lished in one of their documents. This, together with the widely favorable criticism it has received, indicates that it will probably be widely adopted. The Committee recommended that a standing committee of two be appointed to take the further interests of the option in charge, to keep it in touch with educational progress, and readjust it to changing conditions; and that a new edition be prepared for distribution. The report was adopted, and as the committee, the former committee, Professors Ganong and Lloyd, was reappointed.

W. F. Ganong,
Secretary.

THIRD ANNUAL MEETING OF THE CORDILLERAN SECTION OF THE GEOLOGICAL SOCIETY OF AMERICA.

The Cordilleran Section of the Geological Society of America held its third annual meeting in the Academy of Sciences, San Francisco, on December 30 and 31, 1901. In the absence of the chairman, Professor W. C. Knight, of Wyoming, Mr. H. W. Turner was elected temporary chairman. The secretary reported the following rules as having been adopted by the Council of the Society at Denver, August 26, 1901:

1. *Officers.*—The officers of the Cordilleran Section shall be a Chairman and a Secretary. The latter shall also perform the duties of an accounting officer with reference to the expenses of meetings.

The officers of the Section shall be resident within the geographical limits of the Section. A President or Vice-President of the Society shall be, *ex officio,* Chairman of the Section whenever present at a meeting.

2. *Geographical Limits.*—For purposes of scientific fellowship and discussion the limits of the Section shall correspond with the limits of the general Society, and the meetings of the Section shall be open to all Fellows of the Society for presentation of papers, either in person or by proxy. For purposes of administration the membership of the Section shall be limited to those Fellows residing west of the 104th meridian.

3. *Membership.*—No person not a member of the Society may become a member of the Section. Members may invite contributions to the discussions at their meetings under the same rules as those applied to meetings of the Society.

4. *Date of Meetings.*—The meetings of the Section may be held at any time, subject to approval by the Council of the Society (Article 4 of Constitution). All notices and programs of meetings shall be sent to all Fellows of the Society.

5. *Expenses.*—The expenses of the Section, so far as they shall be paid from the general fund of the Society, shall be limited to the ordinary economical expenses of the meetings.

6. *Publications.*—All papers presented to the Section shall be available for publication in the *Bulletin* of the Geological Society of America under the rules governing publication by the Society.

The officers elected for the ensuing year were: H. W. Turner, of San Francisco, Chairman, and Andrew C. Lawson, of Berkeley, Secretary. An executive committee consisting of the chairman, secretary and Professor J. C. Merriam was appointed.

Resolutions were adopted expressive of the sense of loss sustained by the Section in the deaths of Professors Joseph Le Conte and E. W. Claypole.

The following papers were read and discussed partly in the Academy of Sciences and partly at the University of California, where the Section met after the opening session, for the purpose of viewing illustrative specimens and lantern slides:

An Instance of Variability in a Rock Magma: H. W. TURNER, San Francisco, Cal.

The instance referred to is the granolite area east of Sonora in Tuolumne County, California. This area is enclosed on three sides by the sedimentary rocks of the Calaveras formation, and on the east by a granite and gneiss series of older age, so that it is practically an enclosed area. The rock is designated, on the Sonora geological map of the United States Geological Survey, granodiorite, but it is not a typical example of that rock. It contains at most points some orthorhombic pyroxene. The rock varies from a granodiorite containing nearly 63 per cent. of silica to olivine gabbro containing about 43 per cent. of silica, there being all gradations between these extremes. The mass is intrusive in the Calaveras formation. The gabbro forms a hill in the interior of the area. The variation in mineral and chemical composition is not regarded as being due to absorption of material from the surrounding rocks, but to a differentiation during crystallization. On the west and south the Calaveras rocks contain much limestone, but the most basic facies of the rock, the olivine gabbro, is not near their contact. Moreover the limestone is not a magnesian limestone, and if we seek to explain the high lime content of the gabbro (14.27 per cent.) by an absorption of lime from the adjoining calcareous rocks, we are also brought to account for the high magnesia content (7.65 per cent.) of the gabbro from a similar source, and there are no magnesian rocks in the neighborhood outside of the granodiorite-gabbro mass, except small amounts of perknite or amphibole-pyroxene rock, and these are not, except at one point, in juxtaposition to the granodiorite-gabbro area. There perknites may indeed be themselves the extreme result of differentiation of the granodiorite. There are abundant dikes of diorite in the granodiorite, and pegmatite and quartz-tourmaline dikes or veins.

