within the sound-area, but the observation above recorded from the north-west quarter of St. Helens is worthy of notice in connection with the easterly elongation of the area of disturbance.

For the sake of comparison it may be worth while to refer briefly to the results obtained from previous explosions. At the conclusion of Sir John Moore's retreat, a great Spanish powder magazine, containing, it is said, 1500 barrels, was blown up near Corunna. The ground rocked sensibly for miles, and at a distance the shock was felt before the sound was heard (R. Mallet, *Irish Acad. Trans.*, vol. xxi., 1848, pp. 63-64). In the great Erith explosion (October 1, 1864) two barges, a large magazine and a small one blew up in succession. They contained respectively about 9, 33, and 4 tons of gunpowder. Everything within a distance of half a mile—trees, houses, barns—was utterly destroyed, except two haystacks on the south side of the river. Windows were shattered within a radius of at least five miles. The explosion was heard and felt at Teddington (21 miles), Uxbridge (27 miles), and Windsor (32 miles), and the concussion is said to have been felt near Ashford, which is distant about 40 miles (*Times*, October 3-6, 8, 1864). The catastrophe in the Regent's Canal (October 2, 1874) was caused by the explosion of about five tons of gunpowder. The shock and sound were observed as far as Chiselhurst (13 miles), and the vibrations were felt at Aveley (18 miles) and Gravesend (23 miles) (*Times*, October 3, 5, 1874). To effect the removal of the Flood Rock in Hell Gate, New York Harbour, about 130 tons of dynamite, &c., were exploded; and the vibrations were perceived, with the aid of a mercury bath and telescope, at a distance of 183 miles (*Times*, October 12, 1885; Milne's "Seismology," pp. 98-99). Mr. Fox Strangways states that the blasting operations in the Charnwood Forest quarries can be heard at a distance of 18 miles or more (NATURE, vol. liii., 1895, p. 130). The shock caused by the explosion of nearly 50 tons of dynamite at Johannesburg on February 19, 1896, was felt at Krugersdorp (19 miles) and Pretoria (33 miles) (*Standard*, February 21, 22, 1896). The Lagouban naval magazine (near Toulon), which blew up on March 5, 1899, is said to have contained 50,000 kg. of black powder. The country for a radius of nearly two miles was swept almost bare. Houses were razed to the ground, and trees were overturned or bent into the most extraordinary shapes. It is affirmed that the report of the explosion was heard at Nice (84 miles), and even beyond the frontier at Ventimiglia (100 miles); but it is obvious that, in the absence of intermediate records, we cannot place much reliance on these accounts (*Times*, *Daily Chronicle*, *Daily Mail*, *Daily Telegraph*, March 6, 1899).

CHARLES DAVISON.

THE HURTER MEMORIAL LECTURE.

THE memorial lecture established by the Liverpool Section of the Society of Chemical Industry in memory of Dr. Ferdinand Hurter, and which will be given every alternate year, was inaugurated by Prof. G. Lunge, of Zürich, on October 4, before a large and representative gathering at University College, Liverpool. Prof. Lunge's subject was "Impending changes in the general development of industry, and particularly in the alkali industries." After an appreciative review of Hurter's contributions to technical chemistry, in which special reference was made to his remarkable mathematical power and to the manner in which he employed it side by side with the highest branches of chemical science for the investigation and elucidation of technical problems, Prof. Lunge turned to the more immediate subject of his address. In contemplating the general features of chemical industries as carried on to-day, the question of the supply of fuel and of other sources of power was first considered; it was pointed out that the superiority which many countries, notably Great Britain, enjoy in many industries on account of their wealth of coal is limited in time, and that the increasing consumption of coal with a decreased source of supply as the result, must lead to the employment of other sources of energy. The economical use of coal in the blast-furnace, the adoption of closed coke ovens which, in addition to allowing the recovery of by-products, also increase the yield of coke, and recent improvements in the production of gaseous fuel are likely to postpone the time and force of the competition of those other sources of energy of which water-power stands foremost, but such postponement is restricted essentially to certain industries. From a general standpoint the total energy of the fossil fuel of the world is an infinitesimal fraction of the energy which the sun expends daily on the evaporation of water, and which is transformed to a great extent into the kinetic energy of falling water. The transformation of water-power into electrical energy, with its easy and cheap power of transmission, is likely to lead to revolutionary changes in chemical industries, not only in respect to the conditions of manufacture, but also in regard to the centres of production. Countries possessing great water-power will in the future carry on all those manufacturing processes in which electricity is either essential or an advantage, subject to certain limitations regulated by the cost of carriage of both raw materials and products. Prof. Lunge detailed the present position of electrical processes applied to chemical industries, dealing especially with the alkali trade and the manufacture of bleach and chlorate; the next generation will in all probability, in his opinion, obtain its chlorine by electrolytic methods, but the accompanying alkali will not form more than one-eighth or one-tenth of the world's demands. The bulk of the latter must therefore be derived from other sources—these, in Dr. Lunge's opinion, will be the ammonia-soda process and naturally occurring soda. In regarding the future of these industries the modern developments of the manufacture of sulphuric acid by the catalytic process, in which sulphur dioxide and oxygen are passed over platinised asbestos, were discussed; the success of this method, especially for the manufacture of strong acid, is thoroughly established, and the lead chamber is threatened with extinction in consequence. Prof. Lunge pointed out, however, that this old apparatus has still certain claims of efficiency in the manufacture of weak sulphuric acid. Incidentally, in considering the economical use of fuel, Prof. Lunge gave a most interesting description of the Dellwik-Fleischer water-gas process, the efficiency of which he had himself examined with the result that he found that it gave no less than 82 per cent. of the fuel value of the coke against the 45 per cent. of the older processes. The characteristic of the process is the formation of carbon dioxide during the "blow" instead of carbon monoxide, a fact which reduces the time of the blow from 10 minutes to $1\frac{3}{4}$ minutes.

