

centrifugal force on each mass is proportional to its radius of rotation, hence the mass which starts farthest out tends to go still farther out, and stability is only reached when the rod is at right angles to the axis of rotation. If a second similar rod were fastened at right angles, the forces upon it would balance those on the first rod. The combination would be neutral and would take up a neutral position. Hence an airplane with its masses symmetrically disposed would be free from such couples and free therefore from the peculiar difficulties of a flat spin. In practice, however, airplanes cannot be so made, and as a fair example of what occurs in practice the case of the well-known Bristol Fighter airplane may be cited. Here the moments of inertia about the longitudinal axis and the transverse axis are found to be about equal, whilst that about a vertical axis is half as much again.

A simple calculation shows that for any given rate of rotation this disturbing couple reaches a maximum when the fore and aft line of the airplane is inclined downwards at 45° . Once that

angle is exceeded the couple grows less. When, therefore, an airplane is being brought out of a very flat spin the pilot has to exert a control not merely large enough to balance the inertia couple at the moment, but also large enough to overbalance this growing couple as the barrier angle is reached. The barrier angle will come at exactly 45° if the rate of spin remains constant, if it does not it may be somewhat above or below this angle. But a barrier there will in general always be, and recovery from any flat spin must depend on its being satisfactorily surmounted. (An experimental demonstration was given to show the effect of the inertia couple in raising the nose of the fuselage.)

A typical pilot's impression of the change from the ordinary spin to the flat spin appeared in one report as follows: "After the first two or three turns, which were relatively steep, the nose came up and the machine settled down to an exceptionally steady spin at moderately large incidence and a quick rate of rotation. There was no noticeable jerkiness during the turn."

(To be continued.)

The Bristol Meeting of the British Association.

PROGRAMMES OF SECTIONS.

MATHEMATICAL AND PHYSICAL SCIENCES.

THE presidential address of Section A (Mathematical and Physical Sciences) will be delivered on Monday, Sept. 8, by Dr. F. E. Smith, who has chosen as his subject "The Theories of Terrestrial Magnetism." On each of the other days a considerable portion of the available time will be taken up by a series of related papers. Thus on Thursday, Sept. 4, there will be a discussion on "The Meteorological Relations of Atmospherics," in which Dr. R. A. Watson Watt, Prof. E. V. Appleton, M. R. Bureau, Dr. F. Schindelhauer, and Mr. M. A. Giblett will participate. On the following day there will be a series of papers dealing with aspects of the solid state, the contributors being Prof. J. E. Lennard-Jones, Prof. W. L. Bragg, Dr. J. D. Bernal, and Dr. F. Bloch. These will be followed by a brief discussion, opened by Prof. Heisenberg. On Tuesday, Sept. 9, there will be a discussion on flow in gases, and the aerodynamical and meteorological aspects of this subject will be dealt with by Mr. E. Ower, Mr. F. C. Johannsen, Mr. G. Bilham, and Mr. M. A. Giblett. The programme contains also the usual papers on particular investigations.

Many distinguished foreign visitors are contributing to the proceedings. In addition to those mentioned above, Prof. M. Siegbahn will present a paper on "The Highly Ionised Spectra in the Extreme Ultra-Violet," and the section will probably listen to other eminent visitors.

There will be a strong Sub-Section of Mathematics, and twenty papers appear on its programme. Several of these will be of interest to physicists and others. Thus Prof. S. Brodetsky will read a paper on "The Einstein Field-Theory," and Prof. A. C.

Dixon will discuss integral equations, a subject which is rapidly becoming important in physical investigations. There will also be a paper on modern Babbage calculating machines by Dr. L. J. Comrie.

CHEMISTRY.

For his presidential address to Section B (Chemistry) Prof. G. T. Morgan, director of chemical research in the Department of Scientific and Industrial Research, has chosen the title "A State Experiment in Chemical Research". He will discuss the development of the Chemical Research Laboratory at Teddington since its beginning five years ago. His account of the investigations now in progress at that institution will be illustrated by an exhibit of preparations, apparatus, and models of chemical plant.

