Toronto Meeting of the British Association.

THE preliminary programme of the annual meeting of the British Association in 1924, to be held in Toronto, Ontario, on August 6-13, under the presidency of Sir David Bruce, has just been issued. This will be the second occasion on which the Association has visited Toronto, the first being in 1897, under the presidency of Sir John Evans, the second of the three meetings previously held in Canada (Montreal, 1884; Toronto, 1897; Winnipeg, 1909). Active measures are being taken, both in Toronto and at home, with the object of ensuring that the meeting shall afford an exceptional opportunity for intercourse between British, Canadian, American, and European workers in science, and, to visiting members, an unique occasion for acquainting themselves with the manifold scientific interests of the Dominion. The University of Toronto, which ranks with its affiliated colleges as one of the largest in the British Empire, will be the principal centre of the meeting.

The Association will meet in thirteen sections as follows, the names of the president and recorder of each being given, together with the address of the latter. A (Mathematics and Physics): Sir William Bragg; Prof. A. O. Rankine, Imperial College of Science and Technology, London, S.W.7; B (Chemistry): Sir Robert Robertson; Prof. C. H. Desch, University, Sheffield; C (Geology): Prof. W. W. Watts; Prof. W. T. Gordon, King's College, Strand, London, W.C.2; D (Zoology): Prof. G. Elliot Smith; Prof. R. D. Laurie, University College, Aberystwyth; E (Geography): Prof. J. W. Gregory; Dr. R. N. Rudmose Brown, University, Sheffield; F (Economic Science and Statistics): Sir William Ashley; Prof. H. M. Hallsworth, Armstrong College, Newcastle-upon-Tyne; G (Engineering): Prof. G. W. O. Howe; Prof. F. C. Lea, 36 Mayfield Road, Moseley, Birmingham; H (Anthropology): Dr. F. C. Shrubsall; Mr. E. N. Fallaize, Vinchelez, Chase Court Gardens, Enfield, Middlesex; I (Physiology): Dr. H. H. Dale; Prof. C. Lovatt Evans, Physiological Laboratory, St. Bartholomew's Medical College, London, E.C.1; J (Psychology): Prof. W. McDougall; Dr. Ll. Wynn Jones, 7 St. Mary's Avenue, Harrogate; K (Botany): Prof. V. H. Blackman; Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge; L (Educational Science): Principal Ernest Barker; Mr. D. Berridge, 1 College Grounds, Malvern; M (Agriculture): Sir John Russell; Mr. C. G. T. Morison, School of Rural Economy, Oxford.

The inaugural general meeting will be held on Wednesday, August 6, in the Convocation Hall of the University of Toronto, when Sir David Bruce will deliver his presidential address. In the sections, addresses will be delivered by the respective sectional presidents, and papers will be read, on and after Thursday, August 7, until the conclusion of the meeting (Wednesday, August 13).

Joint meetings of various sections will also be held, at which the following are among the subjects expected to be discussed: A and B—Crystal structure, and colloid solutions; A and G—Optical study of elasticity; B, I, and M—Vitamins; B and C—Liquid fuels; C and E—Changes of sea-level in relation to gravitation, continental shelves, and coral islands; D and K—Species concept; D and M—Soil population; F and M—Diminishing returns in agriculture; H and J—Racial mental differences; I and J—Physiological and psychological factors of muscular efficiency in industry; J and L—Mental and educational tests in scholarship examinations.

For those in Great Britain desirous of attending the meeting, some useful information is afforded in the programme. The main routes to Toronto are from Southampton, Liverpool, or Glasgow, either direct to the Canadian ports of Quebec or Montreal, or to New York or another United States port. The lines to Canadian ports have the advantage of an open sea voyage of only four to five days, the remaining three to four days of transit being on the land-locked waters of the Gulf of St. Lawrence, and on the St. Lawrence River. The journey to Toronto by this route occupies nine to ten days. By taking one of the fastest steamers to New York, Toronto may be reached in about seven days.

