Tertiary the whole of the southwestern portion of the United States as well as northern Mexico was very much lower than now, and that the sea reached in through long arms among the mountains toward the present continental divide. Just how far it is impossible to say from present knowledge, but the facts point toward

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the presence of bodies of water in all the large plain-like valleys in the region of the present continental divide in the latitude of the Mexican border. They may have been more or less isolated by the low divides connecting the mountain ranges, but were probably at or near sea level.

During the deposition of the beds and following them flows of lava occurred in places, and then the uplift and arching of the crust along the present divide.

This differential uplift gave rise to the conditions necessary for the excavation of the great canyons of the Plateau region and perhaps originated the Colorado river. The lower portion of this stream as well as the Mohave river has been superimposed upon an old topography as shown at numerous points.

Some Gypsum Deposits of Northwestern Nevada. By GEO. D. LOUDERBOCK, Reno, Nev.

A DEPOSIT of gypsum occurs some six or seven miles south of Virginia City. It is an isolated mass inclosed in limestone walls, the whole surrounded, in the main, by diorite. The principal body gives a surface exposure of over 100 yards in width and over 150 yards in length. This is practically all gypsum almost vertical in attitude. The mineral occurs as a milk-white holocrystalline granular aggregate, with some soft secondary earthy material at the surface and along a gully draining the area. The granular variety is quite pure, running generally over 90 per cent. $CaSO_4.2H_2O$, the chief impurity being $CaCO_3$.

Another large deposit occurs in the Humboldt range some five miles east of Lovelock. It occurs interstratified with limestone and a little quartzite. While undisturbed by intrusion, it is faulted and folded. Surface exposures of 300 yards or more in width occur, some two-thirds of which is gypsum, the rest mainly limestone. The thickest gypsum bed is about 150–175 feet thick. The mineral occurs as a holocrystalline granular aggregate except on the surface and lower slopes down which it has washed. It runs from 95–97 per cent. $CaSO_4.2H_2O$, practically the only impurity being calcite.

Reasons are given for believing that both of these gypsum deposits are original members of the stratigraphic series—*i. e.*, that they were formed by deposition from a saline water-body, and are probably of Middle or Upper Triassic age.

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Physiography and Geology of the Siskiyou range. By F. M ANDERSON.

THE Siskiyou range forms the central portion of the mountain system often referred to as the Klamath mountains. It follows approximately the boundary line between Oregon and California, and, branching toward the west, divides the drainage of the region in three directions, on the north toward Rogue river, on the south toward the Klamath river, and on the west toward Smith river. The topography of the range, together with its main geological features, suggests a system of transverse folds, one of which is older than the other. The areal geology of the range consists of an alternate succession of igneous and sedimentary, or metamorphic, belts crossing the major axis of the range nearly at right angles. The axis of the range is interpreted as being an expression of, or representing, an earlier topography, and the geological zones as representing a later system of folding.

There is a variety of both igneous and sedimentary, or metamorphic, rocks. The igneous rocks range from ultra-basic to acid types, and are mainly deep-seated. Three belts of igneous rocks cross the range. The sedimentary rocks are for the most part Palæozoic in age, though Triassic rocks may also occur. They include radiolarian cherts, siliceous and calcareous slates, limestones, and crystalline schists. The character of the metamorphic rocks varies in accordance with the character of the original sediments and with the character of the plutonic which has effected their metamorphism.

Magmatic differentiation in the plutonic rocks is extreme, the granitic rocks passing by gradations into diorites, gabbros, and other pyroxene-bearing rocks.

The Genesis of Ore Deposits in Boulder County, Col. By RUFUS M. BAGG, JR., Brockton, Mass.

THE geology of Boulder county was outlined. The formation of veins was considered. A description was given of the occurrence of fissure veins along irregular fracture zones which, after faulting, have been secondarily filled with solutions and sublimation products, chiefly the tellurides of gold, mercury, and the sulphide of iron, marcasite. The genesis of these rich ore pockets was discussed. A description of some of the principal mines was given. A summary of field observations when examining mines in the district was given.

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A Contribution to the Geology of the Leucite Hills, Wyoming. By J. F. KEMP, New York, and W. C. KNIGHT, Laramie, Wyo.

The Mechanics of Igneous Intrusion. By R. A. DALY, Ottawa, Canada.

THE more important facts of the writer's summary are:

1. *The facts of the field.*—(*a*) Lack of sympathy between structural planes in the invaded formation and form of intrusive body. (*b*) Respective magmatic chambers are not prepared for intrusion by circumferential faulting. (*c*) Contact phenomena demonstrate some kind of active assimilation of their corresponding country rocks by the respective magmas. (*d*) In the normal stock there is a lack of any enrichment of the endomorphic zone by the invaded formation; general freedom in the interior and characteristic abundance of angular inclosures near the contacts; exceedingly sharp lines of contact with country rock; a high degree of homogeneity in the igneous body, and common occurrence of many long and narrow apophyses form the igneous body. (*e*) Isolated observations prove that solid rocks may sink in molten magmas because of differential density.