On Friday, Sept. 5, a discussion will be held on the present position of the British dyestuff industry—a topic which is particularly opportune in view of the impending lapse of the Dyestuffs (Import Regulations) Act in January 1931. In opening the discussion, Prof. A. G. Green will review the development of the British industry since 1901, when he gave an account of the position at the Glasgow meeting of the Association. Subsequent speakers will be Prof. J. F. Thorpe, president of the Chemical Society and a member of the Dyestuffs Industry Development Committee, Sir William Pope, and the following members of the Dyestuffs Industry Development Committee: Messrs. C. J. T. Cronshaw, G. Holden, J. Morton, and Major L. B. Holliday. Mr. W. J. U. Woolcock will sum up the debate.

Another important discussion will be opened on Monday, Sept. 8, by Dr. F. L. Pyman, on "Chemo-

therapy". This is the first time that this important subject has been discussed, and those taking part include Prof. G. Barger, Prof. R. Robinson, Dr. A. J. Ewins, Dr. T. A. Henry, Dr. H. King, Prof. G. T. Morgan, and Prof. C. S. Gibson (Recorder).

Amongst other important individual communications are those by Prof. M. W. Travers, and Prof. N. Semenov, of Leningrad. Prof. Travers will give an account of "New Experimental Methods for the Study of Gas Reactions". Although Prof. Semenov is unable to attend the meeting, his paper on "The Initiation of Combustion" will be summarised by Prof. W. E. Garner, and it is hoped that this will lead to a discussion in which Prof. Garner and Mr. A. C. G. Egerton will take part.

GEOLOGY.

Prof. O. T. Jones's presidential address to Section C (Geology) will deal with "Some Episodes in the Geological History of the Bristol Channel Region", a subject that seems particularly appropriate to the place of meeting. Two of the items on the agenda arise out of the meeting in South Africa last year. Dr. G. Slater spent the greater part of his stay there in studying the earlier glacial deposits and will read a paper entitled "The Dwyka Tillite of Griqualand West". The question of the correlation of past pluvial and glacial periods is to be discussed jointly by Sections C, E, and H (geology, geography, and anthropology). It is perhaps doubtful if any geologist thinks this is possible at present, but a summation of the present position and a consideration of the difficulties in view may indicate lines for future work.

Perhaps of greater interest will be the sectional discussion on "The Validity of the Permian as a System". Since Murchison in 1841 divided the New Red Rocks into two systems, the Permian and the Trias, the status of the former division has been the subject of much controversy. Whilst abroad much greater thicknesses of rocks have been placed in that division, in England the system has been whittled down by the placing of the lower beds in the Carboniferous System. No doubt the exceptional British position will be thoroughly explored, and it is hoped that the wider aspects of the problem will receive due attention.

Both Upper and Lower Carboniferous Rocks come under review, for Prof. G. Delépine (of Lille) will describe "The Dinantian Zones of Goniatites in North France and Belgium", and Dr. D. A. Wray will discuss the sequence of non-marine lamellibranchs in the Upper Carboniferous of Yorkshire. Two papers on classification by Dr. A. E. Trueman and W. S. Bisat may prove somewhat controversial.

Of wide general interest should be Prof. J. W. Gregory's account of the recent cable fractures due to an earthquake in the Western Atlantic. The first description of a liverwort-like plant from the lower Downtonian of the Llandoverly District will be made by Dr. A. Heard and Mr. J. F. Jones.

GEOGRAPHY.

The president of Section E (Geography) will be Prof. P. M. Roxby, of the University of Liverpool, whose address will be devoted to a review of "The Scope and Aims of Human Geography". Since one of the most fruitful local applications of the work of modern human geographers has been in connexion with the development of regional survey and regional planning, it is opportune that this aspect should receive particular attention at this meeting. Thus the main principles of the South-West Lancashire regional plan are to be analysed by Mr. Peirson Frank, while Prof. P. Abercrombie will deal with the problems of satellite towns. A discussion on these papers will be opened by Dr. Vaughan Cornish.