The cost of passages varies according to route and vessel; the following average *minimum* figures for the single voyage are given: By largest vessels on New York service, 57*l*.-59*l*. (First class) to 17*l*. (Third class); by smaller vessels on New York service, and by vessels to Canadian ports, 39*l*.-50*l*. (First class) to 16*l*. (Third class). In round figures, the cost of the journey from a British port to Toronto and back, by "cabin" ship or second class, may be put at 60*l*. (excluding incidentals). The third-class accommodation on many of these ships, having cabins (two or more berths) and saloons, is also stated to be very good; the open "steerage" of former days having disappeared. If it should be found that any considerable number of members desire to travel by this class at any particular date, the companies have offered to make, so far as possible, special arrangements for their comfort. The return fare from a British port to Toronto, third class on steamer, may be put at approximately 36*l*. (excluding incidentals). The shipping companies have offered to provide members with superior accommodation at minimum fares, so far as it is possible to do so. Convenient sailings range from July 23 to 29. Members are warned that, unless they are citizens of the United States, they must obtain the United States consular *visa* on their passports not less than a fortnight before leaving Great Britain. British subjects proceeding to Canada and returning to the British Isles require passports to secure re-entry.

As regards accommodation in Toronto, particulars are given of various hotels, and in addition the University of Toronto men's and women's residences, Burwash Hall, Annesley Hall (women), Wycliffe College, and Knox College will be available for upwards of 600 persons (single rooms), for which the charge will probably be 1 dollar per day, and it is expected that the University dining-halls will be available for meals at tariff rates.

A preliminary programme of excursions after the meeting is also being arranged. For those able to devote the maximum time, an excursion across Canada to Vancouver, and possibly also to Prince Rupert and Victoria, is contemplated. This excursion offers an excellent opportunity of seeing the physical features of the country and its natural resources. Those who are able to take advantage of it will be able to see something of the farming, fisheries, mining, timber, pulpwood for paper-making, and water-power in Quebec and Ontario; the nickel, silver, and gold regions of Northern Ontario; the prairie and ranching country of the West, including the Great Wheat Belt; the Alberta and British Columbia coal regions; and the timber, pulpwood, and fruit-growing country of British Columbia, and the famous fisheries of its coast. The route crosses the Rocky Mountains and passes close to the Red Deer Valley in Alberta.

Each of the two Canadian railway systems has granted the Association the exceptionally low rate

of 1½ cents a mile to overseas visitors for the trans-continental excursion, exclusive of sleeping berths. The exact route has not yet been decided, but an approximate estimate of the expenses is 17*l.* for fare and 15*l.* for berths, and the total cost of the excursion will be, approximately, 50*l.*

The officers of the local committee dealing with arrangements in Toronto are as follows: Chairman of general and executive committees: Prof. J. C. McLennan; local hon. secretaries: Prof. J. C. Fields, University, Toronto, and Prof. J. J. R. MacLeod, University, Toronto; assistant local secretary: Major J. M. Mood; local hon. treasurer: Dr. F. A. Mouré, University of Toronto.

Delegates of Corresponding Societies will meet, by invitation of the Museums Association, during the meeting organised by that Association at the British Empire Exhibition, Wembley, on July 21-26. At the British Association meeting, there will be a conference of local scientific societies.

The Tarnishing and Fogging of Metals.

By Prof. H. C. H. CARPENTER, F.R.S.

SOME years ago, as a result of the action taken by certain members of the Royal Institute of British Architects, a Committee was set up composed of representatives of that Institute, the Institute of Metals, and the British Non-Ferrous Metals Research Association, charged with the duty of making arrangements for the experimental investigation of the causes of the atmospheric corrosion of non-ferrous metals. The necessary funds were provided by the Department of Scientific and Industrial Research, the British Non-Ferrous Metals Research Association, and various interested persons. Mr. W. H. J. Vernon was appointed to carry out the experimental work, and the report of his first investigation was presented and discussed at the Faraday Society on December 17 last.

