work associated therewith; the investigation of various devices and aids to the location of casual icebergs, and of the waters of polar origin in which they are found.

The early experiments of Profs. Barnes and L. V. King on the detection of icebergs by temperature differences in the neighbouring sea water, which were carried out with the assistance of the Canadian Government, seem to have been unsuccessful, since we find that attention is now being concentrated on underwater echo methods of detection similar to those used for echo sounding. These methods formed the subject of a recent illuminating article in NATURE, May 9, 1925, p. 689. In the 1925 season an echo sounder of U.S. Navy type was tried by the Ice Patrol, and it was established that weak echoes could be obtained from a large iceberg in favourable circumstances at a maximum range of 2500 yards, the echoes being, however, first reflected from the bottom of the sea. 'Growlers' and very small bergs did not reflect well under normal conditions.

In the meantime, it is encouraging to note that the Canadian Government and the Research Council of Canada have afforded Prof. Boyle and his co-workers the financial and material assistance which has enabled them to institute a series of fundamental investigations[1] on the properties of ultrasonic (high-frequency) sound waves in water. Some tests have also been carried out at sea. The investigations included the measurement of the energy in an ultrasonic sound beam in water by means of a torsion pendulum, together with the measurement of the energy reflected from various materials, such as steel, various types of rock, and ice immersed in the water. The lateral distribution of energy in the sound beam has also been determined in this way. One of the most striking experiments has been the production of stationary waves in a small tank, which were made evident by the pattern formed on a tray by the dust of coal cinders which had fallen slowly through the acoustic energy field above. This method of rendering visible the interference pattern due to the combination of direct and reflected beams has been utilised to check the values of the coefficient of reflection from different substances by decreasing the energy output of the transmitter until a definite pattern just failed to form in the case of each reflector.

[1] *Trans. Roy. Soc. Can.*, Third Series. Vol. 19, 1925, p. 167. "Visualisation and Energy Survey of a High-Frequency Diffraction Beam." By R. W. Boyle, J. F. Lehmann, and C. D. Reid. Vol. 20, 1926, p. 245. "Reflecting Powers of Various Materials for Ultrasonic Waves." By R. W. Boyle and G. B. Taylor. Vol. 20, 1926, p. 233. "Practical Experiments on the Detection of Icebergs and on Sounding by Means of an Ultrasonic Beam." By R. W. Boyle and C. D. Reid.

The experiments showed that ice was, of the materials tried, the worst reflector of sound. This, indeed, was expected from the fact that the products (density × velocity of sound) for ice and water differ little from one another. The circumstance that ice in its natural condition contains a considerable amount of included air in the form of bubbles held under pressure will, however, tend to make the detection of icebergs by echo methods less unpromising than might be judged from calculations on the basis of the data relating to pure ice, while the variations in temperature and salinity in the water surrounding a melting berg must also be taken into consideration.

The final report details the results of some practical trials to determine the range of iceberg detection at sea by the use of a high-frequency sound transmitter fitted on the s.s. *Montcalm*, a vessel maintained by the Department of Marine and Fisheries of Canada. It was anticipated that the small transmitters used would enable echoes to be obtained from rocks at a range of about 1000 yards, and this estimate was found to be justified. Echoes from a medium-sized iceberg were detected at a range of only 250 yards, but echoes due to multiple reflections between the berg and the ship were observed in other cases at a distance of 150 yards. In spite of this statement, it is clear that a very accurate measurement of time interval between echoes must be made before the explanation of the cause of the multiple echoes can be accepted. It is stated that the tests, which were carried out in shallow water, showed that echoes from the bottom and surface of the sea were a source of disturbance up to and beyond the time of arrival of the echoes from the iceberg.

The results obtained by Prof. Boyle are promising in that more powerful transmitting apparatus has already been constructed by him. Whether a reasonable increase in power will permit detection of the smaller icebergs and 'growlers,' which must be considered the most dangerous types of ice, can only be decided by further practical experiments at sea. In view of the attitude already displayed by the Canadian Government and by the Research Council of Canada, there is room for little doubt that Prof. Boyle will be enabled to continue his investigations to a point which will decide whether the directional high-frequency, or the relatively non-directional low-frequency, sound beam is better adapted for the detection of floating ice.

C. S. W.

The Total Solar Eclipse of January 14, 1926.

