duces folded and overthrust mountains. The argument is still valid. It applies, however, only to an earth constructed according to the planetesimal program; it is utterly ineffective in an earth which has solidified from a molten state. If at last we find no escape from the idea of a shrinking earth, we must render our verdict in favor of the planetesimal theory rather than the tidal.

The second basis for testing the theories of earth origin is found in the attempt to explain the segmentation of the lithosphere into continents and ocean basins. Here the problem is to account for the segregation of less dense, granitic materials beneath the protuberances and the denser, gabbroic material beneath the basins. Chamberlin's explanation was in terms of selective in-gathering of planetesimal debris under the influence of atmospheric circulation, combined with selective placement of the products of weathering by the agents of transportation and deposition. Under the tidal theory, the segmentation of the granitic shell, originally continuous the world around, must be accomplished during the rupture accompanying the birth of the moon. Both ideas must be critically reviewed in the light of any new knowledge which may be secured in the coming years. Neither can be whole-heartedly accepted or bluntly rejected at the present moment. The line of departure between the two is so clearly defined and leads to such far-reaching consequences that there is good reason to expect a definite verdict in the near future. The bearing of that verdict upon the theories of earth origin is obvious.

In summary, it would appear that the concept of earth structure based on recent geophysical and seismological research is not nearly so unfavorable to acceptance of the planetesimal theory of earth origin as many geologists have supposed it to be. On the contrary, in at least one particular—that which deals with the origin of folded mountains—modern investigations pertaining to the fundamental structures of the earth have brought renewed confidence in the basic principles of that theory.

OBITUARY

EDWIN HERBERT HALL

PROFESSOR EDWIN HERBERT HALL, universally known to physicists as the discoverer of the Hall effect, died on November 20, 1938, at the age of 83 years. He was born in Gorham, Maine, on November 7, 1855, fitted for college in Gorham Seminary, entered Bowdoin at 15, and graduated with the A.B. degree at the head of his class at 19. During 1875–76 he taught as principal at Gould's Academy in Bethel, Maine, and during 1876–77 was principal of the Brunswick High School. In 1877 he entered the Johns Hopkins University as a graduate student of physics, and from 1878 to 1880 was fellow in physics, working under Rowland and receiving the Ph.D. degree in 1880. He continued on as assistant in physics during 1880–81, when he was appointed to a Tyndall scholarship for study and travel abroad. During the summer he made measurements on the "Hall" effect in Helmholtz's laboratory in Berlin, and read a paper reporting these measurements at the York meeting of the British Association in the summer of the same year. He returned to this country in the fall of the same year to an instructorship in physics at Harvard, a position which he held until 1888. From 1888 to 1895 he was assistant professor at the same institution, professor from 1895 to 1914, Rumford professor from 1914 to 1921, and professor emeritus from 1921 till his death. He was a member of the A.A.A.S. (vice-president of the section of physics in 1904), of the American Physical Society, the American Academy of Arts and Sciences, the National Academy of Sciences, corresponding member of the British Association for the Advancement of Science and foreign member of the Société Hollandaise des Sciences. He received the LL.D. degree from Bowdoin in 1905, was a member of the Solvay Congress at Brussels in 1924 and of the Volta Congress in Como in 1927, and in 1937 received the award and medal of the American Association of Physics Teachers for notable contributions to the teaching of physics, and was made the first honorary member of the association.

Professor Hall's great contribution to the teaching of elementary physics was a pioneering contribution, made at a time when physical laboratories were almost unheard of in this country. In 1886 he published, with the encouragement of President Eliot, the well-known "Harvard Descriptive List of Elementary Physical Experiments." These had the unique merit of demanding apparatus simple enough so that it could in many cases be constructed by the teachers themselves without undue strain on their meagre budgets. This "list" was followed by several elementary text-books, the best known perhaps being "A Textbook of Physics" by Hall and Bergen in 1891. It would not be unfair to describe Professor Hall's work as entirely remolding the scheme of secondary school physics, and as such exerting a most important influence, but since this matter is freshly in mind through the articles in the *American Physics Teacher* for February, 1938, at the time of the award, it is not necessary to elaborate further here.

