

The portion of the hypothetical curve from *C* to *E* represents states which are essentially unstable, and which cannot therefore be realised.

Now let us suppose the medium to pass from *B* to *F* along the hypothetical curve *BCDEF* in a state always homogeneous, and to return along the straight line *FB* in the form of a mixture of liquid and vapour. Since the temperature has been constant throughout, no heat can have been transformed into work. Now the heat transformed into work is represented by the excess of the area *FDE* over *BCD*. Hence the condition which determines the maximum pressure of the vapour at given temperature is that the line *BF* cuts off equal areas from the curve above and below.

The higher the temperature, the greater the part of the pressure which depends on motion, as compared with that which depends on forces between the particles. Hence, as the temperature rises, the dip in the curve becomes less marked, and at a certain temperature the curve, instead of dipping, merely becomes horizontal at a certain point, and then slopes upward as before. This point is called the critical point. It has been determined for carbonic acid by the masterly researches of Andrews. It corresponds to a definite temperature, pressure and density.

At higher temperatures the curve slopes upwards throughout, and there is nothing corresponding to liquefaction in passing from the rarest to the densest state.

The molecular theory of the continuity of the liquid and gaseous states forms the subject of an exceedingly ingenious thesis by Mr. Johannes Diderik van der Waals,* a graduate of Leyden. There are certain points in which I think he has fallen into mathematical errors, and his final result is certainly not a complete expression for the interaction of real molecules, but his attack on this difficult question is so able and so brave, that it cannot fail to give a notable impulse to molecular science. It has certainly directed the attention of more than one inquirer to the study of the Low-Dutch language in which it is written.

The purely thermodynamical relations of the different states of matter do not belong to our subject, as they are independent of particular theories about molecules. I must not, however, omit to mention a most important American contribution to this part of thermodynamics by Prof. Willard Gibbs,† of Yale College, U.S., who has given us a remarkably simple and thoroughly satisfactory method of representing the relations of the different states of matter by means of a model. By means of this model, problems which had long resisted the efforts of myself and others may be solved at once.

J. CLERK-MAXWELL

(To be continued.)

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Feb. 19.—Annual General Meeting.—Mr. John Evans, V.P.R.S., president, in the chair.—The Secretary read the reports of the Council and of the Library and Museum Committee. The general position of the Society was described as satisfactory, although, owing to extraordinary expenses during the year, the excess of income over expenditure was but small in comparison with former years. The Society was said to be prosperous, and the number of Fellows to be rapidly increasing.

In presenting the Wollaston Gold Medal to Prof. de Koninck, of Liège, F.M.G.S., the President addressed him as follows:—"Monsieur le Docteur de Koninck, it is my pleasing duty to place in your hands the Wollaston Medal, which has been awarded to you by the Council of this Society in recognition of your extensive and valuable researches and numerous geological publications, especially in Carboniferous Palæontology. These researches are so well known, and have gained you so world-wide a reputation, that I need say no more than that your palæontological works must of necessity be almost daily consulted by all who are interested in the fauna of the Carboniferous period. Already in 1853 the numerous and able Palæontological works which you had published in the preceding twenty years had attracted the grateful notice of the Council of this

* Over de continuïteit van den gas en vloeïstof toestand. Leiden: A. W. Sijthoff, 1873.

† "A method of geometrical representation of the thermodynamic properties of substances by means of surfaces." Transactions of the Connecticut Academy of Arts and Sciences, Vol. ii. Part 2.

Society, who in that year begged you to accept the balance of the proceeds of the Wollaston Fund, in aid of the publication of your work on Encrinites, then in progress. It was in the same year that the Society had the satisfaction of electing you a Foreign Member of their body; and now, after a second period of rather more than twenty years devoted to the study not only of geology and palæontology, but also of chemical analysis, I have the pleasure of conferring upon you the highest additional honour it lies in the power of this Society to bestow, by presenting you with the medal founded by the illustrious Wollaston, who was himself also a chemist as well as a geologist. If anything could add to the satisfaction we feel in thus bestowing the medal, it is your presence among us this day, which will enable you more fully to appreciate our unanimous sense of the high value of your labours in the cause which we all have at heart."

The President then presented the balance of the proceeds of the Wollaston Donation Fund to Mr. L. C. Miall, of Leeds, and addressed him in the following terms:—"Mr. Miall, I have much pleasure in presenting you with the balance of the proceeds of the Wollaston Fund, which has been awarded you by the Council of this Society to assist you in your researches on Fossil Reptilia. Those who had the good fortune to be present at the meeting of the British Association at Bradford in 1873, and to hear the masterly report of the Committee on the Labyrinthodonts of the Coal-measures, drawn up by yourself, and those also who have studied the papers which you have communicated to this Society on the Remains of Labyrinthodonta from the Keuper Sandstone of Warwick, must be well aware of the thorough and careful nature of your researches, carried on, I believe, in a somewhat isolated position, and remote from those aids which are so readily accessible in the metropolis and some of our larger towns. I trust that the proceeds of this fund which I have now placed in your hands will be regarded as a testimony of the interest which this Society takes in your labours, and may also prove of some assistance to you in still further prosecuting them."

