

SCIENCE

VOL. LXX

FRIDAY, DECEMBER 20, 1929

No. 1825

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa.

Garrison, N. Y.

Annual Subscription, \$6.00

Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

ZONES OF WEAKNESS IN THE EARTH'S CRUST

By Dr. WILLIAM BOWIE

U. S. COAST AND GEODETIC SURVEY

THE advocates of the theory that the great deformations in the earth's crust have been caused by a cooling of the interior of the earth and the collapse of the crust to fit the reduced area of the surface of the nucleus have, in general, accepted isostasy as a scientific principle. They, however, seem to need zones of weakness within which uplift occurs in order to permit the crust to fit the shrinking nucleus. They also are of the opinion that the Airy idea of isostasy is the true one.

I am writing this paper in order to call attention to the idea that the areas which have been receiving vast amounts of sediments, possibly to depths of five or more miles, should not be the zones of greatest weakness in the earth's crust.

The heavy beds of sediments are laid down, in general, along margins of oceans or inland seas. At least this is the generally expressed opinion of the leading writers of geological literature. It has been

shown in "Isostasy"¹ and in a number of publications of the Coast and Geodetic Survey that areas of heavy sedimentation are not out of equilibrium. It is evident, therefore, that the weight of the sediments pushes down the crust beneath. The lower part of the crust necessarily enters subcrustal space and there is a horizontal movement of the displaced subcrustal material in a direction towards the area from which the sediments were derived. The volume of subcrustal material displaced will not be as great as the volume of the sediments. This is because the upper part of the subcrustal material must be of greater density than that of the sediments. Of course, the unconsolidated sediments have very light density, probably not more than 2.4. It may be that the density is 2.2. When these sediments are consolidated, the density will probably rise somewhat over

¹ E. P. Dutton and Co., New York, 1927. Spec. Pubs. 40, 99, and Serial 366, U. S. Coast and Geodetic Survey.

an irreversible recrystallization of the metal. Theoretical considerations show that the ions are emitted from the metal and are not formed after a neutral atom evaporates.

On shatter-oscillations in liquid columns: E. H. KENNARD (introduced by Ernest Merritt). In some experiments recently witnessed by the writer in an industrial plant an extraordinary and apparently little-known type of fluid oscillation was observed. A pipe thirty-one meters long, filled with water, was connected to a tank containing some water and above it air under a pressure of three to four atmospheres; to the other end of the pipe was attached a pump. A recording gauge attached to the pipe near the pump showed at regular intervals narrow peaks of pressure, ranging as high as seventy atmospheres, separated by calm intervals four to eleven times as long as the duration of the peaks, during which the pressure appeared to be slightly below atmospheric. The interval between the peaks was several times longer than the period of oscillation of the water column regarded as a closed organ pipe. The proposed explanation is that when the water column expands and its pressure sinks to zero, the column "shatters." Theory indicates that, as soon as the pressure reaches zero at one point, a shatter-front will sweep from that point in both directions along the column with a speed above that of sound, leaving the water in an expanding condition behind it; no large breaks in the column can occur, but it will become full of little cracks or holes. During the subsequent reconsolidation of the column the water may acquire high velocities toward the pump, and when the reconsolidation-front reaches the pump an impulsive "water-hammer" pressure will result. A detailed study of such oscillations in the laboratory would be of interest.

On the existence of integrals of Einstein's gravitational equations for free space and their extension to a variable: T. Y. THOMAS (introduced by O. Veblen).

Memoir of John Trowbridge: E. H. HALL.

Biographical memoir of John Merle Coulter: WILLIAM TRELEASE.

