his head visible. At two hundred yards the dog detected her master, and went to him directly.

From these tests, Dr. Romanes concludes that the dog distinguishes him from all others by the odor of his boots (1 – 6), and does not distinguish him in his naked feet (8 – 11). The odor is probably emitted by the feet, but must be mixed with that of shoe-leather to be of service to the dog. This is doubtless a matter of education: had the dog been used to following her master when without shoes, the animal would have learned to follow him thus. The characteristic odor cannot penetrate a sheet of brown paper, but a few square millimetres of surface is sufficient to give the dog the clew. The animal is ready to be guided by inference as well as by perception, but the inference is instantaneous (12 and 13 as compared with 2, 8, and 11). Lastly, not only the feet (through the boots) but the whole body emits an odor that the dog can distinguish in a mass of others (15). This order is recognized at great distances to windward (15), or in calm weather in any direction (16): it is not overpowered by anise-seed-oil (14) or by the foot-prints of another (4).

THE TIME NECESSARY TO PERCEIVE COLD AND HEAT.—It is well known that a cold sensation reaches consciousness more rapidly than a sensation of warmth. Dr. Goldscheider of Berlin, whose researches on the hot and cold points of the skin have gained him a well-deserved reputation, has recently accurately measured the length of the time necessary to perceive these sensations. The observations were made on parts equally sensitive to heat and cold, and with intensities of heat and cold equally different from the temperature of the part. The time of contact was recorded electrically by means of a metallic button fixed to the skin. Contact with a cold point was felt on the face after 13.5, on the arm after 18, on the abdomen after 22, on the knee after 25, hundredths of a second. The sensation of a hot point was felt on the same surfaces after 19, 27, 62, and 79 hundredths of a second respectively. This great difference in time has an important theoretical bearing on the physiology of dermal sensations.

BOOK-REVIEWS.

Geological History of Lake Lahontan, a Quaternary Lake of North-western Nevada. (U.S. Geol. Surv., Monogr. XI.) By I. C. RUSSELL. Washington, Government. 4°.

THIS volume, and the companion monograph by Gilbert on Lake Bonneville, are undoubtedly among the most interesting, if not the most important, contributions hitherto made to the ancient geography of this continent. It must be admitted, however, that the wonderful changes in the aspect of the Great Basin, of which we find here the most conclusive evidence, are scarcely ancient in the geological sense, having been accomplished almost wholly since the close of the glacial epoch, and largely since the advent of man.

Lake Lahontan, situated mostly within the area now forming the State of Nevada, filled a depression along the western border of the Great Basin, at the base of the Sierra Nevada; while Lake Bonneville, embraced almost entirely in the present Territory of Utah, occupied a corresponding position on the east side of the Great Basin, at the foot of the Wasatch Mountains.

The hydrographic basins of these two water-bodies embraced the entire width of the Great Basin in latitude 41°. Lake Bonneville was 19,750 square miles in area, and had a maximum depth of about 1,000 feet. Lake Lahontan covered 8,422 square miles of surface, and in the deepest part, the present site of Pyramid Lake, was 866 feet in depth. The ancient lake of Utah overflowed northward, and cut down its channel of discharge 370 feet. The ancient lake of Nevada did not overflow. Each of these lakes had two high-water stages, separated by a time of desiccation. In the Lahontan basin, as in the Bonneville, the first great rise was preceded by a long period of desiccation, and was followed by a second dry epoch, during which the valleys of Nevada were even more completely desert than at present. During the second flood-stage, the lake rose higher than at the time of the first high water, and then evaporated to complete desiccation; for the present lakes of the basin (Pyamid, Winnemucca, etc.) are of comparatively recent date, and are nearly fresh, for the reason that the salts deposited when the quaternary lake evaporated were buried or absorbed by the clays and marls that occupy the bottom of the basin.

As Lake Lahontan did not overflow, it became the receptacle for all the mineral matter supplied by tributary streams and springs, both in suspension and in solution. The former was deposited as lacustral sediments, and the latter as calcareous tufa, or formed desiccation products when the lake evaporated.

The introductory chapter contains a sketch of the Great Basin as the explorer finds it to-day. It stands in marked contrast in nearly all its scenic features with the remaining portions of the United States. The traveller in this region is no longer surrounded by the open, grassy parks and heavily timbered mountains of the Pacific slope, or by the rounded and flowing outlines of the forest-crowned Appalachians; and the scenery suggests nought of the boundless plains east of the Rocky Mountains or of the rich savannas of the Gulf States. He must compare it, rather, to the parched and desert areas of Arabia and the shores of the Dead Sea or the Caspian.