Triassic Reptilia from Northern California: JOHN C. MERRIAM, Berkeley, Cal.

Reptilian remains were first discovered in northern California in 1893, when Professor James Perrin Smith obtained two short series of vertebræ and two arch bones in the Triassic limestones. These specimens were described by the writer in 1895, under the name of *Shastasaurus,* and were thought to belong to a form closely related to the Ichthyosauria, though they did not appear to find a place in any known genus. During the summer season of 1901 a quantity of new material was obtained from the original locality. The collection includes considerable parts of five skeletons, also numerous loose limb-bones, vertebræ, ribs, etc. Nearly all of the specimens belong to the genus *Shastasaurus,* of which there are several well-characterized species. Two nearly complete series of dorsal and cervical vertebræ show *Shastasaurus* to be characterized by possessing single-headed ribs on all of the vertebræ in this region excepting the anterior 8–9. In the cervicals the parapophysis is relatively small and in the anterior dorsal region it disappears entirely. As far back as the middle dorsals the articular surface of the diapophysis is confluent with that for the reception of the upper arches. The anterior and posterior limbs have not been found together, but are known from species having the same type of vertebræ and ribs. The anterior limb is ichthyosaurian in type, but the transverse diameter of the humerus is much greater than the longitudinal. The radius and ulna are very short and are separated by a considerable space. In the posterior limb the femur resembles that of *Ichthyo-*

saurus. The tibia and fibula are longer than in that genus and are separated by a wide cleft. The anterior arch is ichthyosaurian excepting the scapula which is very broad. The posterior arch is very different from that of *Ichthyosaurus*. The skull is not well known. The dentition resembles that of *Mixosaurus*. The forms of this genus represent a distinct group of the Ichthyosauria. In some respects they are generalized and resemble *Mixosaurus*, in the other characters they show specializations which separate them from the other members of the family.

Ore Deposits of Shasta County: F. M. Anderson, Berkeley, Cal.

The copper belt of Shasta County, California, embraces, geologically, a series of old sedimentary rocks, Devonian, Carboniferous and Triassic, which extend in somewhat parallel bands northeasterly and southeasterly across the course of its longer axis. These strata have been penetrated and disturbed by intrusions of acid granolite, generally of the character of granite porphyry, though variable, which have been accompanied by flows of rhyolite and lavas resembling trachyte. In the vicinity of these intrusions and generally enclosed in the metamorphosed sedimentary rocks occur the deposits of sulphide ore which forms the subject of this paper. There are three or more types of ore represented among these deposits. The first class includes deposits found to the south of Pitt river near the mouth of the McCloud. They consist essentially of lenticular bodies of pyrrhotite carrying pyrite and chalcopyrite, but on the whole a low percentage of copper. These pyrrhotite bodies sometimes reach a thickness of 8 or 10 feet and a length of 50 or 60 feet, and are apparently connected with intrusions of dioritic rock. The second class of deposits is represented in all of the large ore bodies west of the Sacramento river, including the properties of the Shasta King, Balaklala, Iron Mountain and Mammoth mines. They are immense bodies of sulphide ore, consisting almost entirely of pyrite and chalcopyrite, with comparatively little zinc blende, but carrying both silver and gold. They appear to be replacement deposits, and have preserved in a measure the banded or stratified form of the original rocks. The largest of these deposits approximates 2,000,000 tons in extent. The grade of the ore varies from 1 to 20 per cent. in copper, averaging generally between 3 and 7 per cent., and carrying silver and gold to the value of $2.50 per ton. The ores of the Pittsburg and Afterthought districts, which constitute the third class, are similar to each other in character and probably in the mode of their occurrence. They are comparatively poor in iron and contain a larger percentage of zinc blende than any of the others. The ore includes little pyrite, consisting largely of chalcocite, bornite, chalcopyrite and other rich sulphides, with a gangue of silica and barite. The average grade of the ore at Bully Hill is nearly 10 per cent. copper with a relatively high value in silver and gold. The surface alteration in these deposits has resulted in the removal of the copper contents from the upper levels in which there is considerable concentration of gold and silver. In many cases the copper has found secondary lodgment in lower portions of the deposit, forming what is sometimes designated the 'copper level.' This secondary enrichment of the ore bodies is the rule throughout the whole extent of the copper belt. The grade and magnitude of these sulphide deposits entitle them to rank among the most important in the United States.

