other of them may usually be found in a chlorate blasting explosive. The addition of aluminium greatly increases the heat of explosion; it is present in the explosives of the ammonal type.

NITRO-AROMATIC COMPOUNDS.—Modern high explosives very frequently contain nitro-derivatives of the aromatic compounds obtained from coal tar, especially the mono- di- and tri-nitro-derivatives of benzene, toluene, and naphthalene. The nitro-groups in these compounds contribute oxygen for the explosive reaction. The trinitro-compounds of substances containing only one benzene ring are explosives in themselves; trinitrotoluene, for instance. Trinitrotoluene is not only a constituent of composite explosives, but is also very largely used by itself as a charge for shell and submarine mines, and for other military and naval purposes, for which its insensitiveness combined with its great violence render it suitable. Picric acid (trinitrophenol) is also much used for these purposes, and trinitrocresol to a less extent. Although they detonate with great violence, these trinitro-compounds do not contain sufficient oxygen to oxidise the whole of the carbon they contain even to the stage of carbon monoxide. Their power as explosives is, therefore, increased by mixing them with oxygen carriers. Commercial explosives containing trinitrotoluene always have also some other constituent which can supply the deficient oxygen.

NITRIC ESTERS.—Nitroglycerin and the nitrocelluloses are the principal members of another very important group of substances that can be used as explosives without admixture. Strictly speaking, they are not nitro-derivatives, but nitric esters. The more highly nitrated celluloses, such as guncotton, contain enough oxygen to convert all the hydrogen into water and the carbon into monoxide, and even some of it into dioxide. Nitroglycerin, $C_3H_5N_3O_9$, not only has enough to oxidise entirely all its hydrogen and carbon, but also has a little oxygen left over. Nitroglycerin is the most powerful explosive compound known, but its power is increased by dissolving in it a small proportion of nitrocellulose, which utilises the excess of oxygen and at the same time converts it into a gelatinous solid known as blasting gelatin.

SMOKELESS POWDERS.—All smokeless powders consist largely of nitrocellulose, which has been more or less gelatinised and converted into a compact colloid by means of a suitable solvent; many of them contain practically nothing else, but in others there is a considerable proportion of nitroglycerin. Small percentages of mineral jelly, inorganic nitrates, and other substances are also added, in many cases to improve the ballistics or the stability. Powders for rifled arms are always colloided as completely as possible, whether they be for small-arms or ordnance, to make them burn slowly and regularly, but in shot-gun powders the original structure of the nitrocellulose is not always destroyed entirely, as they are required to burn comparatively rapidly.

ENDOTHERMIC COMPOUNDS.—There are some explosive compounds which do not depend at all for their action on oxidation or reduction. These are endothermic substances, which decompose with the evolution of gas and heat; they are usually rather sensitive. The only compounds of this class that are of commercial importance are fulminate of mercury, $Hg(CNO)_2$, and lead azide, PbN_6, both of which are used only for exploding other explosives.

VELOCITY OF EXPLOSION.—The heat and gas evolved are the two principal factors which govern the power of an explosive, *i.e.* the amount of work it can do in the way of displacing objects. But the time taken by the explosion is also a matter of great importance. The rate of explosion is measured by making a column of the explosive, confining it, if necessary, in a metal tube, and measuring the time that the explosive wave takes to travel a known distance. In black powder and similar nitrate mixtures the velocity of explosion is only a few hundred metres a second, but with modern high explosives the velocity of detonation is from two to seven thousand metres a second. This naturally makes them much more violent and destructive. Explosives of the gunpowder type are used when earth or soft rock is to be blasted, or when the material must not be broken up too much. Propellants for use in firearms are required to burn slowly; for rifled arms they must be slower even than gunpowder. They are not exploded by means of another high explosive, but merely lit by a powerful flame, and should then burn by concentric layers. The rate of burning increases with the pressure in the gun, but for completely gelatinised powders it is less than a metre a second.

A. MARSHALL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Scottish Association for the Medical Education of Women has placed with the authorities of the University of Edinburgh the sum of 237*l.* for the purpose of founding a prize for women medical students.

THE Foulis memorial scholarship of the University of Glasgow has been awarded to Dr. John Cruickshank, pathologist to the Crichton Royal Institution, Dumfries, for distinction in original work in pathology.

IT is announced in the issue of *Science* for January 14 that four business men of Portland have contributed 5000*l.* toward the new buildings for the medical department of the University of Oregon, Portland. This makes available the 10,000*l.* appropriated by the State. The officers of the college now propose to raise an additional 20,000*l.*

THE issue of the *Pioneer Mail* for January 1 contains a report of the eleventh session of the Indian Industrial Conference, which commenced its sittings on December 24 last. It was the first time the conference had met in Bombay since its inception. There was an unusually large attendance of delegates and distinguished visitors. The president, Sir Dorabji J. Tata, is one of the pioneers of Indian industry. In the course of his address, he referred to the importance of industrial education, and said industrial education in the widest sense of the term is primarily the function of the State. But a good many people wish the State to go far beyond this *rôle* and to enter into the actual field of industrial enterprise. The president's message to the Congress, and through it to his countrymen, was "Educate, Organise, Co-operate." Scientific, technical, economic education is the function of the State, but he said they must take their share of the burden. If they really wanted higher scientific education and were determined to profit by it, they would get it. Dr. H. H. Mann, principal of the Agricultural College, moved a resolution earnestly recommending the establishment of a technological faculty at the principal Indian universities, the development of already existing technical institutions, the opening of new institutions, and the gradual introduction of technical instruction in primary and secondary schools. The resolution, which was adopted, appealed to men of capital and industry to help young Indians technically trained in finding practical work and employment.

