

Naturally the detection of products which may indicate decomposition actually occurring or likely to occur is important, and for this purpose Abel's heat test, first introduced for gun-cotton about 1875, is employed for cordite. The test depends on the liberation of iodine from potassium iodide by the action of nitrogen peroxide, the principal decomposition gas. The ground explosive is heated to 180° F. in a tube, and the time noted for discoloration of the test paper to a certain standard tint. The question at once suggests itself, Does the test show decomposition products which were present in the explosive, or have they resulted from heating during the test, or both conditions acting together? Very divergent opinions are held as to the value of the Abel test as an indication of the stability or "life" of gelatinised explosives. Certainly a powder giving a bad test must be regarded with suspicion, but it is obviously not an easy matter to fix a time limit for a test which is subject to adverse criticism.

One of the most important considerations with any explosive is its stability. The question naturally arises, Is the molecular arrangement in such substances as nitrocellulose and nitroglycerine stable under ordinary conditions of temperature? Their explosive properties depend entirely on molecular rearrangement, which is practically instantaneous when detonation occurs. Certainly slow decomposition occurs in most nitro-compounds of the explosive class at temperatures not greatly above the normal with the production of oxides of nitrogen, and it has been shown that these oxides act catalytically on the explosive; in other words, their effect becomes cumulative and may lead to ignition. In order to avoid this catalytic action, "stabilisers" have been introduced in many explosives, substances capable of absorbing these nitrogen compounds. As already mentioned, the vaseline in cordite appears to perform this useful function.

THE SHEFFIELD MEETING OF THE BRITISH ASSOCIATION.

FOR the last few months the various committees dealing with the local arrangements for the meeting of the association have been hard at work and the general outlines are settled. The hardest task, perhaps, has fallen to the lot of the hospitality committee in finding accommodation for the large number of visitors expected, the city being notorious for its small hotel accommodation. A first list of hotels and lodgings is now ready, and members should lose no time in engaging rooms. To meet the expected demand, the committee has arranged for the two training colleges' hostels for women to receive members, the larger one for gentlemen, with a limited number of married people in an annexe, and the University Hostel for single ladies. The list may be obtained from the secretary of the hospitality committee, Mr. J. Wortley, George Street, Sheffield.

The reception-room will be at the Cutlers' Hall. Here, in addition to the various rooms and offices usually associated with the reception-room, will be a large luncheon-room, giving, close at hand, sufficient accommodation to prevent the pressure and overcrowding so prevalent in many previous meetings. The Cutlers' Hall is conveniently situated in the centre of the city, close to the tram termini, and the various section rooms are grouped round it, all within a radius of 400 yards, with the exception of that of physiology, which, for evident reasons, is better placed in the University. The president's address, and the popular lectures by Prof. Stirling (types of animal movement), Mr. Hogarth (new discoveries about the

Hittites), and Mr. C. T. Heycock (the Saturday evening lecture to operatives), will be given in the Victoria Hall.

The first evening reception will be at the Town Hall, by the Lord Mayor and Countess Fitzwilliam. The Weston Park is to be the central scene of the second on Tuesday, September 6, at which about 4,000 guests are expected. The University lies along the east side of this park, and the Mappin Art Gallery is in it on the west. Advantage has been taken of this to have a combined reception by the University and the local committee. The Chancellor and the Duchess of Norfolk will receive one category of guests at the University, and the Earl and Countess Fitzwilliam another in the Art Gallery, but the two will really form a combined *conversazione*, with an evening garden-party in the park. One of the features of the latter will be a military tattoo with torches after dark. Afternoon garden-parties for the whole association will be given by the Lord Mayor at his seat at Wentworth, and by the local committee in the Botanical Gardens, whilst a number of smaller garden-parties will be given on other days. Arrangements have been made for visits to more than twenty works, covering the chief staple trades of the city. In the University also the various furnaces in the metallurgical department will be run on different days to illustrate that feature in the University curriculum.