To the geographer the most striking characteristic of the country stretching eastward from the base of the Sierra Nevada to the Rocky Mountain system is that it is a region of interior drainage. For this reason it is known as the 'Great Basin.' No streams that rise within it carry their contributions to the ocean; and the climate is dry in the extreme, the average yearly precipitation not exceeding twelve or fifteen inches.

The area thus isolated from oceanic water-systems is 800 miles in length from north to south, and nearly 500 miles broad, and contains about 208,500 square miles. At the south the valleys of the Great Basin are low-lying, Death Valley and the Colorado Desert being depressed below the level of the sea; but at the north the valleys have a general elevation of from 4,000 to 5,000 feet, while the intervening mountain-ranges rise from 5,000 to 7,000 feet above them.

The mountains exhibit a type of structure not described before this region was explored, but now recognized by geologists as the 'Basin Range structure.' They are long, narrow ridges, usually bearing nearly north and south, steep upon one side, where the broken edges of the strata are exposed, but sloping on the other with a gentle angle conformable to the dip of the beds. They have been formed by the orographic tilting of blocks of the earth's crust, that are separated by profound faults, and they do not exhibit the anticlinal and synclinal structures commonly observed in mountains, but are monoclinal instead. The mountains are rugged and angular, usually unclothed by vegetation, and owe their marvellously rich colors to the rocks of which they are composed, especially the purple trachytes, the deep-colored rhyolites, and the many-hued volcanic tuffs so common in western Nevada, often rivalling the brilliant tints of the New England hills in autumn.

The valleys or plains separating the mountain-ranges, far from being fruitful, shady vales, with life-giving streams, are often absolute deserts, totally destitute of water, and treeless for many days' journey, the gray-green sagebrush alone giving character to the landscape. Many of them have playas in their lowest depressions (simple mud-plains left by the evaporation of former lakes) that are sometimes of vast extent. In the desert bordering Great Salt Lake on the west, and in the Black Rock Desert of northern Nevada, are tracts hundreds of square miles in area showing scarcely a trace of vegetation. In winter, portions of these areas are occupied by shallow lakes, but during the summer months they become so baked and hardened as scarcely to receive an impression from a horse's hoof, and so sun-cracked as to resemble tesselated pavements of cream-colored marble. Other portions of the valleys become incrusted to the depth of several inches with alkaline salts, which rise to the surface as an efflorescence, and give the appearance of drifting snow. The dry surface material of the deserts is sometimes blown about by the wind, saturating the air with alkaline particles, or is caught up by whirlwinds and carried to a great height, forming hollow columns of dust. These swaying and bending columns, often two or three thousand feet high, rising from the plains like pillars of smoke, form a characteristic feature of the deserts.

Chapter II., on the genesis of Lake Lahontan, contains a summary of the facts which show that the lake filled a compound orographic basin, resulting from the tilting of faulted beds. The question of outlet is discussed in detail, the conclusion being that the lake did not overflow.

Chapter III. discusses the physiography of the Lahontan basin, describing in detail the valleys and mountains, and its lakes, rivers, and springs, and including numerous analyses of the waters from these three sources. Attention is given to the peculiar playas or broad mud-plains of the arid region of the Far West, as well as to the temporary lakes, called 'playa-lakes,' which frequently flood them.

The physical history of the ancient lake is fully and ably discussed in Chapter IV. Under the head of 'Shore Phenomena' we find detailed descriptions and illustrations of the terraces, bars, embankments, etc., that were formed about its shores. The highest of the ancient water-lines is named the 'Lahontan Beach;' and the most conspicuous terraces below this are the 'lithoid,' 'dendritic,' and 'thinolitic.' Each of these marks the upper limit of a variety of tufa, from which it derives its name.

Numerous sections are introduced to show the structure and relations of the mechanical sediments, which consist of two deposits of lacustral marls, separated by a heavy layer of current-bedded gravels; thus recording two lake periods and an intermediate low-water stage.

Chapter V., on the chemical history of the lake, is especially important. It includes, first, a general account of the chemistry of natural waters as they occur in streams, springs, lakes, oceans, and enclosed lakes or seas, followed by descriptions of the tufas precipitated from the water of Lake Lahontan, the salts precipitated when complete evaporation took place, the efflorescences now forming on the desiccated floor of the lake, and the salt-works of the region. As already indicated, the tufas present three main divisions. The lithoid tufa is a compact, stony variety, and is the oldest of the principal calcareous deposits that sheathe the interior of the basin. Thinolitic tufa is composed of crystals, and was formed in the ancient lake when it was greatly reduced by evaporation. The dendritic tufa has a branching or dendritic structure, whence its name, and it is the newest of the tufa formations.

Chapter VI. presents the life-history of the ancient lake as determined by the abundant molluscan remains and other fossils that have been found. The shells show that the lake was fresh throughout its higher stages. During the period when thinolite was formed, it seems to have been too concentrated to admit of the existence of molluscan life, as no fossils have been found in that deposit. A chipped implement discovered in the upper lacustral beds indicates that man inhabited the Far West during the last rise of Lake Lahontan.