Mr. Miall, in reply, said that he felt that his sincere thanks were due to the Geological Society for awarding him the balance of the proceeds of the Wollaston Donation Fund as a token of appreciation of the little work that he had been able to do, and also to the President for the terms in which he had been kind enough to speak of him. He should regard this donation, not only as an honour received by him, but also as a trust to be expended to the best of his power in accordance with the intentions with which it had been conferred upon him by the Society.

The President next handed the Murchison Medal to Mr. David Forbes for transmission to Mr. W. J. Henwood, F.R.S., and spoke as follows:—"Mr. David Forbes, in placing the Murchison Medal and the accompanying cheque in your hands, to be conveyed to our distinguished Fellow, Mr. William Jory Henwood, I must request you to express to him our great regret that he is unable to attend personally to receive it. His researches on the metalliferous deposits, not only of Cornwall and Devonshire, but of Ireland, Wales, North-western India, North America, Chili, and Brazil, extending as they do to questions of subterranean temperature, electric currents, and the quantities of water present in mines, are recorded in memoirs which form text-books for mining students. They have for the most part been contributed to the Royal Geological Society of Cornwall, which has taken a pride in publishing them; but I trust that it will be a source of satisfaction to Mr. Henwood, after fifty years of laborious research, and amidst the physical suffering caused by a protracted illness, to receive this token of appreciation at the hands of another Society which takes no less interest in the subjects of his investigations."

Mr. David Forbes said that in receiving the Murchison Medal, on behalf of Mr. W. J. Henwood, he was commissioned by that gentleman to express his great regret that the bad state of his health and his advanced age prevented his appearing in person to thank the Council for the high honour they had conferred upon him, and the extreme gratification he felt in finding that the results of his labours in the investigation of the phenomena of mineral veins, which had extended over more than fifty years, had thus been recognised by the Geological Society of London.

The President then presented to Prof. H. G. Seeley the balance of the Murchison Geological Fund, and said:—"Mr. Seeley, your researches in geology and on fossil osteology have already extended over a period of upwards of sixteen years, and the numerous and valuable essays which you have contributed to the Annals and Magazine of Natural History, as well

as to the Quarterly Journal of this Society, are only a portion of their fruits. Your separate works on the fossil remains of Aves, Ornithosauria, and Reptilia, in the Woodwardian Museum at Cambridge, and on the bones of Pterodactyles, are well known to every student of fossil osteology, and have been thought worthy of the by no means empty compliment of being printed at the expense of the Syndics of the University Press of Cambridge. The esteem in which your researches are held by the Council of this Society, and their hope that you may still be enabled to prosecute them, are best evinced by their presenting you with the balance of the proceeds of the Murchison Fund, which I now have the pleasure of placing in your hands."

Prof. Seeley replied as follows:—"Mr. President, I have ever been taught that the Geological Society is the fountain of geological honour. It has always been a great honour to be associated with the Fellows of this Society, who are constructing the sciences we cultivate. Out of this association have grown bonds of comradeship, encouraging some of us to follow on in the labour of those whose work is ended; and when, sir, I receive at your hands this award of the balance of the Murchison Fund, I am grateful for such a distinguished mark of sympathy with my special studies, and shall be encouraged by it to prosecute researches which I hope may be better worthy of the Society's acceptance."

The President then proceeded to read his Anniversary Address, in which, after congratulating the Fellows upon their having at length got possession of their new premises, he called attention to the advantage which accrued both to the Fellows of the Society and to the officers of the School of Mines, Geological Survey, and Museum of Practical Geology, by the close proximity of the two establishments, and expressed a hope that there might be no severance of this union, whether by the removal of the School of Mines to South Kensington or otherwise. He also contrasted the position of the Society as regards funds, number of Fellows, &c., in 1829 and in 1875, the former being the first year in which the anniversary meeting of the Society was held in the Society's rooms at Somerset House. He then took up the main subject of his address, namely, the question of the antiquity of the human race, and the geological evidence bearing upon it. The address was prefaced by some obituary notices of Fellows and foreign members deceased during the past year, including Prof. Phillips, Dr. F. Stoliczka, the Rev. C. Kingsley, Mr. J. W. Pike, Dr. Arnott, Prof. W. Macdonald, M. Elie de Beaumont, and M. J. J. d'Omalius d'Halloy.