Saturday, September 3, will be devoted to excursions to the Derwent Waterworks, to Chatsworth, Welbeck, and Clumber, where members will be entertained respectively by the Dukes of Devonshire, Portland, and Newcastle, also to Haddon, Roche Abbey, and Bolsover Castle. The neighbourhood is so rich in picturesque scenes that there will be ample scope for members to arrange private excursions, such as to the Peak Caverns, the limestone dales, Buxton, Matlock, Wingfield Manor, or even further afield, to York, Lincoln, or Newark Castle, and Southwell Minster.

A local handbook of 500 pages has been compiled under the editorship of Dr. Porter, with the assistance of a large number of local experts, containing a large amount of interesting matter, scientific, historic, and local. During the meeting the University will hold a congregation for the purpose of conferring honorary degrees on the president and other eminent scientific men attending the meeting.

PROVISIONAL PROGRAMMES OF SECTIONS.

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCE).—The address of the president (Prof. E. W. Hobson) will be delivered at 10 a.m. on Thursday, September 1. Two discussions are under arrangement. On Monday, September 5, there will be a joint discussion with Section G on the principles of mechanical flight, to be opened by Prof. G. H. Bryan; and on Tuesday, September 6, Dr. C. Chree will open one on atmospheric electricity. The section will meet with Sections G and B on Friday, September 2, to participate in the discussion on the report of the gaseous explosions committee, and in papers to follow dealing with combustion. Several papers have been already promised to the section, but the programme is still incomplete.

SECTION B. (CHEMISTRY).—The feature of the programme is the joint discussions with other sections. These are:—Friday, September 2, with Sections A and G: Subjects of general interest; in particular, combustion. Monday morning, September 5, with Sections I and K: Respiration; afternoon, with Section L: The neglect of science by commerce and industry. Reports will be presented by Prof. W. A. Bone, on combustion; Dr. J. V. Eyre, on solubility.

Papers on a fourth recalcence in steel, Prof. Arnold; the provident use of coal, Prof. H. E. Armstrong; influence of chemical composition and thermal treatment on the properties of steels, Prof. A. McWilliam; ferro-silicon, Dr. S. Monckton Copeman; corrosion of iron and steel, Dr. J. N. Friend; the crystalline structure of iron at high temperatures, Dr. Rosenhain; allotropy or transmutation? Prof. Howe; the molecular weight of radium emanation, Sir Wm. Ramsay and Mr. R. W. Gray. Papers from the Sheffield University Chemical Department: Formation of tolane derivatives from *o*- and *p*-chlorobenzylchloride, Dr. J. Kenner and E. Whitham; sulphonic derivatives of chloro- and nitrochlorotoluene, Dr. J. Kenner and Prof. W. P. Wynne; an instance illustrating the relative instabilities of the trimethylene ring as compared with the tetramethylene ring, Dr. J. F. Thorpe; three physical chemical papers dealing with viscosity and molecular association, W. E. S. Turner (in conjunction with C. L. Peddle and E. W. Merry).

AGRICULTURAL SUBSECTION OF SECTION B: Sugar beet growing, Sigmund Stein and G. L. Courthope, M.P.; nitrogen fixation, Prof. Bottomley and J. Golding; various: cost of a day's horse labour, A. D. Hall; cost of Danish dairy farming, Christopher Turnour; effect of town atmosphere on vegetation, Dr. Crowther; scientific problems in live stock breeding, K. J. J. Mackenzie. Joint meetings (1) with Economic and Statistical Section: The magnitude of error in agricultural experiments; scientific method in experimental work, Prof. H. E. Armstrong; experimental error in feeding trials, T. B. Wood and A. B. Bruce; experimental error in field trials, A. D. Hall and E. J. Russell; experimental error in milk analysis, S. H. Collins; experimental error in plant analysis, R. H. Berry; (2) with the Geological Section, *Soil Surveys (Agricultural)*: Survey of Kent, Surrey, and Sussex, A. D. Hall and E. J. Russell; survey of Norfolk, Mr. Newman; "Teart" land of Somerset, C. T. Gimmingham; (3) with the Zoological Section: Part played by organisms other than bacteria in soil fertility, E. J. Russell and H. B. Hutchinson.