Of course Professor Hall will always be best known for the Hall effect, discovered while working for his

Ph.D. degree with Rowland in 1879. This effect is usually described as a difference of potential transverse to the lines of current flow, which appears when a magnetic field is applied perpendicular to the current. It had been vaguely predicted by Kelvin in 1851, expected and vainly searched for by a number of experimenters, including Rowland himself, independently expected by Professor Hall and found only after a couple of unsuccessful attempts. The pertinacity which kept him at the search for the suspected effect remained one of his most striking characteristics. The announcement of the discovery was received with the greatest interest. Of it Kelvin said in commenting on Hall's paper at the York meeting of the British Association in 1881: "The subject of this communication is by far the greatest discovery that has been made in respect to the electrical properties of metals since the times of Faraday—a discovery comparable with the greatest made by Faraday." A large number of other investigators rushed into the field thus opened. The three other analogous transverse effects bearing the names of Ettingshousen, Nernst and Righi-Leduc were speedily discovered, and a very extensive literature rapidly grew up.

Professor Hall himself continued to contribute papers on the new effect for eight years, but then turned for a considerable interval to other matters, mostly related to questions of thermodynamics, which was his principal field of graduate instruction. He was thus led to take up the thermo-dynamic analysis of thermo-electric phenomena, to which he contributed new points of view. In his attempt to understand the mechanism of these phenomena he was confronted with the whole problem of the theory of electrical phenomena in metals. He had the vision to realize that the significance of the Hall phenomenon and the other transverse effects had not been adequately appreciated, and his scientific life from 1910 on was dedicated with rare singleness of purpose to creating a theory of electrical phenomena in metals which should include thermo-electric and the transverse phenomena as well as those more usually considered. Part of his program demanded better numerical values for the various transverse coefficients. The exact measurement of these coefficients is admittedly one of the most difficult tasks which an experimental physicist can set himself, but with marvelous spirit Professor Hall undertook the problem after the construction of the new Research Laboratory for Physics at Harvard in 1931, and had succeeded in measuring the four coefficients for a number of metals as a function of temperature with an accuracy which satisfied his exacting requirements. He was actively engaged on this work up to within a few weeks of his death.

His theoretical work has probably never received the attention that it deserved because it was written in an idiom of his own, not familiar to most theoretical physicists. For a number of years before his death he had been attracted by the idea of collecting his theoretical results into a book, and actually was on the verge of publication a couple of times, but finally last summer (1938) he issued a book of 170 pages, considerably smaller than he had at one time contemplated, entitled, "A Dual Theory of Conduction in Metals," published by the Murray Printing Company, Cambridge. This book, I think, will be found to be much more readable than many of the original papers, and to be well worthy of intensive study. It should not be difficult to put into the language of present quantum theory many of Professor Hall's points of view. It was a particular gratification to him toward the end of his life that quantum theory found itself naturally driven to a point of view on the importance of which he had always insisted, namely, that conduction phenomena can not be understood without considering the rôle of the positive ions in the metal as well as the free electrons.

Those who knew him personally will feel a loss greater than can be accounted for by any scientific eminence. It will be agreed, I believe, that his outstanding personal characteristic was his utter honesty and integrity, coupled with an independence and strength of character which enabled him to trust his own judgment and steer his own course once he had made his carefully reasoned decision. Combined with this was a very unusual reluctance to force his own views on others; he truly treated the opinions of others as equally worthy of respect with his own. He was unobtrusively but consistently and persistently religious, with a strong sense of civic duty. He served in executive positions of importance in a number of community enterprises, and his volunteer services at the time of the Boston police strike will be long remembered. His conversation was often enlivened by a refreshing wit, and his writings by a felicity that made them a pleasure to read. His satisfaction with writing as a means of expression probably went back to his college years, for he described himself as the most prolific editor of the college paper, and refers to writing as the only talent he may have had in college. On occasion he was capable of effective verse. Those who knew him more intimately knew that he had passed through dark times of discouragement or even despair, over which he triumphed by sheer force of character. Sometimes they were permitted glimpses of a depth and quality of sentiment rare and moving.

His friends will not soon forget the erect vigor of his old age, or cease to be thankful that his last illness was not protracted.

P. W. BRIDGMAN

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