

Sir Edward Strickland, K.C.B., Hon. Treasurer, and Prof. Liversidge, F.R.S., and Dr. George Bennett, Hon. Secretaries.

The formation of the Council was afterwards proceeded with, each learned or scientific Society electing one representative for every hundred of its members; and the Chief Justice, Minister for Public Instruction, the Chancellor and Vice-Chancellor of the Sydney University, the Mayor of Sydney, and the Presidents of the Royal Societies in other colonies were elected Vice-Presidents for the year.

The Presidents of Sections were then elected, the gentlemen chosen being all resident in other colonies than New South Wales; whilst the Secretaries of Sections, as a matter of necessity, were elected from amongst residents in Sydney.

The Association is hence thoroughly Australasian in its character, and the succeeding general meetings are to take place in turn in the capitals of the other colonies, the executive officers being elected year by year by the colony in which the meeting is held.

The first general meeting is to be held at the Sydney University, the opening ceremony, at which His Excellency the Governor will be present, taking place on Tuesday evening, August 28, when the Presidential address will be delivered.

On the following day the Sectional meetings for the reading and discussion of papers will commence, and it is thought that the principal portion of the business will close with the end of the week.

Up to the present time the titles of about ninety papers have been sent in by gentlemen of distinction in science, literature and art, in the different colonies, and it seems probable that this number will be considerably increased before the meeting.

It may therefore be anticipated that the nature of the work done by the Association during the first year of its existence will be of a highly important and useful character.

The more solid work of the meeting is to be lightened by excursions to various places of interest to geologists, botanists, and others; and efforts are being made to provide for the entertainment and comfort of visiting members, as far as possible, so that they may spend their time to the best advantage.

The various steamship companies have arranged to carry members proceeding to Sydney to attend the meeting at a reduction of 20 per cent. on the ordinary rates, and it is anticipated that liberal concessions will also be granted in the railway fares.

The rules, as already mentioned, are practically the same as those of the British Association, and all who join the Association before the first general meeting in August next become original members, without entrance fee, the subscription of £1 entitling members to receive the publications of the Association gratis.

The number of members at the end of July exceeded 400.

#### PROFESSOR RUDOLF JULIUS EMANUEL CLAUSIUS.

BY the death of Prof. Clausius, which occurred on August 24 last, science has lost another member of the great triumvirate—Rankine, Clausius, and Thomson—who, upon the foundation laid by the experimental work of Davy and Rumford, the theoretical suggestions of Mohr, Séguin, Mayer, and Colding (which, though resting on imperfect data and defective reasoning, were the results of real scientific insight), and the splendid experimental investigations of Joule, founded and built up the great structure known as the science of thermodynamics.

Clausius was born at Cöslin, in Pomerania, on January 2, 1822. While yet at school in Berlin, he gave unmistakable evidence of the bent of his mind towards mathe-

matics and physics, and on the completion of his University course he became Privatdocent in the University of Berlin and Instructor in Natural Philosophy at the School of Artillery. He very soon gave evidence of his power as an original worker, and some of his earliest papers—"On the Nature of those Constituents of the Atmosphere by which the Reflection of the Light within it is effected," and "On the Blue Colour of the Sky, and the Morning and the Evening Red"—contributed to *Poggendorff's Annalen*, were selected for translation in the first volume of Taylor's "Scientific Memoirs."

In 1857 he was appointed Professor of Natural Philosophy at the Polytechnic School of the Helvetic Confederacy at Zürich. Here he continued his researches in various branches of physics, and among these we may mention, to give some idea of the extent and variety of his investigations, "The Influence of Pressure on the Freezing-point," "The Mechanical Equivalent of an Electric Discharge, and the Heating of the Conducting-wire which accompanies it," "Electrical Conduction in Electrolytes," and "The Effect of Temperature on Electric Conductivity." He also published some short papers on some purely mathematical questions, suggested, however, by physical problems, and some papers dealing with points of what is generally known as physical chemistry.