SECTION C (GEOLOGY).—Thursday, September 1, 10.0: The Joredale Series and its equivalents elsewhere, Cosmo Johns; the Palæozoic rocks of Cautley (Sedbergh), Dr. J. E. Marr and W. G. Fearnside; the graptolitic zones of the Salopian rocks of the Cautley (Sedbergh) area, Miss O. R. Watney and Miss E. G. Welch; pleochroic halos, Prof. J. Joly. 11.30: Presidential address by Dr. A. P. Coleman; mountain temperatures and radium, Dr. C. H. Lees; outlines of the geology of northern Nigeria, F. D. Falconer; notes on the geology of the Gold Coast, W. Parkinson; the geological significance of the nickel-iron meteorites, Cosmo Johns. Friday, September 2, 10.0: Joint meeting with Section E (Geography): (1) Papers on local geography and geology, (a) the local geology, Cosmo Johns; (b) the local geography; (c) the marine bands in coal measures of south Yorkshire, H. Culpin; (d) the Maltby deep boring, W. H. Dyson. (2) Joint discussion on the economic products of Sheffield as affected by the structure of the district. Paper by Prof. McWilliam on the metallurgical industries in relation to the rocks of the district. (3) Regional surveys. Paper by T. Sheppard on the Humber during the human period. Monday, September 5, 10.0: Seismological report by Dr. J. Milne; thrust masses in the western districts of the Dolomites, by Mrs. W. M. Ogilvie-Gordon; on the geology of Cyrenaica, Prof. J. W. Gregory; on the geology of Natal, Dr. F. H. Hatch. 12.0: Joint discussion with subsection Agriculture on soil surveys. Tuesday, September 6, 10.0: Discussion on the concealed coalfield of Notts,

Derbyshire, and Yorks. Papers by Prof. P. F. Kendall and Dr. Walcot Gibson; two papers by Ernest Dixon; (1) Kilauea and its lessons, (2) some volcanic phenomena in New Zealand, Dr. Tempest Anderson.

SECTION D (ZOOLOGY).—Address by the president, Prof. G. C. Bourne; mitokinetism and the electrocolloid hypothesis, Prof. Marcus Hartog; semination in *Calidris armarica*: a key to some problems regarding its migratory movements during the breeding season, Prof. C. J. Patten; some experiments and observations on the colours of insect larvæ, Prof. Garstang; a cytological study of artificial parthenogenesis, Dr. Edward Hindle; avian coccidiosis, Dr. H. B. Fantham; relation of regenerative and developmental processes, Dr. Jenkinson; first results from the Oxford anthropometrical laboratory, Dr. E. H. J. Schuster; development of the pectoral girdle in *Acanthias vulgaris*, Dr. H. W. Marett Tims; a paper dealing with some sex problems, Geoffrey Smith; Dr. Gadov will give the afternoon lecture on coral snakes and peacocks.

SECTION E (GEOGRAPHY).—Presidential address, Prof. A. J. Herbertson; cotton-growing within the British Empire, J. Howard Reed; the Uganda-Congo Boundary Survey, Major R. G. T. Bright; the river systems of Nigeria, Dr. J. W. Falconer; the alluvium of the Nile, Capt. Lyons; the homeward voyage of the *Nimrod*, Capt. J. K. Davis; Prince Charles Foreland, Dr. W. S. Bruce; the geology and metallurgical industries of the Sheffield district, joint meeting with Section C.

SECTION G (ENGINEERING).—Presidential address, Prof. W. E. Dalby: (1) the testing of lathe tool steels, (2) a new method of testing the cutting quality of files, Prof. Ripper; experiments on aeroplanes, W. A. Scoble; accelerometers, H. S. Wimperis; optical determination of stress, Prof. Coker; laws of electro-mechanics, Prof. S. P. Thompson; the electrification of the Brighton Railway, Philip Dawson; heat insulation, F. Bacon; report of the gaseous explosions committee; joint discussion on combustion with Section B (Chemistry); joint discussion on aerial flight with Section A (Mathematics and Physics).

