Kan., also in the bench along the north side of Kansas City, Missouri. At Leavenworth, St. Joseph, and south part of Sioux City, besides several less conspicuous points between, and further down the river. Similar deposits are found in the lower part of the Kansas River near Edwardsville, Holliday and Bonner Springs. Here it is due to back water from the Missouri, and the character and color differ from those of the Missouri River deposit.

After considerable examination I have no doubt that the similar terraces in western Iowa along the streams which headed near the edge of the Wisconsin ice are to be referred to the same cause. I refer to the terraces on the Boyer, Soldier and Maple. The absence of such along Mosquito, Nishnabotna and Nodaway confirms this conclusion. They were too far away to share in the floods from the Wisconsin ice.

Similar floods may have attended similar recessions from later moraines, but they were less effective, and after the third or fourth the ice retired too far away to affect the Missouri notably. Numerous lower terraces are found along the Missouri and its tributaries, which record such stages which attended the gradual deepening of their channels in the 15,000 or 60,000 years since.

In the recession of the ice, glacial lakes were formed from time to time. Lake Dakota was formed in the central part of the James River valley, while the fourth moraine was forming. It became nearly filled with a fine silt closely resembling loess.[7] Later Lake Agassiz occupied the Red River valley, but it was beyond the scope of our subject.

I leave the subject with you. If I have made any point clearer or suggested a thought which may lead to further light I shall be well satisfied.

It may gratify our national pride a little to see how cleverly nature, not long ago, changed so much of the drainage which was sweeping the rich soil of our great plains into the British dominions, so that it was permanently diverted into our borders.

From this sketch, we see how nature has wrought the course and character of the greatest stream on earth, and one of the most important. It may not be called as historic as others, for its history is yet to come. Who can doubt that it is destined to be associated with some of the mightiest and most far-reaching events of the future,

J. E. Todd

University of Kansas

[7] *Iowa Acad. Sci.*, Vol. XIII., p. 187.

BENJAMIN OSGOOD PEIRCE

The death of Professor Benjamin Osgood Peirce at Cambridge on January 14 removes before his time one of the most valued members of the Harvard faculty and one of the most scholarly of American physicists. Having been asked by the editor of Science to contribute an obituary note, although feeling that one of his colleagues could do it in a more accurate manner, I could not forego the melancholy satisfaction of paying a personal tribute to the best of teachers and the cherished friend of thirty years. Peirce came to Harvard as instructor in the same year as the writer as a freshman, and the admiration he then inspired has only grown with years.

Peirce's first ancestor in America was Richard Norman, who came to Gloucester in 1623. His great-grandfather, Benjamin Peirce, was killed at Lexington. From him was also descended Benjamin Peirce, the distinguished mathematician. On his mother's side Peirce was descended from ship-owners in Salem. Born on February 11, 1854, at Beverly, it was from such sterling stock that Peirce inherited the New England conscience and capacity for thoroughness which were his leading characteristics. He received an excellent preliminary education in the schools of Beverly, and afterwards prepared himself for college, with plenty of Latin, Greek and mathe-

matics, then, as now the best training for a scientist, and he never forgot them. Neither did he slight the modern languages nor the vernacular, for nothing but the best of English ever proceeded from his mouth or pen.

Graduating at Harvard in 1876, he had already shown a marked talent for both mathematics and physics, and, receiving a traveling fellowship, he proceeded for further study to Leipzig, where he worked in Wiedemann's laboratory, and obtained the degree of Ph.D. in 1879. After this he spent another year at Berlin with Helmholtz, from whom he drew much inspiration. During these four years he had not only obtained skill in experimental research, but he had obtained a thorough grounding in the principles of mathematical physics, then almost entirely untaught in any American university.