Lake Chelan, Washington: H. W. Fairbanks, Berkeley, Cal.

Lake Chelan is one of the most remark-

able and interesting bodies of fresh water in the west. It is situated in an ancient valley upon the eastern slope of the Cascade range in northern Washington. The lake has a length of about 60 miles and a width of one to two miles. It has an elevation of 950 feet above the sea level and a depth of about 1,400 feet. The country surrounding the lower end of the lake is quite open and contains numerous settlers, but through the greater portion of its length it is inclosed by mountains which rise quite precipitously 3,000 to 5,000 feet. The valley in which the lake lies has had an interesting history. It was occupied in quite recent times by one of the largest glaciers upon the eastern slope of the Cascade range. Previous to that there was another lake here, but at a somewhat lower level. The earlier lake was probably raised but slightly above the level of the Columbia river, into which it must have emptied. In the opinion of the author the great depth of the lake is due not to the erosion of the glacier, but to the fact that it was the bed of a stream, and was cut out chiefly by stream erosion. The glacier undoubtedly enlarged the valley somewhat and may have deepened it a little. If this view is the correct one the valley in which the lake lies must have been eroded at a time when the level of the land with respect to the ocean stood many hundreds of feet higher. The Columbia lava plateau would interfere with the drainage of such a valley, so that it must have been excavated prior to the formation of the plateau. The lake is held at its present level of 325 feet above the Columbia river, from which it is distant only three miles, by a morainal dam. The lower end of the lake is shallow, but as far as known to the author there is no reason to suspect that bedrock would be encountered at about the level of the Columbia river, which would be the case if the bed of the lake had been dug out by the glacier.

Lake Quiberis, an Ancient Pliocene Lake in Arizona: WM. P. BLAKE, Tucson, Arizona.

The San Pedro river of Arizona drains a considerable area, and is bordered throughout its course by mountain ranges forming a valley from ten to twenty miles in width and nearly one hundred and fifty miles in length. The valley is in general parallel with that of the Santa Cruz, the next great valley to the westward. A lake-like sheet of water of which we have good evidence filled the greater portion of this valley in late Tertiary or Quaternary time. This evidence is chiefly the presence on both sides of the valley of unconsolidated red clays and sediments in horizontal beds of great thickness, often terraced by the river erosion, and extending high up on the sides of the bordering mountains. One of the best cross-sections is found on the line of the Southern Pacific railway which crosses the valley nearly at right angles to its course at Benson. Benson, in the bottom of the valley, has an altitude of 3,576 feet above the sea. The river is about fifty feet lower. The lacustrine clays rise from this point on each side to the height of about 3,800 feet. The exact limit of clay deposition is not easily determined. It appears most probable that the height of the water was about 4,000 feet above tide. The sediments are similar to those around Benson, bordering the valley northwards, towards the Gila Valley. We there find also, in addition, the thick beds of diatomite mingled with fine volcanic ash. These diatoms are mostly marine species, according to Dr. D. B. Ward, of Poughkeepsie. But some fresh water forms are present. The Quiberis Valley thus appears to have been occupied by sea-water. It was open on the north to the great open valley of the Gila and Salt rivers and would appear to have existed as a partly landlocked estuary, at least in the upper portion between the

Dragoon Mountains and the Whetstones and Huachucas. The phenomena bear testimony also to the great epeirogenic uplift since the Miocene. A depression of four thousand feet would submerge the greater part of southern and southeastern Arizona, including the great valleys of the Gila river, Salt river and of the Santa Cruz, leaving only a few widely separated islands above the Pliocene Sea.

