OBITUARY NOTICES

LORD KELVIN

[For this notice the Council is indebted to Prof. H. Lamb.]

WILLIAM THOMSON, afterwards Lord Kelvin, was born at Belfast on June 26, 1824. His father, a distinguished teacher, migrated in 1832 to Glasgow, where he had been appointed Professor of Mathematics. He himself, with his elder brother James, entered as a student of the University in 1834. In 1841 he proceeded to Cambridge, where he graduated in 1845; he was Second Wrangler and first Smith's Prizeman. He was elected soon afterwards to a Fellowship at Peterhouse, and in the following year to the Chair of Natural Philosophy at Glasgow, which was to become the most famous in the world. He held this till 1899. He continued to be formally connected with the University, first (at his own desire) as "research student" and afterwards, from 1904, as Chancellor. He died at his house at Largs on December 17, 1907.

To hardly anyone has it been granted to work so long, with unfailing enthusiasm, with unabated powers, with universally acknowledged success, and with unquestioned authority. From his undergraduate days to almost the last of his long life he was engaged without ceasing in scientific investigation. In addition to his work as a teacher and explorer, he was associated as adviser with many practical enterprises, notably with oceanic telegraphy. Whether in the classroom or in the laboratory, on yachting cruises or on the "Great Eastern," his mind was constantly engaged in trying to unravel the problems presented by Nature. Nothing was too abstruse, nothing too common-place, for his consideration, if only it could be made to contribute to the great end of making the world intelligible and its energies subservient to our use. True to his ancestry, he delighted in work, and every other capable worker, in whatever field or on however limited a scale, could count on his sympathy and respect. He had the most generous admiration for his great predecessors and contemporaries—such as Faraday, Stokes, Joule, Maxwell, Helmholtz, Rayleigh—in his own lines of research, and he was, of course, not unconscious of the importance of his own achievements, but he never said anything to contribute to the notion, occasionally met with, that scientific work is intrinsically more meritorious or more to be honoured than any other kind of honest endeavour.

To Thomson, more than to anyone else, is to be ascribed the transformation which physical science has undergone during the last century. It would be difficult to appreciate soberly the magnitude of his services in such things as the establishment of the laws of thermodynamics, theoretical and practical electricity, telegraphy, and scientific engineering. In any case, the task cannot be attempted here.* But it is fitting that in the records of our Society, which is proud to number him among her presidents, something should be said of him as a mathematician. In one sense, indeed, it may be claimed that he was above all things a mathematician. His thoughts on even the most concrete subjects were ever cast in a mathematical form, and some of his most valuable practical contrivances, such as his electrometers and other measuring instruments, and his mariner's compass, owed their success to the resolute application of mathematical principles even in the most minute details of construction. Thus, where mechanicians had been wont to accept a compromise, he insisted on scientific thoroughness—as, for instance, in his simple but effective invention of "geometric slides and clamps." Again, when once the principles of a theory were firmly established, he would accept without hesitation the most remote deductions which mathematical analysis could base upon them. Perhaps nowhere was the courage of his mathematical faith more manifest than in the various bold cosmical speculations which he initiated, and which have been the inspiration of many later investigators.

The mathematical equipment with which he started on his career consisted in part of the traditional geometrical training of British Universities, but was in other respects derived mainly from the great school of French analysts who flourished about the end of the eighteenth, or the beginning of the nineteenth, century. Lagrange, Laplace, Fourier, Cauchy, Poisson were familiar to him, and it is interesting to note, in his very latest researches on water-waves, the masterly power with which he wields the trusted weapons. Of the work of later pure mathematicians he assimilated little. Some of it he viewed, indeed, with dislike, if not with distrust; or perhaps it would be fairer to say that he could not bring himself to use tools which he had not time thoroughly to master.

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* For these and many other matters hardly touched upon in this notice reference may be made to the obituary notice by Prof. Larmor, *Proc. Roy. Soc.*, Vol. LXXXI., A., p. iii.

It has been said that he was before everything a mathematician. We might go further and assert that, in his eyes, *the* science of all was dynamics. Probably no one has ever possessed so complete and intuitive a mastery of it, whether on the practical or the analytical side. And certainly no one since Newton has done so much to simplify and to extend it. In particular, his command of the perplexing phenomena of "gyroscopic" systems was unrivalled. It enabled him to make a notable contribution to physics, in the dynamical illustration of Faraday's magnetic rotation of the plane of polarization of light; and it led him to develop the beautiful theory of cyclic motions in hydrodynamics. In his subtlest speculations in optics and electricity his constant aim was to reduce everything to a mechanical explanation; to his mind no theory was complete and satisfactory until it was resolved into the operations of a dynamical system.