In looking back upon the industry with which Hurter's life-work was associated, Prof. Lunge dwelt upon the fact that the very processes Hurter had helped so ably and successfully were without doubt doomed, if not to complete extinction, still to a most serious crippling. Like other earnest workers, Hurter had but tilled the soil from which others will reap a harvest; and although there is a feeling of sorrow in the thought that so much genius, inventive talent and honest labour had been expended in what seemed now a transient aim, still

> Der wer den Besten seiner Zeit genug gethan
> Der hat gelebt für alle Zeiten.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. A. Hutchinson, of Pembroke College, has been reappointed Demonstrator in Mineralogy and Assistant-Curator of the Museum of Mineralogy for a term of five years.

Sir Walter Gilbey and Mr. Austin Keen have been appointed additional members of the Board of Agricultural Studies.

Mr. H. Woods, of St. John's College, is to be appointed a University lecturer in Palæozoology. He has hitherto held the post of demonstrator in this subject at the Woodwardian Museum.

The awards of entrance scholarships have been made at the two groups of Colleges, the first comprising Trinity, Clare and Trinity Hall, the second Pembroke, Caius, King's, Jesus, Christ's, St. John's and Emmanuel. One hundred and seventeen scholarships and exhibitions have been given; of these 23 are for mathematics, 28 for natural science, and 49 for classics. The value of these scholarships varies from 80*l.* to 40*l.* a year, that of the exhibitions from 50*l.* to 20*l.* a year.

NEGOTIATIONS have been proceeding with the authorities of Mason College and King Edward's Foundation relative to the provision of a remodelled system of commercial education in Birmingham. It is expected that the charter of the new University for Birmingham will be granted early next year, and that there will be a faculty of commerce in connection therewith.

Speaking at the Birmingham Chamber of Commerce last week, Mr. Neville Chamberlain said they were on the eve of a new departure in the educational life of Birmingham. They were looking forward to the rise of a University which would take up new and special lines, including commercial education. That was a great experiment, and it seemed to him to be the duty of that chamber, as representing the commercial life of Birmingham, to do what it could to ensure the success of the experiment.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, October.—The number opens with a partial analysis of the papers communicated at the sixth summer meeting of the Society, held at Columbus, Ohio, in August last, by Prof. Holgate.—The President, Prof. Woodward, congratulated the Society on the manifest interest in mathematical study and investigation as evidenced by the large number (twenty-three) of communications presented.—A report on the recent progress in the theory of linear groups is an interesting and thorough report by Dr. L. E. Dickson, which was made before Section A of the American Association for the Advancement of Science at its meeting at Columbus, previous to the above gathering of the Society. It is a supplement to the previous report, drawn up by Dr. G. A. Miller, which appeared in the February (1899) number of the *Bulletin*. The author restricts himself to finite linear groups, and of these he considers first the finite collineation groups and afterwards the linear congruence groups and the more general groups in Galois fields. These reports are very useful to students of the subject.—A few shorter notices (small reviews) follow.—The "Notes" contain many items of interest, but two of them are not quite accurate. For instance, the London Mathematical Society has *not* decided to issue its *Proceedings* in two volumes per annum. The resolution, as stated in the appendix to Volume xxx., says "in future the volumes of *Proceedings* shall contain as nearly four hundred pages as may be found convenient, provided that each volume shall begin with the report of proceedings at a meeting, not necessarily an annual general meeting." This may sometimes result as in the "Notes," but not necessarily so. A statement on p. 40 would lead one to infer that Dr. Graves was professor at Trinity College, Dublin, at the time of his death, and had been so ever since 1843.