The Debris Fans of the Arid Region in their Relation to the Water Supply: E. W. Hilgard, Berkeley, Cal.

The debris fans or cones of the torrential periodic streams that enter the broad and deep valleys of the Cordilleran region are wholly different in their genesis and structure from the alluvial fans of the streams that enter lakes, as described by Gilbert (Monograph No. 1, U. S. Geol. Survey). Immediately in front of the cañon mouth we always find an accumulation of cobbles and boulders, the latter sometimes of enormous size; these grade off into smaller cobbles and gravel as the distance increases, but there is always an irregularly semi-elliptical area, of an extent proportioned to the size of the stream, on which the water is partly or wholly absorbed unless the discharge exceeds a certain amount, when a portion of it passes over the gravel area, carrying with it the finer materials, which are deposited beyond. As the valley is filled up and the slope decreases, it takes exceptional floods to carry the coarse materials to any great distance from the cañon mouth. Yet while the slope was steep and the valley channel relatively narrow, the cobbles were often carried to considerable distances. The water so absorbed in the coarse materials forms a pressure column behind the main body of the fan, which when large becomes a prolific source of artesian water, as is prominently exemplified in the upper San Bernardino valley and elsewhere in California. The extreme irregularity of structure within the fan, and the variations in the quantity and course of the main discharge of the stream, cause corresponding irregularity in the flows and static pressures of wells; high pressure being frequently coincident with small flows, and vice versa. Spontaneous outflows also frequently occur in times of high floods, or as the result of erosion on the fan slope. 'Artesian' springs and streams thus formed are important sources of irrigation water in southern California; they respond to the variations of the seasonal rainfall in from three to six months. Hence these debris fans form natural storage and regulating reservoirs of great importance. A striking example of the effect of these conditions upon the topography and hydrography of the valleys is afforded by the debris fan of San Antonio creek, a snow-fed torrent descending from the Sierra Madre northward of Pomona, Los Angeles County. Its typically regular fan has extended clear across the valley (nine miles) to the foot of the hills opposite, thus forming a water-divide between the Santa Ana and San Gabriel rivers. The creek itself has in the past evidently discharged alternately into the two drainage basins, which originally were probably a single one draining through the Los Angeles plain into the sea. This is an easily verifiable illustration of the manner in which the broad Cordilleran valleys have been filled in, as lately discussed by Shaler. Similar though less obvious examples exist in the Great Valley of California, as well as in the Santa Clara valley on San Francisco Bay.

A Post-Tertiary Elevation of the Sierra Nevada shown by a Comparison of the Grades of the Neocene and Present Tuolumne Rivers: H. W. Turner, San Francisco.

