and the famous catechisms to Thomson "concerning demons".

If one sought evidence for the unchanging perversity of scientific writers, there was Maxwell's letter written in October 1876:

> "How vile are they who quote newspapers, journals, and translations by number of vol. and page, instead of the year of grace, as if one should refer to the standard No. 16240 instead of Oct. 10, 1876. Lockyer always alters a reference to NATURE for Sept. 7, 1876, into vol. ?, p. ?, as if all promoters of natural knowledge counted everything from the epoch when NATURE first began."

Most interesting pictorial records of Maxwell's early life were provided by Jemima Wedderburn's sketch-book, very fortunately saved from the recent fire at Glenlair and lent by Capt. Wedderburn Maxwell for the celebration. There one could see the child of three years of age gazing in awe at the fiddler at the servants' dance, wondering, no doubt, 'what was the go of it'; there, too, his escape from his unsympathetic tutor by paddling himself into the middle of a pond, together with other charming sketches of early life at Glenlair. The Institution of Electrical Engineers lent its portrait of Maxwell, and Dr. William Garnett sent the original of the well-known photograph of his later years.

As a final entertainment, the guests were shown the connexion of Maxwell's colour work with modern work on colour photography.

In 1861 Maxwell prepared for a Royal Institution lecture three lantern slides of a bow of ribbon taken through solutions of sulphocyanide of iron, chloride of copper, and ammoniated copper. The slides were projected on to a screen by means of three lanterns. Mr. Thorne Baker, of Messrs. Spicer, Ltd., reconstructed the projection, using the original slides, and then showed a colour film of the procession of delegates from Corpus Christi College to the Senate House which had been taken the previous day. The projection was very successful, the brilliant blue of Prof. Cabrera's robes being particularly well reproduced.

The proceedings closed by a banquet in Trinity College.

THE addresses presented on the occasion of the Clerk Maxwell centenary celebrations have been brought together and issued as a single volume.* The book forms a most fitting permanent memorial of Maxwell's achievements and personality, linking certain aspects of his work with that of Faraday, placing it against the background of his time, and showing its influence on those great movements in scientific thought which have completely revolutionised our outlook.

It is no easy matter either to review or to summarise adequately a volume dealing with a life which has touched and dominated so many activities of our modern world. Planck puts the matter in a nutshell when he points out that Maxwell's work has materially influenced two great regions of conceptual thought, the regions which deal with the physics of particles and with the physics of continuous media. In half a dozen masterly pages, Planck sketches the development of the kinetic theory, shows how Maxwell's great discovery of the velocity distribution law roused the interest and enthusiasm of Boltzmann, and how these two masters, marching along different ways, one attempting "to find the statistical laws of a complicated mechanical structure by considering the structure simultaneously in a number of different states, while Boltzmann, on the other hand, preferred to follow over a long period of time a single structure through its manifold changes of state", laid the foundations of the modern science of statistical mechanics.

There is no more fascinating chapter in the history of kinetic theory of gases than that which describes the difficulties encountered by the theory when dealing with certain irreversible processes. Here again these two pioneers followed very different routes, and Maxwell's artifice of looking on a collision as a rapid and continuous transition from the initial to the final state governed by a repulsive force which varied according to the inverse fifth power of the distance, roused Boltzmann to a high pitch of enthusiasm. His famous comparison of Maxwell's work to a musical drama is unique in the literature of science:

> "At first are developed majestically the Variations of the Velocities, then from one side enter the Equations of State, from the other the Equations of Motion in a central field; ever higher sweeps the chaos of formulæ; suddenly are heard the four words 'put $n=5$'. The evil spirit V vanishes and the dominating figure in the bass is suddenly silent; that which had seemed insuperable being overcome as if by a magic stroke. . . . Result after result is given by the pliant formulæ till, as unexpected climax, comes the Heat Equilibrium of a heavy gas; the curtain then drops."

Sir J. J. Thomson's essay tells the story of Maxwell's greatest contribution to science—the theory of the electric field—with all the force and authority of one of whose influence on post-Maxwellian physics it can with literal truth be said, *pars magna fuit*. It is difficult in these days, when the concept of lines of force is a school commonplace, to realise the state of electrical science in 1855, when Maxwell's first paper appeared. An imposing mathematical superstructure had been built on the inverse square law and the notion of action at a distance, and, indeed, if we endeavour not to be wise after the event, we see that there is a measure of justification for Sir George Airy's dictum when he says that he "can hardly imagine anyone who knows the agreement between observation and calculation based on action at a distance to hesitate an instant between this simple and precise action on the one hand and anything so vague and varying as lines of force on the other."

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* James Clerk Maxwell: a Commemoration Volume, 1831–1931. Essays by Sir J. J. Thomson, Max Planck, Albert Einstein, Sir Joseph Larmor, Sir James Jeans, William Garnett, Sir Ambrose Fleming, Sir Oliver Lodge, Sir R. T. Glazebrook, Sir Horace Lamb. Pp. vi+146+2 plates. (Cambridge: At the University Press, 1931.) 6s. net.