SECTION I (PHYSIOLOGY).—Thursday, September 1: Presidential address, Prof. A. B. Macallum; the mechanism of reflex standing and walking, Prof. C. S. Sherrington. Friday, September 2: Discussion on prevention of caisson disease, to be opened by Dr. Leonard Hill. Monday, September 5: Joint discussion with Sections of Botany and Chemistry on biochemistry of respiration. Tuesday, September 6: Joint discussion with Section of Education on speech. There will be the usual reports of committees, and the following papers have been promised:—The relation of light perception to colour perception, Dr. Edridge Green; the combination of poisons with the contractile substance of cardiac muscle, Dr. H. M. Vernon; (1) the inorganic composition of the blood of vertebrates and invertebrates and its origin, (2) the inorganic composition of the blood serum of the laboratory frog in spring, (3) further observations on the localisation of potassium salts in animal and vegetable cells, Prof. A. B. Macallum.

SECTION K (BOTANY).—A joint discussion between the Botanical, Chemical, and Physiological Sections, on the biochemistry of respiration, Dr. F. F. Blackman and others to take part; a new method of estimating the opening of stomata, Dr. F. Darwin; the paths of translocation of sugars from green leaves, S. Mangham; (1) two synthetic genera of Filicales, (2) note on *Ophioglossum palmatum*, Prof. Bower; the pollen chambers of fossil and recent seeds, Prof. F. W. Oliver; the morphology of the ovules in *Gnetum* and

Welwitschia, Mrs. Thoday; further observations on the fossil flower, Dr. M. C. Stopes; chromosome reduction in the Hymenomycetes, Harold Wager; the sexuality of *Polystigma rubrum*, Prof. V. H. Blackman; telophases and prophase in Galtonia, Prof. Farmer and Miss Digby; a cytological paper, Dr. H. C. J. Fraser; the zoospores and trumpet-hyphæ of the Laminariaceæ, Dr. Lloyd Williams; plant distribution in the woods of north-east Kent, M. Wilson; the absorption of water by leguminous seeds, A. S. Horne. Papers are also expected by Prof. F. E. Weiss and others. The semi-popular lecture will be given this year by Prof. F. O. Bower; subject, sand dunes and golf links.

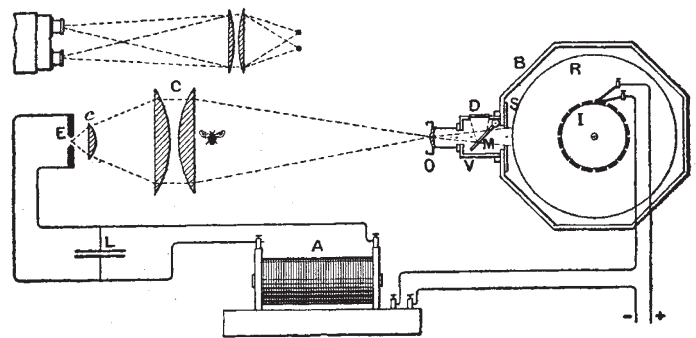
SECTION L (EDUCATIONAL SCIENCE).—The president for the meeting is Principal H. A. Miers, and his presidential address will be delivered on Thursday morning, September 1. It is intended to give up the whole of Friday, September 2, to the subject of educational research, and the meeting will be a joint one with the Anthropological Section. Prof. J. A. Green, of Sheffield, the secretary of a committee which has been investigating the mental and physical factors involved in education, will present a report on the present position of educational research at home and abroad. Dr. Gray will also present a report on behalf of a committee of the Anthropological Section on methods of observing and measuring mental characters. It is hoped that Prof. Münsterberg, of Harvard, will open the discussion, which promises to be an important one. Dr. Lucy H. Ernst, Prof. Lippmann, of Berlin, Dr. Kerr, the principal medical officer of the London County Council, and several members of his staff, Prof. C. S. Myers, Dr. T. P. Nunn, and Dr. Rivers, of Cambridge, amongst others, have signified their intention to take part, and reports will be presented, by the investigators, of serial observations on school children and others which have been conducted in London, Liverpool, Sheffield, Wolverhampton, and elsewhere. On Monday morning, September 5, Mr. J. G. Legge, Director of Education in Liverpool, will open a discussion on handwork and science in elementary schools. On Monday afternoon there will be a joint discussion with the Chemistry Section on the neglect of science in commerce and industry. Mr. R. Blair, the Education Officer of the London County Council, will open the discussion, and Prof. Bovey, Principal E. H. Griffiths, Sir William Tilden, and others have promised to take part. On Tuesday morning, September 6, the subject of open-air studies in schools of normal type will be taken up. There will be papers by Mr. J. E. Feasey, of Sheffield, Mr. G. G. Lewis, of Kentish Town, and Prof. Mark R. Wright, of Newcastle-on-Tyne, will read a paper on a training college under canvas. On Tuesday afternoon a joint meeting will be held with the Physiological Section for the discussion of voice production. Dr. A. A. Gray, Mr. H. H. Hulbert, Principal Burrell, of Isleworth, Prof. Wesley Mills, Mr. W. H. Griffiths, and others, will contribute papers.