Returning to the United States in 1880, Peirce spent a year in teaching at the Boston Latin school, and in 1881 received the appointment of instructor in mathematics at Harvard. This was not what he desired most, but he took hold of the work with enthusiasm, and among other subjects taught the calculus in a two-years' course, alternating with Professor Byerly. A splendid course it was, and those students who took it under one disputed with those taking it under the other as to which was the better teacher. But the most notable course instituted by Peirce and shared by this pair of masterly teachers was that one in which Peirce treated the theory of the Newtonian potential function, and Byerly the theory of Fourier's series. The writer well remembers his feeling of mystification, when at the end of his freshman year, on consulting the elective pamphlet to select courses for the next year, he came across the announcement, Arbitrary Functions and the Theory of the Potential. What on earth were arbitrary functions, and what was the "potential"? His highly respected teacher in the high school, hitherto an unfailing adviser, could not tell. But as a matter of fact this course marked a new era in American university work, for, as has been stated above, the teaching of mathematical physics in this country was practically non-existent. I say this advisedly, having in mind that mechanics was taught to a certain extent, and that there were one or two courses on the theory of light, but the character of the teaching was totally different from that of the present era. Peirce had come back from Germany full of enthusiasm for the thoroughgoing German methods and the magnificent achievements of Gauss, Riemann and Dirichlet, which had opened up to him a new world. The backbone of theoretical physics is the subject of partial differential equations, and the most suitable gate to enter by is the theory of the potential belonging to forces acting according to the law of the inverse square. This Peirce had the insight to perceive, and made it his part to work up a course on this subject, which he treated with rare clearness and skill. The subject-matter of this course afterwards appeared in his treatise "Elements of the Theory of the Newtonian Potential Function," which passed through three or four editions and constituted a model of what such a work should be. One other of the fruits of his teaching was the short table of integrals, whose convenience has brought him the gratitude of many a student of the calculus.

In 1884 came the appointment as assistant professor of mathematics and physics, and Peirce took his place in the department of physics, to which he rightly belonged, and in which he was able to do his share in the reconstitution and modernization of that department which it was now to undergo in the new Jefferson laboratory. This was at the beginning of systematic laboratory work in physics in this country, and there was a certain amount of friction in getting the new ideas started. In 1888 with the retirement of Professor Joseph Lovering he was succeeded by Peirce in the Hollis professorship of mathematics and natural philosophy, a decided honor for so young a man. At the same time Professor John Trowbridge became director of the laboratory, and from this time on there was a rapid development of the laboratory work into what has become one of the best organized courses in the country, while re-

search was for the first time recognized and encouraged. Peirce took for his field the development of the laboratory course in electricity and magnetism, which he brought to a high degree of efficiency and interest. At the same time he devoted a large part of his powers to the graduate courses on mathematical physics, particularly the theory of electricity and magnetism and hydrodynamics. Besides this he threw himself vigorously into the prosecution of research, which he kept up with unabated assiduity until the end. Without going into these researches in detail, it will suffice to say that they were probably about fifty in number, and of considerable variety. Beside those on various subjects of mathematical physics, the experimental papers nearly all required an unusual amount of mathematical theory. Most notable are the researches on the thermal conductivity of various kinds of stone and its variation with temperature, in which he had the collaboration of his friend R. W. Willson, and his researches on magnetism, on which he was still engaged at the time of his death. Both these subjects are of extreme difficulty, and to them he devoted his best efforts, combining remarkable experimental skill with the mathematical knowledge necessary for their treatment. It was this rare combination that characterized the success of Peirce's work, and made him such a valuable colleague. It was said by one of his colleagues that he knew more physics than any other member of the department of physics, and more mathematics than any other member of the mathematical department, and the statement was not contradicted by any of them.

But this devotion to work, while producing most satisfactory results, was not without its penalty, for the inevitable result of overwork was a nervous breakdown, to which he was obliged to give way nearly a dozen years ago, and to take the much-needed year of rest in Europe. Unfortunately it was too late, and one year was not enough. Although he recovered sufficiently to resume his work, eventually at his normal pace, he really never recovered, and the rest of his life was a brave fight against ill-health, carried on against tremendous odds, with a cheerfulness which deceived many. For years he suffered from insomnia, and at last the mechanism was entirely worn out, and after an extremely painful illness borne with great fortitude he succumbed to an attack of angina pectoris.

