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 age of eighteen, entered Peterhouse, Cambridge. Four years later he left the University without, however, taking a degree. Little is known of his early manhood, but in 1760, three years after his father had been awarded the Copley Medal of the Royal Society for his "Very Curious and Useful Invention of making Thermometers", he, too, became a fellow of the Society, and six years later, after reading his first scientific paper, was also awarded the Copley Medal, "for his Experiments relating to Fixed Air".

Already deeply absorbed in scientific research, thence onward his study and laboratory claimed practically every moment of his life. His published papers were by no means numerous, but they firmly established his reputation, and as time went on he came to be regarded both at home and abroad as the foremost British natural philosopher of his age.

Cavendish occupied himself with many branches of physical science, including chemistry, meteorology, heat, magnetism, electricity, mathematics, and astronomy, but it was in the realm of chemistry that he first made his mark. He proved the elementary nature of hydrogen, he established the practical uniformity of atmospheric air, he was the first to show that water is not an elementary body but a compound of hydrogen and oxygen, and he discovered the composition of nitric acid. When sparking a mixture of common air and oxygen over potash he made observations which were not properly explained until Rayleigh and Ramsay in 1894 discovered argon. His great contemporaries included Black, Priestley, Scheele, Bergmann, Lavoisier, and others, whose work created a revolution in chemical science. A tremendous controversy for long raged around the question of who first discovered the composition of water, but it would probably never have occurred had Cavendish acted on Faraday's advice to investigators to "work, finish, publish".

The chemical researches of Cavendish were well known to his contemporaries; it has remained for the last two generations to learn of his many discoveries in electricity. Only two of his electrical papers were published in his lifetime, but he left behind him a mass of manuscripts and note-books which, though containing many 'pearls of scientific truth', were allowed to remain hidden for nearly a century. After the opening of the Cavendish Laboratory at Cambridge, the princely gift of the Chancellor, William Cavendish, seventh Duke of Devonshire, and the appointment of Clerk Maxwell as Cavendish professor of experimental physics, these manuscripts were placed in Maxwell's hands, and after much study were published in 1879. A further and enlarged edition of Cavendish's papers was issued in 1921, edited by Sir Joseph Larmor, Sir Edward Thorpe, and others. They showed that Cavendish had made electrical condensers and had measured their capacity, that he had anticipated Faraday's work on specific inductive capacity, and had completed an inquiry amounting to an anticipation of Ohm's law.

In another branch of science, geophysics, Cavendish is remembered for his capital experiment for determining the density of the earth. The plan adopted and apparatus used for the experiment were devised by the Rev. John Michell, rector of Thornhill, Yorkshire. He died before he could carry out the investigation, but his apparatus passed to the possession of Wollaston of Cambridge, and was given by him to Cavendish. The results obtained by Cavendish in 1784 were not far different from those obtained by later investigators working with more refined apparatus, and are a tribute to that care and exactness which characterised all his researches.

The character of Cavendish has baffled many inquirers. His habits were more those of a recluse than of a scion of a noble house. At first given an allowance of £500 a year by his father, after his fortieth year he was a man of immense wealth, and Biot after his death spoke of him as "le plus riche de tous les savants, et probablement aussi le plus savant de tous les riches". All his life he was shy, reserved, and taciturn, Brougham saying that "he probably uttered fewer words in the course of his life than any man who ever lived to four score years, not at all excepting the monks of La Trappe". Yet, from his bachelor home on Clapham Common, he would come to attend the weekly dinners of the Royal Society Club, and his library, housed in Dean Street, Soho, was available for all men of science. His life was written by Prof. George Wilson, who had to admit that Cavendish was singularly passionless: "An intellectual head thinking, a pair of wonderfully acute eyes observing, and a pair of skilful hands experimenting and recording, are all that I realise in reading his memorials". Of such a man anecdotes were sure to be told, and among them was the strange one of the manner of his death. Feeling his end was near, he said to his servant, "Mind what I say—I am going to die. When I am dead, but not till then, go to Lord George Cavendish and tell him—go!" He died on Feb. 24, 1810, at his house at Clapham, and on March 8 his remains were removed to Derby and interred in the family vault in All Saints' Church.

Obituary.

SIR HOWARD GRUBB, F.R.S.

FOR more than sixty years, Sir Howard Grubb, who died at Kingstown, Co. Dublin, on Sept. 16, at the age of eighty-seven, was actively engaged in the design and manufacture of astronomical and other optical instruments. He was born in Dublin in 1844 and educated at a private school and at Trinity College, Dublin, as a civil engineer. His father, the late Thomas Grubb, F.R.S. (1800–1878), who was engineer to the Bank of Ireland, founded a small works near Charlemont Bridge early in the nineteenth century, where he manufactured for the