Chapter VII. is a brief *résumé* of the preceding chapters; while Chapter VIII. is devoted to a discussion of the quaternary climate of the Great Basin, the periods of greatest lake-expansion being correlated with the two glacial epochs of the Sierra Nevada, and believed to indicate cold and moderately humid periods.

In Chapter IX. we have a summary of the evidence bearing on the determination of the geological age of the lake. The conclusion reached is that it existed during the quaternary, but was more recent than the date usually assigned for the close of the glacial epoch.

The tenth and concluding chapter contains an account of the orographic movements that have affected the Lahontan basin since the last high-water period, including a map showing all the post-Lahontan faults, some of which are marked by exceedingly fresh escarpments, and are evidently still in process of formation.

The illustrations are profuse and admirably executed, and Mr. Russell's style is throughout clear and graphic. Details are mainly kept in the background, or presented in tabular form; and it is probable that both in general interest and educational value this monograph is excelled by none of the publications of the Geological Survey.

Elements of Geodesy. By J. H. GORE. New York, Wiley. 8°.

THE present publication is a treatise on some geodetic operations, and intended to give the beginner a clear insight into the subject. It begins with a brief historical sketch of the various attempts to determine the figure of the earth. The former half of the book is devoted to a description of the instruments and of the elementary operations and methods of plane geodesy, but the principal object of the author is to describe the methods of spheroidic and geoidic geodesy. The student who begins to study this important branch of geodesy will, or at least ought to, be conversant with the instruments applied by geodesists, with the theory of least squares, and with the calculation of triangulations, which are set forth at some length in the first part of the book. On the other hand, the beginner, who will find some valuable and practical hints in the chapters on base measurements and the field-work of triangulations, will miss a discussion of topographical methods and operations. The book would become far more useful for the beginner, who must study the simpler geodetic operations before beginning with the measurement of the figure of the earth, if a description of the methods and theories of topography were included in the plan. The development of each formula is very complete, and the results are given in the shape that the majority of writers have considered the best. Examples are given to illustrate the application of the formulæ. The student will find at the end of each chapter a list of books referring to the subject under discussion. F. B.

NOTES AND NEWS.

AS we go to press we have obtained a copy of the opening remarks of Prof. S. P. Langley, president of the American Association. Professor Langley spoke as follows: —

MEMBERS OF THE ASSOCIATION, — While, for the main purpose of our coming here, we are all of one mind, some must remember a peculiar pleasure in their first attendance, when they came to these meetings as solitary workers in some subject for which they had met at home only indifference, and held themselves alone in, till here, with a glad surprise, they met others, too, caring for what they cared for, and found among strangers a truer fellowship of spirit than their own familiar friends had afforded. With such communities of purpose wherever two or three among us are gathered together, it is a happy thing that we cannot remain strangers; for doubtless, of the many here who have habitually breathed "the calm and still air of delightful studies," there are few but know by experience how hard it is for one coal to keep alight alone, and how especially good it is for the solitary workers to be brought at times into the warmth of companionship. To a great many of us, then, it may be counted as the very chiefest good of such an assembly as ours to-day, that here each meets some one with a kindred glow, and finds that interest and sympathy from his co-worker without which the scientific life would be but too cold. It is most fortunate, nevertheless, that our happy constitution as a body, not only of investigators in science, but of teachers and lovers of knowledge, brings those here in greatest numbers who disseminate as well as produce it, and who are skilled to recognize the value of the newly mined product when brought into this public exchange of ideas. We must admit here, that foolish ideas as well as wise ones are brought to this open mart, and that, in dealing with the variety of papers now presented for acceptance, it becomes almost as hard a task for us to shut out folly as to entertain wisdom; for, after all, who are we that judge, and how can we say " wisdom is in us to decide," when it is chiefly because we are ignorant that we are here? Probably the only rule is that taught by experience, that since art is long and life short, experience difficult and judgment uncertain, knowledge commonly advances best by such little steps, that one foot is not lifted till the other is securely planted on the solid ground of fact. On the whole, then, while we agree that some rare visitors have come to us over the "high *priori* road," do not let us welcome without scrutiny all those who would walk over it into this association's domain. At the same time, in view of our ignorance as to the real nature and causes of things, I would plead with those of you who are judges, for a large tolerance, even of what seem to be errors of speculation, *when* these are found in company with evidence of a faithful original study of facts; for we shall then have, at any rate, done our best not to turn away Truth, even if she has come to us in an unfamiliar dress. And now I can only congratulate this assembly of her followers on a meeting which opens so auspiciously, and express the hope, that whether in the new knowledge which we may take to the section-room or find there, or in the