But it was not alone his scientific work that made Peirce such a source of strength to the university, it was the influence of his rare personality that drew to him hosts of friends among students and colleagues. Absolute self-abnegation and devotion to duty were the keynote of his character. With him modesty was so excessive as to almost cease to be a virtue. When consulted by a colleague with regard to some difficulty, almost invariably his first response was that he did not know anything about the subject, and it was necessary to draw him out with insistence in order to get at his superior knowledge. He was always fearful of giving trouble to some one, and frequently lay awake at night worrying over the troubles of others, never his own. Always cheerful and ready with a joke or anecdote, he was the kindest and sanest of advisers. Possessed of a sure and childlike religious faith, he was almost a Puritan in the conduct of his own life, but absolutely sympathetic and charitable toward others. Only himself he did not spare. Often his friends would remonstrate with him against his risking his health by overwork, but it was impossible to get him to desist. His teaching was characterized by the greatest clearness and infinite pains. Everything that he did was done with elegance and neatness. Often the writer has marveled to see the beautiful drawings that he made to illustrate his papers, the curves being laboriously cut out in zinc for greater accuracy. He kept a font of mathematical type in the laboratory, and set up many of the complicated formulæ in his table of integrals with his own hand. Though a thorough Yankee, he had a broad knowledge of Europe, spending much time in England and Scotland, and never forgetting his precious years in Germany. He was a great reader, and was extremely well informed

on a wide range of subjects, never giving up his interest in the classics. In every way Peirce was a living example of that breadth of character and interest which has so often been characteristic of great scientists, but which the specialist is so commonly supposed to lack.

Peirce's scientific activity was rewarded with many distinctions. In 1906 he was elected a member of the National Academy of Sciences. He was also a fellow of the American Academy of Arts and Sciences and of the American Philosophical Society, member of the American Mathematical and American Physical Societies, of the Astronomical and Astrophysical Society of America, the Société Française de Physique, and the Circolo Matematico di Palermo. He was one of the founders of the American Physical Society, and was last year elected its president. The election would have been renewed this year, but just before the meeting Peirce, evidently feeling his inability to discharge the duties of the office, had a notice sent out urging members not to vote for him. Unfortunately his misgivings were justified. In 1910 Harvard conferred upon him the degree of Doctor of Science.

Professor Peirce married, on July 27, 1882, at Edinburgh, Scotland, Miss Isabella Turnbull Landreth, by whom, with two daughters, he is survived. At his funeral Appleton chapel was crowded with colleagues and students, but the number of friends who will never forget his influence is far greater than could be contained in any building.

ARTHUR GORDON WEBSTER

THE BRYANT WALKER EXPEDITION, OF THE UNIVERSITY OF MICHIGAN, TO THE SANTA MARTA MOUNTAINS, COLOMBIA, IN THE SUMMER OF 1913

THIS expedition, sent out from the museum of zoology, was organized to do zoological work in and about the west end of the Sierra Nevada de Santa Marta, in northeastern Colombia. The plan of the work was that adopted for all expeditions sent by the museum to regions outside of the state of Michigan. Relatively small areas where a variety of conditions prevailed were located, and these were examined for those groups of animals to which the members of the museum staff are giving most attention. Particular study was made of the habits and local distribution of the species, and the results were preserved as specimens, notes and photographs of specimens and environments.

The party consisted of A. S. Pearse, of the University of Wisconsin, F. M. Gaige, of the University of Michigan, and the writer (in charge); and the groups which received most attention were the reptiles, amphibians, ants, crustaceans and molluscs. The collections of these forms may be summarized as follows: reptiles and amphibians, about 1,000 specimens; ants, 603 lots; crustaceans, 140 lots; molluscs, 150 lots. Small collections of other groups were made by preserving such material as was discovered, the collecting being restricted to a few forms which could be secured in series without interfering with the regular work. The groups which received such attention are leeches, earthworms, myriapods, scorpions, beetles, the genus *Peripatus,* and fishes. The other material secured consists almost entirely of specimens of those forms needed for illustrative purposes or as additions to the synoptic collections in the museum.

The expedition reached Santa Marta on July 1 and at once proceeded to an elevation of 4,500 feet. From this point a strip of territory from 2,200 feet to 8,300 feet (the summit of San Lorenzo) was explored for twenty-six days. On July 27 the party moved to the plain and spent nine days in continuing the explored strip from 2,200 feet to the foot of the range. The remainder of the time until September 1 was given to the investigation of the lowlands in three places—about Santa Marta, at Fundacion and on the Salamanca coast near Cienaga.

Not a little of the success of the expedition is to be attributed to the assistance and hospitality of Mr. and Mrs. O. L. Flye and the members of their family, Mr. and Mrs. M. A. Carriker, Mr. William A. Trout, consular agent