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Nevertheless, although the exponents of the theory of action at a distance took little account of the properties of space, Faraday's fundamental experiments show that this neglect is erroneous. After all, it is necessary to take cognisance of such elementary results as those shown on rotating a coil (*a*) when a magnet is in the neighbourhood of the coil, (*b*) when the magnet is removed. Faraday expressed the difference by saying that space traversed by magnetic lines of force is in the electro-tonic state.

Maxwell's physics was that of the Scottish school, and he had a passion for exhibiting and explaining his views by means of a model. In his model of the magnetic field he represents "the lines of magnetic force . . . by cylinders rotating round these lines as axes, the magnitude of the force being represented by the velocity of rotation and its direction by that of the axis of rotation". The cylinders, in order that they may rotate in the same direction, must not be geared directly, but something of the nature of idle wheels must be introduced. The part of the idle wheels is played by electric particles, symbolised as small spheres. It is not difficult to see that changes in the magnetic field (that is, in the velocity of rotation of the cylinders) will produce motion of the spheres—that is, will give rise to an electric current; and it is the great virtue of the model that it suggests that changes in the electric force will give rise to motion of the cylinders—that is, will create a magnetic field. There is no need to labour the matter further. We may leave it here with Sir Joseph Thomson's comment that "the introduction and development of this idea was Maxwell's greatest contribution to Physics".

We have remarked on Maxwell's partiality for a model; and it is difficult, based as our mechanical views are (or were) on laws deduced from observation of large-scale phenomena, not to extrapolate our macroscopic conceptual world into the region of the infinitely small. So we obtain a concept of a gas based on billiard-ball mechanics; so we give the realities of elasticity and density to a luminiferous ether. Maxwell ran no such danger. His model was never confused with the physical reality (whatever that may be), and could be cheerfully discarded when it had done its work. "The changes of direction which light undergoes in passing from one medium to another are identical with the deviations of the path of a particle in moving through a narrow space in which intense forces act. This analogy was long believed to be the true explanation of the refraction of light; and we still find it useful in the solution of certain problems, in which we employ it without danger as an artificial method. The other analogy, between light and the vibrations of an elastic medium, extends much farther, but, though its importance and fruitfulness cannot be over-estimated, we must recollect that it is founded only on a resemblance *in form* between the laws of light and those of vibrations."

It is of this passage that Sir James Jeans remarks that it reads almost like an extract from a lecture on modern wave-mechanics.

In these two great divisions of physical science Maxwell's influence has been supreme. But any memorial of Maxwell which did not include some account of his wonderfully attractive personality would suffer seriously. Fortunately a few personal friends are still with us, and Dr. Garnett, Sir Ambrose Fleming, Sir Richard Glazebrook, and Sir Horace Lamb have added some precious details to that store from which many of us have been wont to glean—Campbell and Garnett's "Life".

Perhaps not enough has been made of Maxwell's remarkable genius as a writer of light verse. His mind was nimble, versatile, and scholarly; he had, moreover, that sympathetic understanding of an author which is the first essential for a successful parodist; and hence results the production of a volume of verse, small in itself, but of remarkably high quality. Much of his verse is technical, and its appeal is to a narrow audience; but such a parody of Tennyson as is seen in the well-known stanzas beginning

> "The lamplight falls on blackened walls"

is not unworthy of Calverley.

The autumn of 1931 has been a memorable period in the history of the physical sciences in Britain; it has seen the centenary of the British Association; it has seen the centenary of one of Faraday's fundamental discoveries; in celebrating the centenary of James Clerk Maxwell, we honour one whose life in its gentleness, its geniality, its single-hearted devotion to a lofty ideal is, equally with his contributions to science, a κτῆμα ἐς ἀεί—a treasure for all time.

Allan Ferguson.

Henry Cavendish, 1731–1810.

Of all the many members of the Cavendish family who have made the name famous, none will probably be remembered longer than the distinguished eighteenth-century natural philosopher, the Honourable Henry Cavendish, the bicentenary of whose birth falls on Oct. 10. The founder of the fortunes of the family was the fourteenth-century judge, Sir John Cavendish, who was murdered in Jack Straw's rising in 1381, but from whose descendants came both the first dukes of Newcastle and the earls and dukes of Devonshire. William Cavendish, the fourth Earl of Devonshire, the statesman of the reigns of Charles, James, and William and Mary, became the first Duke of Devonshire, and it was from him Henry Cavendish traced his descent, being the son of Lord Charles Cavendish, son of the second duke.

Cavendish was born on Oct. 10, 1731, at Nice, where his mother, Lady Anne Grey, daughter of Henry, Duke of Kent, had gone for the sake of her health. He was educated at the school of Dr. Newcombe in Hackney, and in 1749, at the

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