Various aspects of the Bristol region will be dealt with by Mr. W. W. Jervis and others, while the contribution made by Bristol to English exploration will be reviewed by Col. E. W. Lennard.

Problems concerning past changes in climate will occupy an important place in the work of the Section at the Bristol meeting, since in addition to the joint discussion with Sections C and H on the relations between past pluvial and glacial periods, the Section of Geography is to have papers dealing with climatic changes in historic times in parts of both the Old World and the New. The former will be dealt with by Dr. C. E. P. Brooks and the latter by Prof. A. E. Douglass (of the University of Arizona), who will be the foreign guest of the Section.

One morning is being devoted to papers dealing with various parts of Africa, and another will be occupied by a series of detailed physical and economic studies of parts of Great Britain.

ENGINEERING.

The subjects to be dealt with by Section G (Engineering) are somewhat broad in their scope. The president, Sir Ernest Moir, Bt., an authority on tunnelling and other operations at great depth, will speak on that subject in his address. Section G will afterwards join with Section I (Physiology) to discuss the physiological effects of the high pressures to which those working in these operations are subjected. This discussion is important, since these effects set a limit to what may be undertaken.

Of more general interest, perhaps, are three papers on "The Trend of Airship Development" to be given respectively by Col. V. C. Richmond, the designer of *R101*; Mr. B. N. Wallis, of *R100*; and Herr Direktor Doerr, of the Zeppelin Company. These papers will be followed by films illustrating the construction and operation of the British and German airships.

The question of the economical production of power, so important to us as a nation, is to be considered from various points of view. Mr. George A. Orrok, of New York, on "High Pressure and Temperature Steam"; Sir Henry Fowler, on "Fuel Consumption in Locomotive Practice";

and Messrs. A. L. Stanton and T. Stevens; on the "Distribution of Electrical Power", will lead the discussion.

The importance of Bristol as a centre of the aircraft industry is reflected in the paper on "Recent Developments in Air-cooled Aero-engines" by Mr. C. F. Abell, of the Bristol Aeroplane Co. Messrs. T. F. Hurley and R. Cook, of H.M. Fuel Research Station, Greenwich, will describe some of their researches on petrol engines; while Dr. S. J. Davies and Mr. Edmund Giffen will review the present position of the high-speed heavy-oil engine.

Section G will conclude the meeting with a discussion on steel for structural purposes and its standardisation. The degree of standardisation of steel sections can naturally exert a great influence upon costs of production, and the subject is to be treated from the points of view of the consulting engineer, the manufacturer, and the technician by Mr. J. S. Wilson, Mr. J. S. Lewis, and Prof. C. Bath respectively. Reports of the special research committees will also be presented.

ANTHROPOLOGY.

Anthropology (Section H) at the Bristol meeting will be under the chairmanship of Dr. H. S. Harrison, whose work has made the Horniman Museum a centre of study of the evolution of the arts and crafts. His address will appropriately be followed by a discussion of the project of a National Folk Museum, in which Dr. R. E. Mortimer Wheeler and Prof. J. L. Myres will take part, while the officers of the interesting museum of the City of Norwich will give an account of their valuable work. On Tuesday, Sept. 9, geologists, meteorologists, archaeologists, and geographers will gather to discuss the sequence of phases of the Pleistocene ice age. Agassiz gave an early account of views on this subject at the British Association in 1840, while, about the end of that century, James Geikie in Britain and Penck and Brückner in Central Europe were trying to correlate phases in different regions. This difficult task is entering on a new phase in which study of maritime and river terraces is being brought into the question and dynamic considerations concerning growth and decline of ice sheets are playing an increasing part. The field work of Misses Caton-Thompson and Gardner in the Faiyum, of Messrs. Sandford and Arkell in Egypt, Leakey and Solomon in Kenya, Cammiade in South India, and Armstrong at Bambata in Rhodesia, will be brought into the scheme, and the discussion is likely to make a definite advance.