2. *The facts of experimental research.*—The experiments of Barus, Doelter, Daubree, Cossa, Bischof, Cotling, Morozewicz and others show: (*a*) that representative natural or artificial silicate mixtures, at ordinary atmospheric pressure, become thinly molten at a temperature only slightly above that of solidification; (*b*) that, in every instance, a great increase of volume characterizes the change from the solid to the liquid state; (*c*) that, with strong probability, the volume increment and resulting density decrement are so far preserved in rock magmas under plutonic conditions as to forbid the flotation of blocks of the average country rock immersed in the average magma in depth; (*d*) that the chief rock-forming minerals are soluble in all of the melted silicate mixtures yet investigated and at the temperature ruling when those mixtures are thinly molten; (*e*) that rock magmas become thinly molten at temperatures very slightly above the melting point.

3. *The tests of the hypotheses of overhead stoping and enlargement of magma chambers.*—Reasons are given for concluding that the cause cited for overhead stoping is quantitatively sufficient for the majority of stocks and "batholiths," and the detailed phenomena associated with these inclusions are facts of nature expected on the hypothesis.

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Finally the author concludes that "dikes, sheets, laccoliths, 'byamaliths,' and perhaps a few of the smaller stock-like plutonic bodies are conceived to be due to crustal displacement permitting intrusion; that marginal assimilation in the preparation of subterranean magma chambers is quite subordinate to magmatic overhead stoping; and that *abyssal* assimilation, in contrast to marginal (*hypabyssal*), is responsible for the preparation or notable modifications of magmas whence come, through differentiation, the igneous rocks of the globe."

A Structural Section of a Basin Range. By GEORGE D. LOUDERBOCK, Reno, Nevada.

THE prevalent idea of the structure of the "Basin ranges" having been called into question, a structural section of the Humboldt Lake Range and adjoining country is presented as a contribution to the discussion. This range, where studied, is shown to be made up of strata of the Triassic and Jurassic periods, faulted, folded, in places overturned, which were greatly eroded, in fact were practically in a peneplained condition, before the outpouring of the Cenozoic volcanics. Over their upturned and eroded edges lies a volcanic series made up of rhyolites, rhyolite tuffs—some being current bedded, and with conglomerate layers—capped by basalt. This series is faulted and tilted in a simple manner, in great contrast to the older rocks. Reasons are given for believing that these volcanics were laid down at an approximately horizontal attitude, and that the volcanics of the range and those of the valleys on either side were continuous. On the east slope of the range, the series passes from the summit to the base, with some 20° dip, and disappears under the detritus of the valley. On the west slope they are not to be found, but they occur at the west base, butting into the range at an approximately horizontal attitude, indicating a fault on the west side and simple tilting of the range as a comparatively rigid block.

A well-checked use of the volcanic rocks, which are so abundant in the Great Basin region, to determine the character and extent of the more recent earth movements is urged, and examples are given from other ranges where it has proved of value.

The structure of the range may also be arrived at by the application of the physiographic criteria so concisely stated by Davis;[1] for (1) the range has a unity, and a consistent front, and while lying between broad flat valleys, it shows no approximation to broad intermontane

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valleys; and (2) the form of the range does not agree with the structure of its bed rock series, which latter is variously folded and tilted, in ways not expressed by the physiography, and shows varying degrees of obliquity to the front of the range.

The great erosion of the fault scarp, and lack of erosion of the basalt at its base, shows that the valleys have, during the history of the range as a faulted block, been anything but seats of great erosion; and the great thickness of alluvium and lake deposits shows that they have been areas of deposition.

The following papers for lack of time were read by title:

The Probable Cause of Water Flow in the Mines of Cripple Creek, Colo. By RUFUS M. BAGG, JR., Brockton, Mass.

The Paddles of Shastasaurus. By JOHN C. MERRIAM, Berkeley, Calif.

The Quaternary of the Middle Coast Ranges of California. By ANDREW C. LAWSON, Berkeley, Calif.

ANDREW C. LAWSON,
Secretary.

AUTHORS' ABSTRACTS OF PAPERS READ AT THE WASHINGTON MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

Direction of Flow of the Ancient Beaver River, Shown by Pot-holes.

By RICHARD R. HICE.

THE evidence of the slope of the remaining fragments of abandoned fluvial plains may not always be conclusive as to the direction of flow of the stream that formerly flowed over them. Pot-holes, one of the features of stream erosion, are conclusive. On the Beaver River from Beaver Falls to below the Fallston dam, the present channel, cut in the Homewood Sandstone, is marked by typical pot-hole erosion. Views of pot-holes below the Fallston dam show in all cases that the up-stream side of the hole is abrupt, and often undercut, while the down-stream side is rounded off and eroded by the action of the flowing water. This also applies to channels formed by

[1] *Science*, September, 1901, p. 457.

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