

aires and the *Zeitschrift für physikalische Chemie*, and, secondly, later developments and additions and the application to recent experimental work, most of which was carried out by Prof. Kamerlingh Onnes and his pupils at Leyden. Van der Waals pays an eloquent tribute to Prof. Onnes' merits in this direction in the dedication of this second volume. It appears that but for him the original theory might never have been published and would certainly not have borne any fruit.

The importance of a theory of mixtures, as of other theories, lies in this, that it may show the connection between a number of phenomena which otherwise have to be treated separately, and may, directly or indirectly, bring to light new ones. That a theory was urgently wanted in the phenomena of mixtures even of two substances need not be set forth. In a theory of mixtures we may distinguish different parts, more or less independent of each other, which together form the whole. It consists firstly of an application of thermodynamics to find out the rules for the coexistence of phases—the gas and the one or two liquids. To do this it is only necessary to assume the experimental fact that the properties of mixtures form a continuous series between those of the components and, therefore, that a mixture has an equation of condition of the same general features as that of a single substance. Van der Waals is not the only man of science who has been working on these lines, although doubtlessly the first who conceived the notion of such a theory. Not only had special problems relating to mixtures been successfully treated by Konowaloff and others, but Duhem, applying his method of the thermodynamic potential, had been working in the same direction. In the reviewer's opinion, however, it cannot well be denied that the method used by van der Waals in attacking the problem by means of the "free energy" ψ , and its graphical representation, is by far the most effective and the safest guide amidst the intricacies of the problem.

Leaving alone questions of priority, we may say that the theory as sketched has led, more or less directly, to the complete disentanglement of the critical phenomena of mixtures, to the tracing of the proper features of the various diagrams between the pressure, volume, temperature and composition, and to the discovery of various other new facts, such as the existence of maxima and minima in the critical temperature and their connection with minima and maxima in the vapour pressure, and the influence of pressure on the coexistence of two liquids. All these and many other points are fully set forth by van der Waals in this second volume.

Van der Waals has not, however, contented himself with that; from molecular considerations he was able to deduce an equation of condition for mixtures of a definite form, depending, as does his well-known formula for single substances, on attraction-constants a and volume-constants b . It is somewhat to be regretted that in the original paper no attempt was made to guide the reader in ascertaining in how far special results arrived at were dependent upon this special equation or not; everybody will feel the importance of the distinction, and certain controversies which have arisen in connection with the theory would have been prevented by a clearer distinction on this head.

The importance of this point has increased lately in connection with the modern conception of normal (non-associating) and abnormal (associating) substances. Van der Waals' equation can be used for normal substances as an approximate guide, although even for these the approximation is very rough and hardly amounts to more than a certain resemblance, at least at small and medium volumes. For abnormal liquids the equation cannot even profess to do that, and van der Waals' results, in so far as they depend upon this equation, are not applicable to these substances at all. Lehfeldt has noticed that, so far as we know, normal liquids mix in all

proportions and that partial miscibility occurs when at least one of the components is abnormal. Van der Waals' theory does not confirm this, inasmuch as such values may be assigned to the constants in his equation as will lead to partial miscibility. At the same time, as no normal liquids of partial miscibility have been discovered so far, this subject is outside the scope of van der Waals' equation.

The reader must not get the impression that results deduced for normal liquids by means of van der Waals' equation are of small value owing to the inaccuracy of the equation. An instance will illustrate this. Van der Waals discusses the question, also treated by Ostwald and others, what function of the composition of a mixture its vapour-pressure is. He arrives at certain conclusions, one of which is that there cannot be more than one maximum or minimum, at least that the combination of a maximum and a minimum is very unlikely. Guided by this result, Hartman (Leyden) has discovered that there is an obvious error in Konowaloff's result for propionic acid and water, the curve for this combination being in contradiction to Konowaloff's own measurements, and Kohnstamm, working in van der Waals' laboratory, similarly discovered an error in Linebarger's result for benzene and carbon tetrachloride, a result which, if it had been confirmed, would have been even more striking, as both these substances are normal. On the other hand, Caubet and Duhem maintain to have realised the double phenomenon in question with methyl chloride and sulphur dioxide; if the latter result were confirmed it would certainly show in a striking way with what extreme caution conclusions drawn from the approximate theory have to be accepted.

Owing to the recent establishment of a "van der Waals fund," the famous author is now in a position to conduct experimental researches in his own laboratory. Several valuable memoirs have already appeared under this trust.

A very interesting departure has been lately made by Kamerlingh Onnes and his pupils to construct plaster models of the ψ surface entirely based on experimental data. Models of that kind will no doubt become a powerful assistance in the understanding of the intricate phenomena displayed by mixtures.