THE ULTRA-RAPID KINEMATOGRAPH.

A RECENT number of *La Nature* (April 30) contains a very interesting account of the latest work of the Marey Institute. By means of the new instrument, the ultra-rapid kinematograph invented by M. Bull, sharp stereoscopic kinematograph views may be obtained of such extremely rapid movements as, for instance, the flight of a fly or the breaking of a soap bubble. With the ordinary kinematograph the photo-

graphic film moves discontinuously, being arrested at the moment of each exposure. While this is simple enough at moderate speeds, it would be quite impossible where the exposures are at the rate of 2000 a second, and the mean speed of the film 4000 cm. a second. These are the figures that are necessary for the study of insect flight, and these are attained in the new instrument. With such a speed the movement of the film must be continuous, and a sharp image is possible only if the exposure does not exceed $1/400,000$ second, and for this the electric spark gives a light of sufficiently short duration.

The apparatus is shown diagrammatically in the figure. R is a wheel 34.5 centimetres in diameter, which may be turned at a high speed by means of an electric motor. It carries two long strips of photographic film to receive the stereoscopic images. On the same axis, but outside the octagonal light-proof case, is fastened an interrupter, I, of fifty-four strips of copper, which serve to make and break the primary circuit of an induction coil fifty-four times every turn, or 2000 times a second. The secondary of the induction coil is connected with a pair of spark-gaps, E, arranged in series, the electrodes being of magnesium to increase



the light. The arrangement of the two gaps and their relation to the optical system are shown in plan (but reversed, left for right) in the upper left-hand corner of the figure. A condenser, L, is connected to the wires leading to the spark-gaps. The optical system is made clear by the figure, but the lenses are made of quartz and Iceland spar instead of glass, so as to be transparent to the actinic rays of short wavelength for which glass is opaque. A mirror, M, throws the pair of images on a ground-glass screen, D, or, being turned up out of the way, it leaves a clear passage for them to be formed on the films. In order to prevent the photographs from being spoilt by multiple exposure, two shutters of thin steel, actuated by springs, are released electromagnetically one after the other, the interval being the duration of one turn of the wheel.

The movements photographed are determined as to time by fine wire prolongations of the prongs of a tuning-fork of 50 ~ a second, which are photographed at each successive exposure, and as to distance by a divided glass scale, which equally appears in every picture. It is, of course, necessary to ensure that the fly or other insect shall traverse the field of view just at the time that exposure is made. There is no difficulty in causing the creature to fly in the right direction, as a window is sufficient to determine the line of flight. One method by which M. Bull releases the fly at the right moment is by holding it in electromagnetically-operated forceps, which are relaxed by the same current which starts the first shutter. This works well enough with ordinary flies, but hymenoptera and some other insects hesitate and only make