The research has been initiated and developed mainly along two lines: (1) Tests carried out with relatively large specimens exposed to representative atmospheres in order to compare their effects on typical metals and alloys, and to correlate the behaviour of as wide a range of materials as possible; and (2) laboratory experiments conducted on relatively small specimens with the object of obtaining insight into the mechanism of tarnishing and corrosion. The present report deals mainly with tarnishing, filming, and fogging, which represent the early stages of corrosion. Four types of atmosphere were investigated: (1) An indoor atmosphere maintained continuously in the unsaturated condition with respect to water vapour; (2) an indoor atmosphere of variable but relatively high humidity, occasionally reaching saturation; (3) an ordinary domestic kitchen; and (4) open-air exposure on the roof of the Royal School of Mines building at South Kensington. The specimens have been examined visually and with the aid of a microscope, accurate determinations have been made of the increase in weight of the test-pieces from time to time; but probably the method which has given the most information has been an optical one, in which, after suitable preparation, the reflectivities of the surfaces have been determined, both in the freshly cleaned condition and during the course of exposure. Mr. Vernon has found that the loss of reflectivity affords a very sensitive means of estimating the changes taking place at the surface, more particularly in the earliest stages of tarnishing. His method consisted in comparing the light from two similar lamps in a Lummer Brodhun photometer, one of the lamps being so arranged that its light could be either (1) allowed to fall directly upon the photometer, or (2) reflected on to it from the metal surface under examination, the total length of the beam being the same in each case. The use of a suitable colour screen placed over the eye-piece of the photometer was necessary.

Three types of curves, the co-ordinates of which are weight-increment and time, have been obtained and their significance discussed in relation to the function of the tarnishing product or scale obtained. In the first case, the curve is a parabola the axis of which coincides with the time axis of the co-ordinates. Weight-increment is thus proportional to the square root of the time; that is, the rate of attack is retarded as the period of exposure increases. The scale forms a continuous envelope and subsequent tarnishing can only take place by diffusion of the corroding atmosphere through it. From the point of view of the solution of the problems envisaged by the Committee this is the most favourable case. Copper within a wide range of humidity variations falls within this class. In the second case, the curve is a straight line passing through the origin, and weight-increment is directly proportional to the time. Here the scale is completely permeable and allows free access of the atmosphere to the metal. A typical example is furnished by zinc in an unsaturated atmosphere. In the third case, the curve is a parabola the axis of which coincides with the weight axis. Weight-increment is proportional to the square of the time; that is, the rate of attack is accelerated as the period of exposure increases. The scale is not merely permeable but discontinuous. The metal iron in an atmosphere of relatively high humidity corrodes in this way. The influence of the condition of the surface has been carefully examined, and, as a rule, the rougher it is the greater the tendency to tarnish.

At least two, if not three, types of attack have been found to take place. There is, first of all, what Mr. Vernon terms "tarnishing," in which characteristic colour changes are brought about by the presence of *gaseous* sulphur compounds. Liquid water is not necessary, for the action takes place at temperatures considerably above the dew-point and increases as the temperature is raised. Excess of water vapour reduces the rate of tarnishing. The presence of either solid or liquid particles appears to be without appreciable influence. The metal copper furnishes a variety of instances of tarnishing according to the condition of the atmosphere.

Another variety of attack is the "smoky" film, developed in an unsaturated polluted atmosphere on the high zinc brasses. Microscopical examination shows that in the early stages the action predominates on the α (copper rich) constituent, while subsequently within the areas occupied by the "smoky" film the attack is largely concentrated upon the β (zinc rich) constituent. This attack appears to be due to the presence of solid or liquid particles, probably sulphuric acid. A third type of attack is illustrated by the behaviour of nickel in an indoor atmosphere at temperatures near to the dew-point, when a characteristic filming or fogging of the surface occurs. This film may readily be removed in the early stages but becomes more persistent as the duration of exposure increases. The same phenomenon is shown by nickel-copper alloys. In such cases a humid atmosphere produces "fog" and an unsaturated atmosphere gives rise to tarnish.