The University and city of Bristol have played a great part in anthropological studies, and a memorial lecture by Sir Arthur Keith will offer a tribute to the pioneer, Dr. John Beddoe, the chair being taken by Sir Evan Jones, an old student of Bristol and of Dr. Beddoe. The memory of Dr. Czaplíčka, at one time lecturer at Bristol, is cherished in anthropological circles, and the Spelæological Society of the University has made itself a place in the history of the science. It is, therefore, specially interesting that an unusual

number of papers on local archæology and anthropology are being presented to the section after an introductory study of the area by Mrs. D. P. Dobson. The interesting discussion of the ruins at Zimbabwe in Rhodesia, which was a main feature of last year's meeting, will be continued by Miss Caton-Thompson, with Dr. Randall MacIver in the chair, an appropriate choice, as his book on medieval Rhodesia twenty years ago first made a serious attempt to combat fanciful speculations on this subject.

PHYSIOLOGY.

In Section I (Physiology) the work of the meeting will open with the presidential address by Prof. H. S. Raper on "The Synthetic Activities of the Cell". It is expected that this address will be characterised by vigorous thought and that it will provide material for lively expressions of opinion in the discussion to which the president has consented. Among the remaining items, in all probability the foremost in the breadth of its appeal is the joint discussion with Section G (Engineering), somewhat heavily entitled "Air Pressure Variations encountered in Engineering Works, and their Physiological Effects". The speakers from Section I will be (1) Capt. G. C. C. Damant, R.N., qualified not only by reason of his work with J. S. Haldane and Boycott, and his share in the preparation of the Admiralty tables regulating the decompression of deep-sea divers, but also by a personal experience of such work lasting over twenty years and including the recovery of £5,000,000 of bullion sunk in the *Laurentic*; and (2) Sir Leonard Hill, whose experience of air pressure and movement effects on the physiological side is well known and whose katathermometers (and their modifications) have proved of enormous value in the accurate recording of conditions calculated to promote the comfort of workers in unusual surroundings.

The remainder of the programme includes papers covering a very wide range. On one side, the section has a contribution from Dr. F. W. Edridge-Green of the Board of Trade, on the detection of certain forms of colour-blindness especially important in the mercantile marine and a discussion with Section J (Psychology) on primary colours which, one fears, is likely to prove interesting rather than conclusive. On another part of the wide field over which this section extends, Prof. Ruggles Gates is speaking on "The Blood Groups and their Inheritance". Again, Prof. A. Stanley Kent, well known for his discovery of the auriculo-ventricular bundle, is returning to the laboratory which he designed to communicate some of his hitherto unpublished work.

PSYCHOLOGY.

Section J (Psychology) this year meets under the presidency of Prof. C. W. Valentine, who in his presidential address will review the present position of child psychology. The proceedings will open with an intra-sectional discussion on "The Psychology of Adolescence". A joint discussion

has also been arranged with Section I (Physiology) on the question, "In what Sense can we Speak of Primary Colours?" The various branches of psychology are well represented, experimental perhaps more strongly than usual. A visit has been arranged to Stoke Park Colony, where the director of medical services, Dr. R. J. A. Berry, will give a demonstration of scientific and clinical methods of diagnosis of mental deficiency and will discuss their applicability to child guidance and normal children.

BOTANY.

Dr. A. W. Hill, of the Royal Botanic Gardens, Kew, is president of Section K (Botany) of the Association for the Bristol meeting. The emphasis at present being laid upon original investigation in mycology and plant physiology is reflected in Section K by the preponderance of papers dealing with these aspects of botany, Monday morning being devoted to the former and Tuesday morning to the latter.

A joint discussion (with Section M) on "Mineral Nutrition in Plants" will occupy the major portion of Friday morning. The various aspects of the subject dealt with during the discussion will be summarised by Sir John Russell. An excursion to Long Ashton to study material illustrating some features of the problem will be made during the afternoon.