The Neocene Tuolumne occupied the

same drainage basin and followed approximately the same course as the modern stream. The most western point where the gravels of the Neocene Tuolumne have been preserved is east of the head of Big Humbug Creek in the Sonora quadrangle, and the most eastern Piute Canyon in the Yosemite quadrangle. If we now calculate the average grade of the Tertiary stream between these two points, and the average grade of the present river between the same points, we can compare the grades of the two streams. The altitude of the Neocene Tuolumne gravels at Big Humbug Creek is about 2,800 feet, and at Piute Canyon 7,500 feet, giving a difference of 4,700 feet. The altitude of the present Tuolumne north of Big Humbug Creek is 1,500 feet, and at Pate Valley, at the mouth of Piute Creek, 4,550 feet, giving a difference of 3,050 feet. The horizontal distance between the two points is about 33 miles. Assuming that both the Neocene and the present streams took a direct course, we have a grade of 142 feet to the mile for the Neocene channel, and a grade of 92 feet to the mile for the present channel. While the Neocene river occupied a rugged canyon, nevertheless this canyon was much less deep and rugged than that of the present Tuolumne, which implies, other things being equal, a higher grade for the present than for the Neocene channel, while, as we have seen, the reverse is the case. The broad channels and large sand and gravel deposits of the Neocene streams of the Sierra further north can scarcely be explained on any other hypothesis than of comparatively gentle grades, indicating an old age for the streams, and this must have been likewise true of the Neocene Tuolumne, although in less degree. Assuming that the Neocene Tuolumne had originally a grade at least as low as that of the modern stream, which is evidently yet a young stream, it is clear that the present grade of the Neocene channel must have been brought about by a differential uplift on the east, resulting in a tilting of the range westward.

On an Orbicular Gabbro from San Diego County, California: ANDREW C. LAWSON, Berkeley, Cal.

The rock described in this paper is a very basic gabbro in the form of an aggregation of spheroids having both radial and concentric structure. The spheroids have an average diameter of about 6 centimeters, but are mostly somewhat deformed in shape. The core of these spheroids is a granular gabbro and the space between the spheroids is of a similar character. An analysis of the rock is given.

A Geological Section of the Middle Coast Ranges of California: ANDREW C. LAWSON.

The paper is an attempt to summarize recently acquired information as to the sequence of formations and their respective volumes of sediments in the Middle Coast Ranges of California. The results given for the thickness are approximations sufficiently close to afford a general idea of the section. Other features of the paper are the subdivision of the Franciscan into seven stratigraphic subdivisions by the recognition of a persistent horizon of foraminiferal limestone and two important horizons of radiolarian chert; a similar subdivision of the Monterey into seven stages and a summary announcement of the character and history of the post-Monterey Tertiary. The essential features of the paper are given in the following tabulation.

The Pleistocene Ecology of Southern California: RALPH ARNOLD, Stanford University, California.

A summary statement of the marine Pleistocene of San Pedro and other localities of southern California with a subdivision of the Pleistocene formations partly on the basis of structural unconformities

GEOLOGICAL SECTION OF THE COAST RANGES OF CALIFORNIA IN THE VICINITY OF THE BAY OF SAN FRANCISCO.

			Thickness. Feet.
Merced		Upper marine sandstones, sandy shales and clay shales Lower marine clays, sandy shales, sandstones, fine pebbly conglomerates	5,830
	Unconformity.		
Campan		Volcanics, andesites, basalts, rhyolite agglomerates Fresh water, conglomerates, sandstones, clays, limestones	500
	Unconformity.		
U. Berkeleyan		Volcanics, basalts and tuffs Siestan, fresh water, clays, limestones, sandstones, shales, lignite, tuffs, conglomerates, Volcanics, andesites, basalts, rhyolite tuffs	200
	Unconformity.		
L. Berkeleyan		Volcanics, andesites, basalts, rhyolite tuffs Trampan, marine shales, sandstones, pebbly conglomerates Orindan, fresh water conglomerates, sandstones, clays, limestones, tuffs	2,000 2,400
Pinole—Tuffs (pumiceous) fossiliferous			1,000
San Pablo—Blue tuffaceous sandstone, marine			1,500
	Unconformity.		
Monterey	Upper	Stage 7—Sandstone	1,800
	Middle	Stage 6—Bituminous shale	670
		Stage 5—Sandstone	1,200
		Stage 4—Bituminous shale	460
		Stage 3—Sandstone	600
		Stage 2—Bituminous shale and chert	250
	Lower	Stage 1—Sandstone	400
	Unconformity.		
Karquinez		Tejon—Massive sandstones Martinez—Massive sandstones	2,100 2,200
	Rhyolite flows. (Age not certainly determined).		
	Unconformity.		
Shasta-Chico		Chico—Sandstones and shales Oakland—Conglomerate Peridotite irruptions. Knoxville—Shales with subordinate limestone and conglomerate	3,000+ 500 1,000
	Unconformity. Volcanics.		
Franciscan		Bonita sandstone San Miguel cherts, radiolarian Marin sandstone Sausalito cherts, radiolarian Bolinas sandstone (volcanics) Volcanics. Calera limestone, foraminiferal Volcanics. Pilarcitos sandstone	1,400 530 1,000 900 2,000 60 790
			34,290
	Unconformity.		
Montara granite (correlated tentatively with late Jurassic granite of Sierra Nevada).			