A JOINT meeting of the Royal Society and Royal Astronomical Society was held at Burlington House, London, on Thursday, November 11, to discuss the results obtained by the British eclipse expedition to Sumatra in January of this year. The Astronomer Royal opened the discussion with an account of the coronal pictures obtained by various eclipse expeditions in the past sent out from the Royal Observatory, Greenwich. In addition to the well-known changes of form with the solar cycle, he pointed out the close connexion of certain prominences with arches in the corona, and also certain changes detected as taking place during an eclipse, as seen from a comparison of plates taken at widely distant stations.

Mr. C. R. Davidson gave an account of the instrumental arrangements made for the Sumatra observations (see NATURE, February 27, p. 306), and of the chief results obtained from it. A study of the objective-prism spectra obtained by Col. J. Waley Cohen with a camera of 38-foot focal length, and by Dr. F. W. Aston with a 19-foot camera, gives the heights to which the different elements can be traced, the observed heights being in general accordance with previous results. The coronal rings show evidence of intensification in the neighbourhood of several prominences; the brightening does not quite coincide either in position or in form with the prominences, but some close relation seems to be indicated. The plates taken with the Grove-Hills flint slit-spectroscope do not go beyond the oxygen triplet at λ 7772. The dicyanin stain failed to work satisfactorily under the conditions of heat and damp prevalent in Benkulen. The wave-lengths of the two coronal lines in the green and the red were determined as 5303·4, 6374·1 I Å.U. The flash spectrum obtained by Mr. Davidson with the Grove-Hills quartz slit-spectroscope extends down to λ 3066. The lines have been measured and grouped in series, where the data are available. In the coronal spectrum obtained with the same instrument, the lines from a high prominence, which also appear on the plate, gave an excellent scale for the coronal wave-lengths. These have been determined as 3387·95, 3454·11, 3601·03, 3642·87, 3800·77, 3986·82, and 4086·30 I.Å.U. The relative brightness of the lines of the corona differs from the values found in previous eclipses, but it is easily apparent that the lines themselves differ in the distribution of intensity with height above the sun's limb.

Mr. Stratton gave an account of the photometric work which has been done, by the kind permission of Prof. L. S. Ornstein, by Dr. Minnaert and himself on the ultra-violet slit-spectra with the aid of the Moll spectro-micro-photometer at the physical laboratory at Utrecht. The trustworthiness of the actual measures of intensity of the lines have been tested by examining certain multiplets which have been found to have relative intensities in close accordance with their proper values. The intensity of the K line has been measured at eight different heights and a satisfactory accord found over a range 30,000 km. to 100,000 km. of height with the theoretical value calculated by Mr. P. A. Taylor from Prof. E. A. Milne's theory of the chromosphere. The coronal lines also have been measured for intensity at different heights, and curves plotted connecting the intensity with the height. The lines were divided into three well-marked groups; the extreme groups confirmed the results found some years ago by Sir Norman Lockyer through a study of variations in the coronal rings from different sources. Attempts have been made from a study of line intensities to determine the temperature of the sun at different levels. In the Balmer series an application of Schrödinger's formula has given a temperature which decreases as the height above the sun's limb decreases. The temperatures deduced cannot be accepted, but what the observations gave was a measure of the weakening at lower levels in the chromosphere of the lines in the Balmer series corresponding to the atoms with the larger orbits. This weakening was to be expected from the increased ultra-violet radiation from the sun streaming through these lower layers; its extent has now been measured. Balmer lines from $H\delta$ (6) to H 29 have been used in this work. The hydrogen continuous spectrum which extends towards the violet from the head of the Balmer series has also been examined. From this a measure of the temperature (the distribution of the velocities of the electrons) was possible. The value thus found, 1700° K. at 8000 km. height, is too low, as checked by a cross-determination from the relative intensities of certain ionised titanium lines at that same level and in the low level of the flash spectrum. One further result of interest in the photometric work is a study of the continuous spectrum in the low corona or high prominence at a height of 20,000 km. In agreement with the result obtained by Deslandres in 1893, this continuous spectrum when compared with that of a black body gave a lower temperature than the sun's temperature. The result is consistent with Ludendorff's recent work on the distribution of intensity in the continuous spectrum of the corona, which he finds to be unaltered from that of the sun. But Ludendorff's results come from much higher layers and are consistent with the light being scattered by electrons. The suggestion is that at the lower layers concerned the light is, partly at least, affected by Rayleigh scattering from atoms.