Among the distinguished foreign botanists proposing to attend are Prof. F. A. F. C. Went, of Utrecht, who is to read a paper on "Wegener's Theory and the Distribution of the Podostemaceae"; Dr. W. V. J. Osterhout, of the Rockefeller Institute, who is to contribute to the discussion on mineral nutrition; and Prof. W. Goodspeed, of Berkeley, Cal., who is outlining the results of his experiments with X-rays and radium on the species of the genus *Nicotiana*—a choice of subject which should have a particular appeal to the citizens of Bristol.

A number of attractive excursions have been arranged by local botanists, these including a visit to Mr. C. Hiatt Baker's garden at Almondsbury, and to the Somerset peat moors.

EDUCATIONAL SCIENCE.

The president of Section L (Educational Science) is the Right Hon. Lord Eustace Percy, whose

presidential address will be entitled "A Policy of Higher Education". At the opening session of the section on Thursday, Sept. 4, papers will be given on "The Pre-School Child", by Miss Margaret Drummond (representing the Nursery School Association), Dr. J. A. Hadfield, and Dr. W. E. Blatz (Director of St. George's School of Child Study, Toronto).

Almost all one session will be devoted to "The Curricula of Central Modern and Senior Schools". Mr. W. A. Brockington will open with a general survey; Mr. J. A. White, Mr. H. T. Morgan, and Miss V. E. Carr Gordon will follow with papers dealing with the subject from the selective central school, the non-selective schools, and the modern girls' school points of view respectively. An interesting discussion will no doubt follow. The session will conclude with reports from sub-committees of the section dealing with training for overseas, the production and distribution of educational and documentary films, and the teaching of general science in schools, with special reference to the teaching of biology.

Another session will deal with formal training and disciplinary values in education. Dr. C. W. Kimmins will present the report of a sub-committee on formal training, and Sir Percy Nunn will read the first paper on "Disciplinary Value in Education", and will speak particularly with reference to "The Conception of Mental Discipline". Miss H. M. Wodehouse and Prof. F. A. Cavanagh will follow with papers on "Discernment of Disciplinary Values apart from Experiment" and "Some Further Practical Considerations". A final paper will be read by Dr. W. G. Sleight, and the discussion will be opened by Sir Richard Gregory.

For the final session the subject will be English and foreign ideas on method of education in relation to industry and commerce. Mr. Henderson Pringle and Sir Francis Goodenough are to deal with the subject mainly with reference to commerce; Dr. A. W. Richardson and Miss E. Webb Samuel will give papers dealing with the industrial aspect, and Mr. A. Abbott will conclude with a general paper on the whole question.

Afternoon visits to the local schools and the new Hospital School for Cripples at Winford are being arranged, and also a full day motor trip for the Saturday, during which Dauntsey School will be visited.

News and Views.

VERY hearty congratulations are extended to Sir Howard Grubb, who celebrates his eighty-sixth birthday on Monday next, having been born on July 28, 1844. Sir Howard was educated privately and at Trinity College, Dublin. In most parts of the world where observatories exist one may be sure that he has had a leading and expert part in the preparation of their equipment of mirrors, objectives, and all the varied apparatus and machinery of the modern astronomical observatory. Particularly is this the case as regards many of the great astronomical observatories of America; here his resourceful ingenuity has long been acclaimed. He has published

many memoirs, chiefly through the medium of the Royal Dublin Society—among the earliest, "The Great Melbourne Telescope" (1870) and "On Clocks for Equatorial Telescopes" (1875). In 1896 he read a paper at the Royal Institution on "The Development of the Astronomical Telescope". In 1881 Sir Howard was the recipient of the Cunningham gold medal of the Royal Irish Academy, in recognition of work in the service of astronomers; in 1912 he received the Boyle medal of the Royal Dublin Society, awarded for scientific labours of outstanding merit carried out by Irishmen or in Ireland. Holding the honorary degree of master of engineering in the University of Dublin,