His attention was then directed towards the dynamical theory of gases, owing to the light which it appeared capable of throwing upon questions of thermodynamics. The dynamical or kinetic theory of gases, which has received such extensive developments at the hands of Clerk Maxwell, Boltzmann, and others, was originally suggested by J. Bernoulli about the middle of the last century; but it was Clausius who first placed it upon a secure scientific basis. In 1866 he published a most important paper "On the Determination of the Energy and Entropy of a Body" (translated in the *Philosophical Magazine*), in which the very valuable and suggestive conception of the entropy of a body was first set forth.

In 1869 he was appointed Professor of Natural Philosophy in the University of Bonn.

Among more recent papers of great importance we may mention the following, all of which have been translated in the *Philosophical Magazine*:—"On a New Fundamental Law of Electrodynamics"; "On the Behaviour of Carbonic Acid in relation to Pressure, Volume, and Temperature"; "On the Theoretic Determination of Vapour-pressure and the Volumes of Vapour and Liquid"; "On the Different Systems of Measures for Electric and Magnetic Quantities"; "On the Employment of the Electrodynamic Potential for the Determination of the Ponderomotive and Electromotive Forces"; "On the Theory of Dynamo-electrical Machines"; and "On the Theory of the Transmission of Power by Dynamo-electrical Machines."

When we consider the far-reaching and fundamental character of these and many other investigations, and the very wide field which they cover, we cannot but wonder at the marvellous energy of the great physicist who has passed from among us. The Royal Society catalogue contains a list of no less than seventy-seven papers published up to 1873, and those published subsequently bring the total number up to considerably over a hundred.

In addition to these there is his great treatise on "The Mechanical Theory of Heat," of which the first volume was published in 1864, and a smaller work, "On the Potential Function and the Potential."

It would be impossible to discuss in detail the portions of thermodynamics specially worked out by Clausius, as his work is throughout closely interwoven with that of Rankine and Thomson, but it will be of interest to quote the following from Prof. Rankine, who in his paper "On the Economy of Heat in Expansive Machines,"<sup>1</sup> says:—

<sup>1</sup> "Rankine's Miscellaneous Scientific Papers," p. 300.

"Carnot was the first to assert the law that the ratio of the maximum mechanical effect to the whole heat expended in an expansive machine is a function solely of the two temperatures at which the heat is respectively received and emitted, and is independent of the nature of the working substance. But his investigations, not being based on the principle of the dynamical convertibility of heat, involve the fallacy that power can be produced out of nothing.

"The merit of combining Carnot's law, as it is termed, with that of the convertibility of heat and power belongs to Mr. Clausius and Prof. William Thomson; and in the shape into which they have brought it, it may be stated thus: *The maximum proportion of heat converted into expansive power by any machine is a function solely of the temperatures at which heat is received and emitted by the working substance, which function for each pair of temperatures is the same for all substances in Nature.*"

None will regret the loss of Prof. Clausius more keenly than the students of the University of Bonn, where he formed a centre of attraction not only as a great investigator, but as a teacher of almost unrivalled ability. The secret of his powers as a teacher may easily be guessed from the study of his published papers and treatises. Their great characteristic is the direct insight which they give into the very heart of the physical principles under discussion. The author, while showing himself a master of mathematical methods, ever keeps the physical meaning of the symbols before the eye of the reader, and never allows his analysis to carry him away into the regions of mere mathematical ingenuity. In this he was a worthy compeer of some of our own great mathematical physicists, like Thomson and Maxwell, and the greater part of his work has the additional advantage, for the majority of students, of being effected by the aid of comparatively simple analysis.

In 1868, Prof. Clausius was elected a Foreign Member of the Royal Society, and in 1879 he was presented with the Copley Medal, the highest distinction at the disposal of the Society. He was decorated with various civil Prussian and Bavarian orders; and after the Franco-German war, during which he had volunteered to serve as caretaker of the wounded, he received the German decoration of the Iron Cross, and the French decoration of the Legion of Honour.

G. W. DE TUNZELMANN.

### THE BRITISH ASSOCIATION.

Wednesday Night.