Few occurrences have been more important in the history of mathematical physics than the issue of the first volume of Thomson and Tait's *Natural Philosophy* in 1867. It is not difficult to make out, from internal and other evidence, what were Thomson's own principal contributions. In the first place, we have the elegant symmetrical treatment of spherical harmonics by Cartesian coordinates. In its purely analytical aspect this had, to some extent, been anticipated by Clebsch, but it is owing mainly to Thomson and to his interpretative and illustrative skill that the method owes its present recognition. The sections on attractions and elasticity, and on the figure of the Earth, are also to be attributed to his hand. Perhaps most important of all is the exposition of the theory of dynamical systems in general, starting from the method of Lagrange. To quote Maxwell's brilliant description: "The credit of breaking up the monopoly of the great masters of the spell, and making all their charms familiar to us as household words, belongs in great measure to Thomson and Tait. The two northern wizards were the first who, without compunction or dread, uttered in their mother tongue the true and proper names of those dynamical concepts which the magicians of old were wont to invoke only by the aid of muttered symbols and inarticulate equations. And now the feeblest among us can repeat the words of power and take part in dynamical discussions which but a few years ago we should have left for our betters." Throughout the book, indeed, we meet with a characteristic feature of all his work—viz., the endeavour to give a distinct physical or geometrical meaning to every analytical concept, and, if possible, to invest it with an appropriate name. A mere list of technical terms introduced by him, each embodying some valuable idea, is instructive in this respect. A few examples must suffice:

in general dynamics we have *generalized coordinates*, *velocities*, *momenta*, *impulses*, *normal modes* of vibration, *gyrostatic domination*; in hydrodynamics, *flow*, *circulation*, *vorticity*, *cyclic motion*; in electricity and magnetism, *solenoidal*, *lamellar*, *centrobaric*, *permeability*, *idiostatic*, *heterostatic*, and the fruitful notion of *images*; in analysis, *spherical harmonics*, with their varieties *zonal*, *tesseral*, *sectorial*. The phrase *dissipation of energy*, again, is a monument of his work in thermodynamics.

The first volume of the *Natural Philosophy* was revised and extended in various ways in a second edition, but the work was never continued. Thomson's scientific interests were so numerous and so keen, and his attention was thereby so constantly diverted into new channels, that many of his literary projects, conceived on a large scale, were destined never to be completed, at all events on the original lines. Among such impressive though unfinished structures we may mention an early memoir on magnetism, begun quite in the classical style, a remarkable paper in which the theory of elasticity is discussed with great generality, and the well known memoir on vortex-motion. As time went on, publication tended more and more to take the form of brief and somewhat fragmentary notes, which often hardly did justice to the important ideas which they contained.

The mention of vortex-motion calls up the brilliant theory of vortex atoms, which has had a powerful and suggestive influence on physical speculation, although its author saw reason afterwards to abandon this particular theory of the constitution of matter. The whole subject of hydrodynamics had a life-long fascination for him. The general mathematical analogies were freely employed in illustration of the relations of electric and magnetic fields; and the theory of water-waves, where he was on common ground with Helmholtz and Rayleigh, interested him keenly to the end. It may be permissible now to quote from a fragment on this subject saved "from his waste-paper basket" in 1904. Speaking of a particular type of waves, and referring to the ποντίων τε κυμάτων ἀνήριθμον γέλασμα of Aeschylus, he says: "If sea waves were like these, the eye of the Greek poet, with all its perceptivity for beauty in Nature, would never have seen anything suggesting *countless smilings* to his imagination. We may try, perhaps in vain, to find other cases of unfurrowed waves in water left to itself after an initiating disturbance. We want this very much for waves circling out from a stone thrown into water. I doubt if we can find it. But whether we find it or not, the sea will go on for ever, gaily laughing at the mathematicians."

The extent to which his published writings have inspired the work of others may perhaps some day be estimated. It will be more difficult to appreciate the influence which he personally, but unconsciously, exercised by the simple directness and sincerity of his character, by his ready accessibility, by his generous and kindly encouragement.

There was hardly any distinction accessible to scientific men, in any part of the world, which was not gladly conferred on him. He was knighted in 1866, and was raised to the peerage, by the style of Baron Kelvin, in 1892. He was laid to rest on December 23, 1907, in Westminster Abbey, near the grave of Newton.