Prof. Ornstein raised the point whether a formula due to Miss Bleekers which fits many laboratory spectra need be rejected because when applied to the Balmer series it gives a negative temperature. This is very little different in reality from the extremely low temperatures given by the Schrödinger formula. Both formulæ make it clear that some disturbing factor is affecting the relative intensities of the lines, which clearly do not correspond to thermodynamical equilibrium. He welcomed the co-operation in this work of physicist and astrophysicist.

Dr. Minnaert dealt with the problem of comparing intensities at different wave-lengths and urged the necessity of extending our knowledge of a trustworthy curve of the intensity of the solar radiation for different wave-lengths. Abbot has not used sufficient resolving power to meet present requirements of spectrophotometers, and H. H. Plaskett's work needs to be extended more towards the ultra-violet. It is desirable that astrophysicists living in suitable climates should make further measures by photographic methods, if full value is to be obtained from future eclipse records.

The president of the Royal Society, Sir Ernest Rutherford, expressed his appreciation of Mr. Davidson's beautiful photograph of the Balmer series and of the kind co-operation of the Dutch scientific workers in reaping the fruit of the eclipse expedition, their own expedition having failed through bad weather conditions. It is the first time that intensity measures have been made on eclipse spectra; and the possibility of this has been due to the work of Prof. Ornstein and his colleagues at Utrecht.

Prof. Newall expressed great pleasure at hearing from the Astronomer Royal that Mr. Wesley's drawings of the corona are to be reproduced, and added his view that Mr. Davidson's ultra-violet spectra are the best yet achieved in eclipse work. He, too, welcomed the co-operation with the Dutch physicists and astrophysicists.

Prof. Fowler expressed admiration for the photographs, and pointed out with what refinement the adjustments must have been made. The photographs seen that day were remarkable for the large size of the solar image, and they should add considerably to our knowledge. He was interested to hear about the suggested relation between the coronal intensity and the prominences, as there is no evidence for it in earlier eclipses. The increased accuracy of the wave-lengths of the coronal lines should help in the further investigation of their source. What is now required is higher resolution and more powerful instruments. Longer exposure is necessary, and this could be obtained by working on the edge of the belt of totality or even outside it.

Prof. Milne pointed out that the theories being tested at this eclipse are all of very recent growth. Prof. Ornstein must feel gratified that his contribution is bearing fruit so soon. It is possible that some of the theories of solar physics will need to be revised. He was much interested in Mr. Taylor's results. It is clear that radiation pressure must play its full part in supporting the atoms at high levels if the chromosphere reaches the heights indicated. The low temperatures found at the lower levels of the sun only indicate that the fraction of the more highly excited atoms there is less than it would have been if the atmosphere had been in thermodynamical equilibrium. If the distribution of intensity in the continuous spectrum is due to atomic scattering, then it looks as though the prominence must consist of a mass of material thrown out with a comparatively high density.

Mr. R. H. Fowler suggested that it is the laws of a perfect gas that are failing at lower levels rather than those of thermodynamical equilibrium. He had made a rough numerical estimate of the falling off of intensity of lines of the higher quantum numbers and compared it with Urey's correcting factor. That will account partly for the result expressed in terms of the parameter, T, as indicating a lower temperature.

Prof. Lindemann supported the view that the future of eclipse work lies with photometry rather than with the determination of wave-lengths. In discussing the continuous light, the possibility of light-scattering in the instrument should be borne in mind. He would like to see a negative temperature gradient in the sun, such as might fit the demands of convective equilibrium.

Dopes and Detonation.

WE have received a copy of the Air Ministry Reports and Memoranda, No. 1013, by H. L. Callendar, R. O. King, and C. J. Sims, published by H.M. Stationery Office. The primary object of the investigation which is described was the determination of the physical actions that delay or prevent detonation in the cylinder of an internal combustion engine.

The addition to petrol of non-detonating fuels, such as benzene, has long been familiar as a means of checking the onset of 'pinking' in a high-compression engine. In the case of benzene a large addition is required; alcohol and toluene are more effective than benzene by about 50 per cent., though they still appear to act mainly by dilution of the original fuel.

There are, however, other classes of substances, many times more effective than toluene, the action of which cannot be explained by dilution. Thus, in the case of lead ethide, the addition of 0·25 per cent. by volume is nearly as effective as 100 per cent. of toluene. Nickel carbonyl shows a similar order of effectiveness.

