which had appeared mainly in 1853–56; and in 1890 the third volume, dealing mainly with elasticity, heat, and electromagnetism, appeared with titles 92 to 104. There was also the separate volume, Reprint of papers on electrostatics and magnetism, which had appeared first in 1872 and again in 1884. And furthermore there are the Baltimore Lectures, delivered in 1884, but printed (with numerous additions) only in 1904. In view of this diverse procedure, Larmor found himself unable profitably to continue the old numbering of the first three volumes, and has carried a new series of numbers from 1 to 277 through the three volumes he edits. To some of these numbers correspond merely the titles of papers previously reprinted but cited here for continuity; and there are at the end of volume V some sixty pages of contributions (to engineering societies) which carry no serial number.

It would be futile here to attempt to go into detail as to the contents of these three volumes, which range over some sixty years and contain many of the important contributions of a great and versatile mathematician and physicist; to review them critically would be to review in large measure the progress of physics for the second half of the nineteenth century. We refer the reader to the subheadings, as listed above, to Larmor's interesting prefaces, and to his life of Lord Kelvin in the *Proceedings* of the Royal Society, volume 81 (1908), pages iii–lxxvi. The closer student can only be referred to the text itself of Lord Kelvin's Works.

E. B. WILSON.

Some Problems of Geodynamics, being an Essay to which the Adams' Prize in the University of Cambridge was adjudged in 1911. By A. E. H. LOVE. Cambridge (England), University Press, 1911. xxvii+180 pp.

IT was not surprising that Love, whose treatise on Elasticity has been the standard for so long, should sometime turn his attention to the difficult applications to geodynamics. He had indeed already printed several papers upon the subject when in 1910 the selection for the Adams' Prize was "Some investigation connected with the physical constitution or motion of the earth." His winning essay is now printed.

The hypothesis upon which the author works is that of isostasy, specialized in such a way as to make it definite. Approximately the hypothesis of isostasy regards the earth

as made up of a central core in hydrostatic equilibrium surrounded by a thin "crust" in which the amount of mass in any vertical column is proportional to the base of the column; this means that under heavy high mountains there must be a relatively light region. At first blush this supposition might seem the opposite of reasonable, but it is widely adopted with a view to explaining certain anomalies in gravitational surveys.

The analytical method is that of harmonic analysis which for the most part is based upon Love's earlier discovery that the inequalities in the lithosphere may be approximately represented by an expansion containing the three surface harmonics of lowest order. This expansion does not pretend to represent the mountain ranges on the earth (indeed it makes northern Africa the highest land on the earth), but it does represent adequately the contour of the lithosphere at mean sphere level which is about two miles below sea level. It is reasonable to suppose that if the materials of the earth's crust are strong enough to support the inequalities which the assumed expansion requires, then those materials should be tenacious enough to support the great continental block as it exists. The question of the support of mountain ranges is referred to a special chapter in which the results for a harmonic of high degree (the fiftieth) are calculated.

Other topics treated are: earth tides and the effects of inertia or spheroidal figure upon them, theory of a gravitating compressible planet and the effect of compressibility on earth tides, gravitational instability, vibrations of a gravitating compressible planet, propagation of seismic waves. In the theory of a gravitating compressible planet Love had previously published a long investigation, which he now decides to replace by another founded upon a different hypothesis.

The main body of the text is a mass of intricate analysis interspersed with very readable comment. To make the points of view and the results of the work even more easy to survey, we are provided with a long and carefully written introductory abstract. If any young American student desires to assimilate the formal work of the text, he had best eschew the pure mathematician and such courses as form practically the totality of our mathematical instruction and hie him to some astronomer under whom he may learn accuracy in detailed formal analysis and safety in intricate approximation —unless he happens to have the rare good fortune to find such

a course as B. O. Peirce and W. E. Byerly used to give at Harvard on harmonic analysis and potential function.

E. B. WILSON.

Annuaire pour l'An 1914 *publié par le Bureau des Longitudes.* Paris, Gauthier-Villars. vii+502 pp., with four appendices.

THE most interesting article in the current *Annuaire* is one on the measurement of the day. In this M. G. Bigourdan has given a brief but sufficient summary of its early history and has carried it up to the present time, when the system of hour zones is fairly well established throughout the world. An interesting part of the story is his description of the efforts made in France to introduce the Greenwich meridian for the measurement of civil time and its final accomplishment in 1911. Two brief articles, one on the deformation of the images in telescopes by M. Hatt and the other on the seventeenth international geodetic congress by M. B. Baillaud, complete the "Notices."

Several revisions have been made in the astronomical portions, tending to bring the constants and descriptions up to date. But the mass of information contained in a small compass is too great for special mention here. The volume may perhaps be classified as the most complete travellers' guide to the physical universe which has hitherto been issued. There is even a slight tendency towards the inclusion of biological subjects in the tables of analyses of beers, wines, cereals, and the ashes of plants.

E. W. BROWN.

Les Actions à Distance. Par G. COMBEBIAC. Scientia No. 30. Paris, Gauthier-Villars, 1910. 89 pp.

IN this issue of *Scientia*, M. Combebiac brings together the physical foundations of some of the hypotheses which have been advanced to explain action at a distance. In all of them, a fluid is postulated: the different ways in which motions may be set up in this fluid practically constitute the developments given in the volume.

The formulas of vectors and spherical harmonics are briefly set forth—too briefly we fear for anyone not familiar with them and their uses. Two chapters are respectively devoted to the pulsating spheres of Bjerknes and the oscillating spheres of Korn with special reference to the gravitational hypotheses