Two contradictions in current physical theory and their resolution: F. S. C. NORTHROP. Our purpose is to show that two contradictions exist in current physical theory which can be met only by a certain amendment to our traditional atomic theory. The first contradiction will be demonstrated by establishing three propositions. (1) Atomicity is an inescapable fact. (2) Atomicity necessitates the existence of a referent other than the microscopic particles. (3) According to current scientific theory no such referent exists. It appears that the facts permit no conclusion but that a new referent must be introduced into our traditional atomic theory to replace the discarded absolute space. The second contradiction also rests on three propositions. (1) The metric of space is conditioned by matter. (2) This metrical structure exhibits uniformity over macroscopic distances. (3) Matter, as currently conceived, is incapable of producing

such uniformity. Since neither of the first two premises can be escaped it follows that our traditional theory of matter must be amended to provide a basis for the metrical uniformity which was previously assigned to absolute space. A consideration of what is required to produce the type of metric, which Einstein suggests and the facts reveal, indicates what the required amendment must be. In a relativity theory, space is a relation between objects. Hence metrical variability means that the relations between the ultimate atomic entities change; and metrical uniformity means that they do not. It becomes evident, therefore, that the kinetic and contingent properties of the microscopic elements of the traditional atomic theory insure their adequacy as the source of local metrical variability, but eliminate them as the source of macroscopic metrical uniformity. In short, the general macroscopic uniformity must be regarded as imposed upon their contingent relatedness from without. This calls for an entity which is atomic and physical in character, and so large in size and fixed in form as to surround and congest all the microscopic atomic entities of the traditional atomic theory.

BOOKS RECEIVED

- BORING, EDWIN G. *A History of Experimental Psychology*. Pp. xvi + 699. Century. \$4.00.
 BRYANT, HAROLD CHILD. *Outdoor Heritage*. Pp. ix + 465. Illustrated. Powell. \$5.00.
 CANU, FERDINAND, and RAY S. BASSLER. *Bryozoa of the Philippine Region*. Pp. xi + 685. Smithsonian Institution. U. S. National Museum. Bulletin 100, Vol. 9. 224 figs. 94 plates.
 CLARK, W., T. SLATER PRICE and B. V. STORR, Editors. *Proceedings of the Seventh International Congress of Photography*. Pp. xiii + 571. Illustrated. Heffer. 25s.
 CONDON, EDWARD U., and PHILIP M. MORSE. *Quantum Mechanics*. Pp. xiii + 250. 28 figs. McGraw-Hill. \$3.00.
 CROFTS, DORIS R. *Haliotis*. Liverpool Marine Biology Committee. Memoirs. XXIX. Pp. viii + 182. 8 plates. University Press of Liverpool. 10s. 6d.
 EPPER, PAUL. *Animals Looking at You*. Pp. x + 163. Photographs by Hedda Walther. Viking Press.
 EWER, BERNARD C. *Social Psychology*. Pp. ix + 436. Macmillan. \$2.25.
 HELLMAYER, CHARLES E. *Catalogue of Birds of the Americas*. Part VI. Pp. v + 258. Field Museum of Natural History. Publication 266. Zoological Series. Vol. XIII. Field Museum.
 MEISTER, MORRIS. *Magnetism and Electricity*. Pp. xiv + 210. 149 problem pictures. Living in a World of Science. Scribner.
 PEAKE, HAROLD, and HERBERT J. FLEURE. *The Corridors of Time*. Vol. VI. The Way of the Sea. Pp. viii + 168. 72 figs. Yale University Press. \$2.00.
 ROE, JOSEPH H. *Principles of Chemistry*. Pp. 427. Second edition. Mosby. \$2.50.
 SIMPSON, WALTER M. *Tularemia*. Pp. xix + 162. 53 text illustrations, 2 colored plates. Hoeber. \$5.00.
 SMITHSONIAN INSTITUTION. *Annual Report, 1928*. Pp. xii + 763.
 VOLKRINGER, H. *Les Étapes de la Physique*. Pp. ix + 217. Gauthier-Villars. Paris.
La Propriété Scientifique ou le Droit du Savant sur l'Exploitation Économique de sa Découverte. Société des Nations. Institut International de Coopération Intellectuelle. Cahiers des Droits Intellectuels. II. Pp. 11 + 265.



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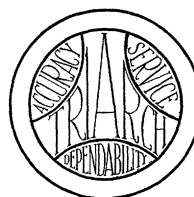
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