

HERMANN WILHELM VOGEL.

PROF. HERMANN WILHELM VOGEL, the well known photo-chemist and spectro-analyst, died on December 17 at his villa in the Grunewald Colony, near Berlin. To him is due the honor of the scientific development of photography, the progress in photo-chemical processes and in the technology of photography, the introduction of photography in colors, the application of photography to printing; in fact, of important advances in all branches of the art. The services he rendered to photo-chemistry constitute the most prominent features of the picture of his life work, but upon closer examination other fine lines strike us. Hand in hand with his photo-chemical researches go studies in astronomy and astro-physics, in esthetics and in practical psychology, and finally, we must not forget Vogel's delightful books of travel.

Vogel was a self-made man. His education was most unusual. He was born in 1834 at Dobrilugk, in Prussia, and when fourteen years of age he left school to enter a business house as an apprentice, but when nineteen years old he changed his vocation. An ardent interest in the natural sciences determined him to enter the Gewerbeakademie (academy of technology), in Berlin, where he devoted himself chiefly to the study of physics and chemistry. His principal teachers were the chemist Karl Rammelsberg, the physicist Dove, and the technologist Rudolf Weber. After the completion of his academic studies, Vogel was occupied for a short time as chemist in a sugar factory, but afterward returned to the Gewerbeakademie, and in 1858 was given a position there as assistant in the chemical laboratory. In 1860 Gustav Rose called him to the Mineralogical Museum of the University. Vogel's apprenticeship lasted until 1864, and then he attained an independent position. He had recognized that the development of photography depended on the careful study of photo-chemistry, and he made this study his special task. At the same time he began to give instruction in photography, being the first to teach it in a German technical academy. In 1864 he was made an instructor of photography in the Gewerbeakademie; he began with courses in photography, but added to this practice in the blue print process. Later he lectured on and experimented in spectrum analysis. Gradually Vogel accomplished what he had planned for himself at the beginning of his academic course, for

vided that they are capable of combining with iodine. One of Vogel's greatest discoveries, namely, that silver bromide could be made sensitive to the less refrangible rays of the spectrum, by staining it with certain dyes, was made in 1873. By this discovery Vogel showed that it was possible to photograph yellows as readily as blues. His theory of color sensitizing, which for a long time remained dormant, has, in many ways, changed the methods and practice of color photography; and although the problem of photographing in nature's colors is not yet completely solved, his discovery has indirectly rendered possible the reproduction of colored objects in hues very nearly those of nature. This discovery of Vogel's seems to have been partly accidental. He found that some collodio-bromide plates imported from England were more sensitive to the spectrum in the green at the line *E* than in the light blue at *F*. This action seemed to point to the presence of some coloring matter which absorbed the green rays. Experiments proved the correctness of his theory. He then tried whether the addition of a substance capable of absorbing the yellow rays, such as coralline, would increase the sensitivity of his bromized collodion to yellow. He found that it would do so. From these experiments he concluded that the sensitivity of a plate depended not only upon the optical absorption power of the silver salts, but also upon the optical absorption power of substances mixed with them.

Vogel was a skilled spectroscopist, and his analysis of absorption and emission spectra led him to researches in chromatics. Latterly he and his son were engaged in perfecting a system of three-color printing in conjunction with Kurtz, of New York.

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THE GEOLOGY AND ARCHÆOLOGY OF THE CALIFORNIA GOLD FIELDS.*

By W. J. MCGEE and W. H. HOLMES.