THE meeting of the British Association which opens to-night, after twenty-four years' absence, in Bath, will be the fifty-eighth. At the meeting of 1864, the President was Sir Charles Lyell, and the occasion was rendered memorable by the presence at once of Dr. Livingstone and Bishop Colenso, both at the time filling a large space in the public eye. Though a vast majority of the members of the Association would prefer to visit Bath to either Birmingham or Manchester, the latter towns possess in Owens College and the Town Hall buildings which offer greater conveniences for the meeting of a scientific Congress. In Bath the Sections will be somewhat scattered. The Physical Science Section meets at the St. James's Hall; the Mechanical Section in the Masonic Hall; the Chemical Section in the Friends' Meeting-House; Geology and Biology are housed at the Mineral Water Hospital, with the Blue Coat School for the sub-sections; Geography at the Guildhall, and Anthropology at the Grammar School; while the President's address and some of the popular lectures, as well as the concluding general meeting, will be delivered at the Drill Hall. The Mayor gives a *conversazione* to-morrow in the

Assembly Rooms, and the Chairman and Local Committee give another on Tuesday. A large number of foreign visitors, especially geologists for the International Geological Congress to be held in London on the 17th inst., are expected. Amongst those already arrived are Prince Roland Bonaparte; Profs. Dufont, Gilbert, Capellini, Stephenson, Lory, von Koenen, Frazer, Kalkowsky, and Waagen.

The retiring President, Sir Henry Roscoe, M.P., F.R.S., in introducing Sir Frederick Bramwell, the President-Elect, spoke as follows:—

"My Lords, Ladies, and Gentlemen,—Four-and-twenty eventful years in the history of science have passed away since the British Association last visited the city of Bath. Those of us who were present here in 1864 will not soon forget that memorable meeting. It was presided over, as you all will remember, by that veteran geologist, that great forerunner of a new science of life, Sir Charles Lyell, of beloved and venerated memory. Yes, ladies and gentlemen, it was he who prepared the way by his recognition of the true history of our globe for the even more illustrious Darwin. It was he who pointed out that the causes which have modified the earth's crust in the past are, for the most part, those which are now changing the face of Nature. Lyell was a typical example of the expositor of Nature's most secret processes. His work was that of an investigator of science pure and undefiled, and as such, his life and labours stand for ever as an example to all those who love Science for her own sake.

"But the far-seeing founders of this our British Association were as fully alive to the fact as we, in perhaps our more utilitarian age, can be, that, just as man does not live by bread alone, so it is not only by purely scientific discovery that the nations progress, or that science advances. They knew as well as we do that to benefit humanity the application of the results of scientific research to the great problems of every-day life is a necessity. Hence our founders, whilst acknowledging that the basis of our Association can only be securely laid upon the principles of pure science in its various branches, recognized the importance of the application of those principles in the establishment of a Section which should represent one of the most remarkable outcomes of the activity and force of the nation—a Section of Engineering. It is therefore meet and right that in due proportion this great department of our scientific edifice—a department which, perhaps, more than any other, has effected a revolution in our modern social system—should be represented in our Presidential chair.

"Twenty-four years ago it was pure science that we honoured in Sir Charles Lyell: to-day it is applied science to which we show our respect in the person of Sir Frederick Bramwell. It would ill become me, engaged as I have been in the study of subjects far removed from those which fill the life of an active and successful engineer, to venture on this occasion on a eulogium upon the work of my successor, still less is it in my mind to draw any comparison as to the relative importance to be attached to the work of the investigator, such as Lyell, and to that of him who applies the researches of others to the immediate wants of mankind. It is enough for me, as I am sure it will be for you, to remember that both classes of men are needed for the due advancement of science, and to rejoice that as in former years the names of Fairbairn, of Armstrong, and of Hawkshaw, have adorned our list of Presidents, so in the present instance, this branch of science, which represents lines of human activity rendered illustrious by the labours of many great Englishmen, is to-day represented by our eminent President.

"I have the honour of requesting Sir Frederick Bramwell to take the chair, and to favour us with the Presidential address."