The ballot for the council and officers was taken, and the following were duly elected for the ensuing year:—President, John Evans, F.R.S. Vice-Presidents: Prof. P. Martin Duncan, F.R.S., Robert Etheridge, F.R.S., Sir Charles Lyell, Bart., F.R.S., Prof. A. C. Ramsay, F.R.S. Secretaries: David Forbes, F.R.S., Rev. T. Wiltshire, M.A. Foreign Secretary, Warrington W. Smyth, F.R.S. Treasurer, J. Gwyn Jeffreys, F.R.S. Council: H. Baerman, Frederic Drew, Prof. P. Martin Duncan, F.R.S., Sir P. de M. G. Egerton, Bart., F.R.S., R. Etheridge, F.R.S., John Evans, F.R.S., David Forbes, F.R.S., R. A. C. Godwin-Austen, F.R.S., Henry Hicks, Prof. T. McKenny Hughes, M.A., J. W. Hulke, F.R.S., J. Gwyn Jeffreys, F.R.S., Sir Charles Lyell, Bart., F.R.S., C. J. A. Meyer, J. Carrick Moore, F.R.S., Prof. A. C. Ramsay, F.R.S., Samuel Sharp, F.S.A., Warrington W. Smyth, F.R.S., H. C. Sorby, F.R.S., Prof. J. Tennant, F.C.S., W. Whitaker, B.A., Rev. T. Wiltshire, F.L.S., Henry Woodward, F.R.S.

Victoria (Philosophical) Institute, March 1.—Mr. C. Brooke, F.R.S., in the chair.—A paper on the chronology of recent geology was read by Mr. S. R. Pattison, F.G.S. Mr. Pattison maintained that geology furnishes no proof, nor high probability, that the introduction of man into Europe took place longer ago than about six or seven thousand years.

PARIS

Academy of Sciences, Feb. 22.—M. M. Frémy in the chair.—The following papers were read:—A report, by M. Leverrier, on the meridian observations of the minor planets, made at the Greenwich and Paris Observatories during the last three months of 1874. The details are given for planets 69, 76, 91, 120, 11, 43, 83, 6, 78, 140, 10, 3, 2, 4, 5, 59, 81, 33, 46, and 49.—New observations of the nature of alcoholic fermentation, by M. L. Pasteur.—On ruthenium and its oxides, by MM. H. Sainte Claire Deville and H. Debray. These gentlemen had at their disposal a considerable quantity of ruthenium and

its compounds, and have made them the subject of elaborate investigations. Their report contains valuable details concerning this rare metal and its compounds; among them peruthenic acid, RuO_4 , is of particular interest, as up to the present it was hardly known; they obtained it in yellow crystals of such instability as to make it impossible to determine their form, their melting point was at $40^\circ C$. They also obtained several salts of this acid. At 108° it is decomposed under explosion.—On the simultaneous formation of several crystallised mineral species in the thermal source of Bourbonne-les-bains (Haute Marne), particularly of grey antimonial copper (tetrahedrite), copper pyrites (chalcopyrite), streaky copper (philippite), and copper sulphide (chalcosine); by M. Daubrée.—On the action of borax in fermentation and putrefaction, by M. J. B. Schnetzler. This paper treats of three distinct actions of borax, viz., that upon protoplasma of vegetable cells, that upon mineral organisms, and that upon matter undergoing fermentation.—On the boiling of sulphuric acid, by M. A. Bobier. The boiling of this acid is generally considered a difficult operation; the author shows that it is very easy and even more regular than that of water, if one introduces into the vessel holding the acid a sufficient quantity of platinum.—On the winter vegetation of Algae at Mossel Bay (Spitzbergen), by M. F. Kjellman: observations made during the Swedish Polar Expedition of 1872–73. The author found that the Algae at Mossel Bay during the winter are the same as those during the summer and autumn, and that the dark season in the winter, which lasts about three months and a half, makes little or no difference to this part of the vegetation. He gives a list of numerous species which he observed, belonging to the orders of *Corallinacea*, *Florideae*, *Fucaceae*, *Phaeozosporaceae*, and *Chlorozosporaceae*.—On the chemical composition of the *petit lait* of Luchon, by M. T. Garrigou. The author gives the analysis of these waters, which hold about 7 per cent. of solid matter partly in solution.—On a case of epilepsy treated with sulphate of copper, and the presence of a considerable quantity of copper in the liver, by MM. Bourneville and Yvon.—The Secretary read the following telegram, dated Aden, Feb. 16, 1875, from M. Mouchez, the chief of the expedition sent to observe the Transit of Venus. The telegram runs as follows:—"Three months of bad weather; transit rather fine; interior contacts excellent, exterior contacts cloudy; numerous photographs. *Dives* (the vessel carrying the material for the expedition) started for Cherbourg; all well."—A note by M. J. L. Soret, on the diffraction phenomena produced by circular nets.—On the influence of pressure upon combustion, by M. Cailletet.—On the impurities in boracic acid, by M. A. Ditte.—A note by M. Béchamp on the *Microzymata* and *Bacteria*, with regard to a remark of M. Balard. This paper is a continuation of another one read before the Academy on Nov. 30 last, on the birth and evolution of *Bacteria* in organic tissues sheltered from the air, by M. Servel.—A note by M. Gayat on some comparative researches on man and animals with reference to the ophthalmoscopic signs of death.—M. J. Vinot then replied to a note of M. Chapelas, read at the last meeting, regarding a large bolide, which was supposed to have been an illuminated cloud, and proved that M. Chapelas' idea was erroneous.

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