ACCEPTING the conclusions of Turner, Lindgren, and other geologists regarding the origin and age of the auriferous gravels, the authors described the deposits, the subsequent erosion by which they have been reduced to remnants, and the principal events in the geologic history of the region. Beginning with the

tion, and the distinctive features of their religion are adjusted to this food source. They are as completely acorn Indians as the Dakotas were buffalo Indians, and the implements used by them to-day in making acorn meal are indistinguishable in material, form, and mode of preservation from those reported to have been found in the gravels associated with and commonly below the Tertiary lavas and tuffs. The only fully recorded occurrence of human remains in the gravels below the lava is the case well known to geologists as the Calaveras skull. This fragmentary cranium has not been examined critically by the authors, but comparison of Whitney's reproductions of the specimen with related material in the National Museum indicates that it is a normal Indian skull. The authors described their visit to the locality whence this specimen was reported, and their conferences with the dozen or more surviving miners and business men who were personally acquainted with the circumstances attending the discovery. Of these survivors, two held the skull to be a genuine fossil, while the others regard the affair as a joke, and several of them independently recount a history of the planting of an Indian skull, taken from the vicinity of a saline spring a few miles away, in the shaft to deceive a miner, and of later jocular conspiracies to deceive a local collector, and in turn the State geologist. Indeed, one of the most substantial and highly respected citizens of Angels (a leading merchant and the present postmaster) declares that the skull lay in his store for six weeks before it was planted in the shaft, during a midday nooning, as a joke on the miner, who innocently brought it to light on resuming work in the afternoon. Thus, so far as the contemporaneous human testimony goes, the record of the finding cannot be regarded as above question, and the authors pointed out the desirability of resting conclusion on the firm basis of observation and comparison, which any patient worker can verify.

Next the time scales or scales of serial development recognized by the geologist, the paleontologist, and the anthropologist, respectively, were outlined. The ordinary geologic time scale is a section or series of successive formations and unconformities, representing a succession of episodes in earth making; the paleontologic scale is commonly conceived in the form of a genealogic or rather a phylogenetic tree, showing lines of ascent of orders, a genera or species which may be adjusted to the geologic time scale; the anthropologic scale is best represented as a series of convergent lines showing the blending of activities in the four principal culture grades. Now, the scale of the anthropologist differs greatly from those of geologist and paleontologist, not only in its convergent direction, but even more in the rapidity of its development; and it was held to be inherently improbable—so improbable as not to be acceptable without abundant and unimpeachable testimony—that man, the most variable of all organisms, could have existed at a period so remote that no other animal species and few animal genera have survived, while even the most stable flora has been greatly modified. It was held even more firmly that, if *Homo sapiens* be admitted to have survived since the close of the Miocene, it is incredible that his skeletal characters should have remained so little modified as to permit identification of his cranium with that of the local modern tribes. Most firmly of all was it held to be incredible that the distinctive culture stage represented by the mortars and pestles of the present Californian Indians could have survived throughout the vast period represented by the volcanic overflows and the subsequent erosion of the profound Sierra canyons, with the concurrent transformation of floras—i. e., that an acorn culture could have begun at a time when the nascent *Quercus* flora was probably not yet fruit-bearing, and survived unchanged while the region was transformed from the Miocene peneplain to the present labyrinth of profound canyons.

In answer to an inquiry as to the supposed cumulative character of the evidence offered by relics from the gravels, it was pointed out that nearly all of the records were made by inexpert observers or second-hand collectors, not guided by scientific principles; and it was shown to be natural, and even inevitable, that untrained observers should fall into error as to associations. The most common source of error was the misleading association produced in hydraulicking gravels buried beneath a heavy covering of tuff; in such cases a great part of the material washed into the sluice boxes really comes from far above the gravel horizon, some of it, indeed, from the surface. In one instance, the authors found more than a dozen mortars and a score of pestles within stone's throw of the cliff, formed by hydraulicking the great Dardanelles mine near Dow's flat, where relics had been reported by the miners. Indeed, in working down the cliff, they found a mortar lodged forty feet below the surface, a pestle twenty feet lower still, and near by another mortar on the bed-rock, all manifestly fallen from above. During their work they had been compelled to recognize a considerable number of possible sources of error, with respect to association, against which early observers had not guarded. The paper concluded with the explanation that the investigation was not yet complete, but that it would be continued along each of several special lines, all tending to elucidate the archaeology of California.