and partly on the basis of their fossil fauna.

A Contribution to the Petrography of the John Day Basin: F. C. CALKINS, Berkeley, Cal.

The paper is based on a study of specimens gathered during the last three summers, by the University paleontological expeditions conducted by Dr. J. C. Merriam. It may be considered as a supplement to Dr. Merriam's 'Contribution to the

Geology of the John Day Basin.' The igneous rocks of pre-Eocene age comprise quartz-mica diorite, serpentines and pyroxenite. The Tertiary series, including the fossil-beds, is almost entirely composed of volcanic materials. The Clarno Eocene began with the eruption of andesitic lavas and tuffs, followed by quartz-basalt and rhyolite. The John Day Miocene beds are mainly tuffs of trachytic and andesitic character. Upon them lie the great basalt series, which is in turn overlain by the Mascall beds, similar in general composition to the John Day. The Pliocene Rattlesnake formation comprises rhyolitic lava and tuffs. The most recent evidence of volcanic activity consists in ash-beds interstratified with the terrace gravels.

Colemanite: ARTHUR S. EAKLE, Berkeley, Cal.

The paper contains the results of a crystallographic study of a large number of colemanite crystals from the Calico district, San Bernardino, Cal. The crystals are exceptionally rich in forms and in the number of well-developed faces. Although only showing terminations on one end of the vertical axis owing to their attachment to the matrix, seldom less than twenty faces are present, and some of the combinations if completed would show upwards of one hundred faces. About fifty forms occur, of which one third are new. Four quite distinct habits are noticeable, governed by the absence or predominance of certain of the terminal forms. The measurements were made with the two-circle goniometer designed by Goldschmidt, and since this important method is comparatively new to the mineralogists of this country, a detailed description of the work is given, in order to make clear the method of calculating and projecting the forms. The figures accompanying the paper are a gnomonic projection of the forms, an orthographic projection on the base and several clinographic projections illustrating the varied habits and combinations observed.

Eocene and Earlier Beds of the Huerfano Basin, Colorado, and their Relation to the Cretaceous: R. C. HILLS, Denver, Colo.

The paper discusses the stratigraphical and structural features of the Huerfano Eocene, and associated Upper Cretaceous beds, for the purpose of correcting certain errors that appeared in earlier papers on the subject. The uppermost beds previously assigned to the Eocene have been shown to contain a Wind River and Bridger fauna, but there is a much greater thickness of conformable beds of similar character, the age of which has not been definitely established, which it is thought should be provisionally correlated with the Lower Eocene of the Uinta and San Juan basins. The Lower or Poison Canyon formation is found to be unconformable with the true Eocene and with the underlying Cretaceous, and to present a strong contrast with the latter lithologically. It is suggested that the Poison Canyon beds are nearly related to, if not identical with, the post-Laramie formation of the Denver Basin.

ANDREW C. LAWSON,
Secretary.

A NEW BAROMETRY FOR THE UNITED STATES, CANADA AND THE WEST INDIES.

A NEW system of reducing the barometric observations of pressure at the stations of the Government Services of the United States and Canada was put in operation on January 1, 1902. The Weather Bureau has received all the data necessary for carrying on the Canadian computations simultaneously with its own, through the courteous cooperation of Professor R. F. Stupart, Director of the Canadian Meteorological Office. The reduction of pres-