THERE is a widespread opinion among competent authorities that an independent inquiry should be made into our system of education, particularly as regards its organisation, the powers of the Board of Education, the relations of the Board to local education

authorities, and even the qualifications of members of the Board assigned to special posts in connection with work of science and technology, subjects and methods of instruction, and the like. The matter was brought before the House of Commons on January 26 by Sir Philip Magnus, who asked the Prime Minister "whether he will consider the desirability of appointing a Committee of Members of the House of Commons, and of other persons interested in and having a practical knowledge of the subject, to inquire into the present organisation of education in this country, and to report as to whether, having regard to the experience gained in the operations of the war and to the new social and economic conditions that may result when the war is over, any and, if so, what changes it may be thought advisable to introduce into our national system of education, with a view to establishing, without unduly interfering with other aims, a closer connection between our commercial and industrial requirements and the teaching provided in our several educational institutions, and in order to secure such further development as may be found necessary of existing facilities for scientific research and the better training of all classes of the population for the activities in which they may be severally engaged?" Mr. Asquith's reply was somewhat evasive of the points raised; and the substance of it was that he did not think it would be desirable to set up the Committee suggested, and that the President of the Board of Education would be glad "to consult all persons or bodies who are in a position to give advice on this matter." As the functions and influence of the Board itself are among the main points requiring consideration, the reply cannot be regarded as very satisfactory, and we hope that Sir Philip Magnus will raise the matter again. The Board is now practically the supreme governing body, not only of almost every grade and class of school, but also of most of our university institutions; and in its hands lies the scheme for the development of scientific and industrial research. As we understand the question, one of the objects of the Committee would be to inquire whether the Board is promoting educational and other work adapted to modern conditions and national needs, and whether practical and scientific studies can receive adequate attention under its present constitution. There are many who think otherwise, and a Committee could determine whether the dissatisfaction is well founded or not.

A COMMITTEE of the Association of Public School Science Masters has drawn up a strong memorandum on the unsatisfactory position which science occupies in national affairs, and particularly in our public schools and the old universities. The memorandum is signed by many distinguished leaders of scientific work and thought, and communications with reference to it are invited by the committee; they should be addressed to the secretary, Reorganisation Committee, 107 Piccadilly, London, W. A few of the matters mentioned in the memorandum are here summarised: Not only are our highest Ministers of State ignorant of science, but the same defect runs through almost all the public departments of the Civil Service. It is nearly universal in the House of Commons, and is shared by the general public, including a large proportion of those engaged in industrial and commercial enterprise. An important exception to this rule is furnished by the Navy, and also by the medical service of the Army. Our success now, and in the difficult time of reorganisation after the war, depends largely on the possession by our leaders and administrators of scientific method and the scientific habit of mind. For more than fifty years efforts have been made by those who are convinced of the value of training in experimental science to obtain its introduction into the schools and colleges of the country as an essential part of the education given therein. At Cambridge only four colleges are presided over by men of scientific training; at Oxford not one. Of the thirty-five largest and best known public schools thirty-four have classical men as headmasters. Science holds no place in the list. Science has been introduced as an optional subject for the Civil Service examinations, but matters are so arranged that only one-fourth of the candidates offer themselves for examination in science. It does not pay them to do so; for in Latin and Greek alone (including ancient history) they can obtain 3200 marks, while for science the maximum is 2400, and to obtain this total a candidate must take four distinct branches of science. For entrance into Woolwich, science has within the last few years been made compulsory, but for Sandhurst it still remains optional. This college is probably the only military institution in Europe where science is not included in the curriculum. If a Bill were passed directing the Civil Service Commissioners and Army Examination Board to give a preponderating—or at least an equal—share of marks in the competitive examination to science subjects, with safeguards so as to make them tests of genuine scientific education and not an incentive to mere "cram," the object we have in view would be obtained. Eventually the Board of Trade would be replaced by a Ministry of Science, Commerce, and Industry, in full touch with the scientific knowledge of the moment. Public opinion would compel the inclusion of great scientific discoverers and inventors as a matter of course in the Privy Council, and their occupation in the service of the State. Our desire is to direct attention to this matter, not in the interests of existing professional men of science, but as a reform which is vital to the continued existence of this country as a Great Power.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 27.—Sir J. J. Thomson, president, in the chair.—Prof. J. **Joly**: A collision predictor. The collision predictor is a mathematical instrument of simple construction. It enables the mariner when navigating in fog or thick weather to foretell risk of collision with another ship, and also the moment at which the risk is greatest. The ships concerned are supposed to be aware of each other's course and speed, and (at intervals) of their distance apart. The determination of distance is made according to principles described in a previous communication to the Royal Society. The operation of taking a reading on the collision predictor takes less than half a minute. The construction of the instrument and the principles involved cannot be conveyed without diagrams.—Dr. C. **Chree**: Discussion of Kew magnetic data, especially the diurnal irregularities of horizontal force and vertical force, from ordinary days of the eleven years 1890 to 1900. The paper is mainly devoted to a discussion of the results of measurements of the horizontal force and vertical force curves from the magnetographs at Kew Observatory for the eleven years 1890 to 1900. Subsequent to 1900, artificial electric currents diminished the value of the curves. One of the main objects is the study of the diurnal variation as given by "ordinary" days, *i.e.* all days with the exception of the highly disturbed. The changes of the regular diurnal variation throughout the year are dealt with in detail, and the inequalities are expressed in Fourier series. An investigation is also made of the annual inequality. For this purpose use is made of results for years subsequent to 1900, as well as of those between 1890 and 1900. The relation