In the ensuing discussion, Prof. W. H. Brewer and Prof. S. F. Emmons raised questions concerning the alleged fossilization of the Calaveras skull, which the authors were not in a position to answer, pending an examination of the specimen; though they mentioned finding partly calcified crania from caverns in the vicinity, where the Miwukh Indians frequently disposed of their dead by casting them into the deepest caverns they are able to find. Major Powell noted the untrustworthy character of the testimony of unscientific men as to associations, instancing the Nampa figurine, alleged to have been found under the Tertiary lava sheet in Idaho, which a well operator sought to palm off on him as a genuine discovery, and which was afterward actually foisted on a credulous collector and published as evidence of high human antiquity. Prof. J. A. Holmes described the discovery of an object in Miocene deposits of the coastal plain, which was attested to be in place in the undisturbed formation by affidavits of all finders, including the army officer in charge of the work: the object proving, on examination, to be a piece of a revolver of rather recent make.



THE LATE HERMANN WILHELM VOGEL.

photo-chemistry became a regular branch of study in polytechnic courses, and when the Gewerbeakademie was moved to the buildings of the Technical High School, at Charlottenburg, in 1884, a laboratory for the study of photo-chemistry and spectrum analysis on a large scale was arranged for Vogel, and a large sum of money for the purchase of apparatus was placed at his disposal. At the head of a staff of scientific and technical assistants, he developed great ability as an instructor and an investigator, but his work along these lines was repeatedly interrupted by scientific expeditions, during some of which he did good work in astronomy. In 1868 Vogel went to Aden with the Solar Eclipse Expedition; in 1870 and 1875 he went with similar English expeditions to Sicily and the Nicobar Islands, and in 1887 to Russia to observe the solar eclipse which occurred on August 19. He also attended many international expositions, where he gained many friends for German science and technique in photography. At the request of professional colleagues in America, he made two extended tours in the United States. We see that Vogel was seldom quiet.

Vogel's first important discoveries are to be found in his paper (1863-1864) embodying his exhaustive researches on the action of light on chloride, bromide, and iodide of silver. In this paper [the effect of light on the haloid salts of silver was most carefully described, and a number of new facts brought forward. In 1865 he made the important discovery that compounds, such as tannin, silver nitrate, mercury nitrate, tin salts, sodium arseniate, which readily absorb free iodine, act as sensitizers upon silver iodide. In 1872, after a series of experiments with sensitizers and preservatives, he brought forth his theory that substances which combine with iodine act as accelerators when they render the plate chemically less transparent, and *vice versa* bodies which act so as to render the plate less transparent play the part of accelerators, pro-

base-leveled surface of the peneplain in early or middle Tertiary time, the region was apparently depressed and tilted westward in such a manner that a number of parallel streams (prototypes of the present waterways) clogged their channels with beds of coarse gravel derived from the ancient Sierra rocks; later vulcanism supervened, and some of the waterways were further choked by the ejectamenta in such a manner that tuff beds, interspersed with gravel deposits, were accumulated, while the accumulation ended, in some portions of the area, with outflows of andesitic and basaltic lavas. Afterward the region was lifted and profound canyons were carved by the rivers draining the western slope of the Sierra, most of the previous deposits were carried away, a few remnants only persisting in the form of table mountains, elevated tuff beds, and gravel streams generally overlain by lavas and tuffs, while in the typical part of the region the cutting extends from 1,000 to 3,000 feet below the Tertiary gravels, tuffs, and lavas, and into the obdurate rocks of the Calaveras and Mariposa formations. The fossils and relics derived from the gravel beds were described as (1) plants, (2) animal remains, (3) mortars, pestles, and other stone artifacts, (4) human bones. The plant remains have been found in limited quantity in a number of localities, usually in fine beds associated with the gravels and tuffs, and they indicate ages ranging from about middle Miocene to late Miocene or early Pliocene. The animal remains are much fewer, but their testimony as to age coincides with that of the plants. The stone implements all belong to a single cultural type—the type represented by the living Indians of the region (commonly known as Diggers), whose chief source of food is the acorn. Their habits of life, including most of their industries, much of their language, the essential features of their social organiza-

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