American Journal of Science, November.—March weather in the United States, by O. L. Fassig. If the earth's surface were uniform, the normal circulation of air would produce two belts of high pressure at a latitude of about 30° north and south. The presence of continents breaks up these areas. The author shows that the "permanent" high pressure areas have a great determining influence upon weather in its general aspects, and that a considerable advance in forecasting work may be expected to result from their study. The March weather of the United States is determined by the relative extent of three such areas, and the course of the March storms lies along the gap between them.—Some new minerals from the zinc mines at Franklin, N.J., by S. L. Penfield and C. H. Warren. The minerals include "hancockite," which has the general formula of epidote, but having lead and strontium isomorphous with calcium; "glaucochroite," $CaMnSiO_4$, closely allied to monticellite, $CaMgSiO_4$; and its matrix "nasonite," the empirical formula of which is $Pb_6Ca_4Cl_2(Si_2O_7)_3$. The authors also investigate the chemical composition of ganomalite, and show that the acid, $H_6Si_2O_7$, of which nasonite and ganomalite are salts, is intermediate between orthosilicic acid, H_4SiO_4, and metasilicic acid, H_2SiO_3, and may be regarded as their algebraic sum, or as derived from two molecules of the former by abstraction of water.—Action of acetylene on the oxides of copper, by F. A. Gooch and D. Baldwin. While metallic copper may at comparatively high temperatures induce the polymerisation of acetylene, it is an oxidising action which starts at moderately low temperatures the formation of the peculiar "acetylides." Thus it is found that ferric oxide heated in acetylene at temperatures varying from 150° to 360°, according to circumstances, darkens, glows, and gathers with evolution of heat a dark carbonaceous deposit. In the products of such action the content of iron varies from 2·8 to 5·8 per cent. Silver oxide also acts upon acetylene.—A new mode of occurrence of ruby in North Carolina, by J. W. Judd and W. E. Hidden. Corundum occurs in North Carolina in three different forms. In the ordinary schists of the district, long prismatic crystals, usually of grey, pink and blue tints, occur. In the peridotites, crystals are found, some of very great size and of great variety of colour, but seldom or never clear and translucent. In certain garnet-bearing basic rocks at Cowee Creek, small tabular and short prismatic crystals are abundant, and these very frequently exhibit the transparency and colour of true ruby.

Wiedemann's Annalen der Physik und Chemie, No. 10.—Explosions in air, by W. Wolff. The effect of an explosion in air is propagated by a process analogous to the propagation of sound, except in the immediate neighbourhood of the source, where a bodily translation of the air is superadded. But that translation does not extend further than about 25 m. Up to that point the propagation of the wave is more rapid than the propagation of sound.—Glow-light phenomena with high-frequency alternate currents, by H. Ebert. There is a residual effect of the positive charge in the glow-light, which persists for a short time after the glow has ceased. This produces a repulsion between the two electrodes.—Influence of impurities upon a gaseous spectrum, by P. Lewis. The addition of very small quantities of mercury vapour to hydrogen gives rise to the green mercury line, which only disappears at −20 degrees. When oxygen is added to hydrogen in increasing quantities, the maximum of emission is shifted towards lower pressures. Resistance to projectiles in air, by R. Emden. The resistance offered by air is jointly proportioned to the square of the velocity, v^2, and to another function of the velocity, $f(v)$. The latter quantity is constant up to the point where v becomes the velocity of sound. Then it abruptly increases to about three times its former value, remaining constant at high velocities. The increase is due to the energy expended in producing and maintaining the head wave.—Electric pictures, by L. Fomm. The author produces pictures of sections of different kinds of wood by covering them on one side with tinfoil and on the other with bromide paper, with the film in contact with the wood. A metallic point negatively charged by an influence machine, mounted at 5 cm. from the paper surface, produces a good impression in about half a minute.—The Macfarlane-Moore vacuum vibrator, by J. Elster and H. Geitel. To avoid the sticking of the vacuum interrupter the authors keep it vibrating by a separate interrupter outside the vacuum tube, in unison with the one inside.—A fault in Lippmann's photography, by O. Wiener. There is always a difference of phase between the wave reflected by the gelatine surface and that reflected by the first elementary stratum. The remedy consists either in eliminating the surface reflection altogether, as by immersing the plate in benzol, or in producing a large difference of path, by coating the gelatine with a film of collodion. With a suitable thickness of the latter, very brilliant and true effects are obtained.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 15.—"On the Resistance to Torsion of certain forms of Shafting, with special reference to the Effect of Keyways," by L. N. G. Filon, M.A., King's College, Cambridge, Fellow of University College, London.

In this paper solutions of the torsion problem are obtained for cylinders whose cross-sections are bounded by confocal ellipses and hyperbolas. The method employed is that of conjugate functions, suggested by Saint-Venant, Thomson and Tait, Clebsch, Boussinesq and MacDonald, and applied by them to other cases.

The strains and stresses are obtained in the form of infinite series of circular and hyperbolic functions. There are two types of sections specially studied.

The first is bounded by an ellipse and by the two branches of a confocal hyperbola. The solution is worked out numerically for various values of the eccentricity of the ellipse and of the angle between the asymptotes of the hyperbola.

The position of the fail-points, or points of maximum strain and stress, is investigated at length.

It is shown that the maximum stress does not always occur, as is usually assumed, at the point of the boundary nearest to the centre of the section, but that in some cases there are four fail-points symmetrically distributed round the contour, on the broad sides of the section.