The action of such 'dopes' must evidently depend on some specific property requiring further investigation. It has been shown that the heavier paraffins, on account of their high critical temperatures combined with low critical pressures, are exceptionally liable to persist in the form of nuclear drops, which serve as foci of simultaneous ignition by compression owing to their low ignition temperature. The marked effect of pressure in promoting detonation is explained by the rapid increase of nuclear condensation with increased density of charge. The action of a dope in delaying detonation is to 'infect' the nuclear drops in such a way as to delay their ignition. The fact that these drops form a small percentage of the whole mixture helps to explain the possibility of a relatively small quantity of the dope being effective. It has been shown that lead ethyl and nickel carbonyl, two of the most effective metallic dopes, when mixed with petrol residues, decompose rapidly at temperatures above 200° C., depositing a film of metal on the surface of the liquid. This metallic film would tend to protect the nuclear drops from oxidation, and would help to keep down their temperature by reflecting radiation.

Organic dopes, such as methylaniline and xylidine, have the advantage that much higher compression ratios can be employed than in the case of metallic dopes without risk of fouling the engine with deleterious deposits. On the other hand, much larger quantities are required than in the case of lead ethide. Organic dopes probably act mainly by the dilution of the nuclear drops, which results in a rise in the ignition temperature; but the chemical reactions which may occur are very complicated and require further investigation.

University and Educational Intelligence.

CAMBRIDGE.—Honorary degrees are to be offered to the Maharajadhiraja Bahadur of Burdwan, the Right Hon. W. L. Mackenzie King (Prime Minister of the Dominion of Canada), the Right Hon. J. G. Coates (Prime Minister of the Dominion of New Zealand), and to Mr. W. T. Cosgrave (President of the Executive Council of the Irish Free State).

Amongst those elected to the Council of the Senate are Sir H. K. Anderson, Dr. T. C. Fitzpatrick, Prof. A. C. Seward, Mr. T. Knox Shaw, and Mr. F. J. M. Stratton. Mr. R. E. Priestley, Clare College, assistant registrary, has been elected secretary of the general board of the faculties, a body that is to be elected for the first time on November 30.

Mr. W. H. Florey, lately John Lucas Walker Student and Rockefeller Research Fellow, has been elected to a fellowship at Gonville and Caius College.

MANCHESTER.—The Council has made the following appointments: Dr. William Susman, to be lecturer in morbid anatomy and histology; Mr. C. J. Polson, to be assistant lecturer in chemical pathology; Mr. A. M. Downie, to be assistant lecturer in bacteriology; Dr. F. A. Mason, to be lecturer in tinctorial chemistry and dyestuffs; Mr. Arthur Riley, to be assistant lecturer in textile engineering; Mr. F. W. Bailey, lecturer in papermaking.

Dr. Ivar Waller has been awarded an honorary research fellowship in physics.

Dr. James A. Bowie has been appointed Director of the Department of Industrial Administration in the Manchester College of Technology. After the War, Dr. Bowie was appointed lecturer at the College, where he devoted his attention to industrial relations with special reference to problems of wages, profit-sharing, and copartnership.

THE Universities of South Africa form the subject of an article by Prof. H. Clement Notcutt, of the University of Stellenbosch, in the October number of the *University Bulletin* (issued by the Association of University Teachers). It is pointed out that whereas the Act of Parliament which brought the Union into existence provided that the English and Dutch languages should both be "official," Afrikaans, which differs from the Dutch of Holland both in vocabulary and in syntax and is the home language of a large part of the inhabitants of Dutch descent, has recently been given by Parliament the same status. Consequently there are now three official languages. In the schools, English and Afrikaans are taught with the intention that all children of European descent growing up in the country shall have an adequate knowledge of both languages, but there is an ever-present danger of their failing to acquire the power of using either with that exactness which is necessary for clear thinking. Prof. Notcutt might have added that the prestige won for Afrikaans has reacted unfavourably on the position of Dutch, and a movement inspired largely by enthusiasm for maintaining the Netherlands connexion and cherishing the traditions handed down from the original Dutch settlers is in fact tending to estrangement, for the Dutchmen of Holland cannot, generally speaking, find time to learn Afrikaans, nor can the Afrikanders spare for Dutch so much time as they could before Afrikaans became a literary and official language. It is estimated that a higher proportion of the *white* population is attending college or university than in Great Britain or any of the other British Dominions. A noteworthy characteristic of South African university students is their devotion to sports, in which respect they resemble the students of Oxford and Cambridge rather than those of the other English universities.