Turning our attention towards the work which is being done in the Leyden laboratory, we notice researches which are being carried on relating to Hall's phenomenon, the magnetic rotation of the plane of polarisation and many others. A special feature of the work is the constant use of low temperatures down to the boiling point of air. We feel at a loss what particular part of the work to review specially; in the small space available no justice could be done to any one without being unjust to others, and we abstain from reviewing anything in particular, considering that the "Communications from the Physical Laboratory at Leiden" are widely distributed and will, no doubt, be sent to anybody interested who takes the trouble to apply for them.

Much else might have been mentioned in this review, but we have tried to select that which would find the largest number of interested readers. J. P. K.

MAXIME CORNU.

THE hand of death has been heavy on the French botanical world. In recent years it has fallen successively on Duchartre, Baillon, Naudin, de Vilmorin and Franchet: all men in the foremost rank, whom their fellow-workers in England counted as sympathetic friends. And now the untimely and unexpected death of Maxime Cornu has come upon many of us—and not least at Kew—as a personal grief. I saw him last autumn in Paris full of the business of congresses into which he was throwing himself with irrepressible vivacity

and energy. He had often complained of ill health. But nothing in his appearance had ever suggested to me ground for serious anxiety. I had hoped to have induced him to pay us a visit this year. I could not go to his funeral; nothing remains but the sad satisfaction of writing these lines to his memory.

Cornu was born July 16, 1843, at Orléans. The ability which he displayed in his schooldays seemed at first likely to be absorbed by studies on the literary side. But under the influence of his father and of his distinguished brother, Alfred Cornu, he devoted himself to mathematics, and with considerable success. He published in the *Nouvelles Annales de Mathématiques* papers on geometrical subjects. In my judgment there could be no better preparation for a scientific career. Mathematics, as they are taught in France, habituate the mind to the grasp of general ideas and accustom it to rise from isolated facts to large generalisations. The descriptive side of science, it cannot be doubted, has a cramping influence, and it is the fate of too many of those who devote themselves to it to be unable "to see the wood for the trees." Cornu's mathematical studies, at any rate, decided him for a scientific career, and at the "École normale supérieure" he eventually fixed on botany. He was for a time assistant to Duchartre, professor at the Sorbonne, a man remarkable in many ways, but possessing in a more than ordinary degree the power of presenting with French lucidity the results of current research, not forgetting those of English workers. While with Duchartre, Cornu produced in 1873, as his doctoral thesis, his well-known memoir on the Saprotengiaee, to which the Académie des Sciences awarded the Desmazières prize. From the Sorbonne he moved to the Muséum as aide-naturaliste to Brongniart, whose daughter he afterwards married. Brongniart brought down to our own day the best traditions of that illustrious school of French botanists whose philosophic insight into the principles of plant morphology and taxonomy has probably never been rivalled, and certainly not surpassed.

Under Brongniart, Cornu devoted himself to mycology. He published in a comparatively brief period a profusion of papers, in which one is at a loss whether to admire most the untiring industry, the sagacity, or the wide range of his work. Everything pointed to his taking a foremost place in this branch of botany.

But no one can be a mycologist without being drawn into the study of plant diseases, in which fungi play so large a part. Vegetable pathology early attracted Cornu, and he did much excellent work in it. We owe to him the principle, now so familiar as to seem almost obvious, of preventive treatment by the careful destruction by burning of the *débris* of plants which may harbour resting-spores.

In 1868 a mysterious disease made its appearance amongst the vines in the South of France. Planchon, the professor of botany at Montpellier (who owed his early training to Kew), discovered the cause in an insect—*Phylloxera vastatrix*—introduced from the New World. The injury which this ultimately inflicted on the principal cultural industry of France has been compared, and probably with justice, to that of the most devastating of wars. That France has risen triumphant above this, as above so many other disasters, is but one example of the indomitable courage of its people. Cornu, from his official position and special qualifications, was necessarily at once absorbed in the task—hopeless as it seemed at first—of combating the scourge. For at least ten years, from 1872 onwards, he was occupied in little else. It is needless to enumerate the prominent position in various inquiries which he filled; the most important was that of "secrétaire de la commission académique du Phylloxera." His memoir on the whole subject published by the Academy has always seemed to me, for completeness and finish, a model of what such a research ought to be.

Cornu became the acknowledged authority on the subject of the Phylloxera. It had not been foreseen at first that the scourge, when once emancipated from its American home, might, and probably would, invade every wine-growing country. There were those who thought it impossible that it could cross the equator. The expectation was falsified and, in spite of all precautions, it made its appearance at the Cape. I advised the Cape Government to have recourse to Cornu, and his services were as generously given as, I know, they were warmly acknowledged.

In 1884 Cornu succeeded Decaisne as Professor of Culture at the Muséum—a position, if not so extensive in scope as that of the Director of Kew, scarcely less onerous. I had made Cornu's acquaintance some years before, and the circumstance of our similar official positions speedily brought us into closer intimacy. The position of an administrator under Government does not suit every temperament. The enthusiast must expect his ardour to be quenched with a good deal of official cold water. To Cornu, who had something of the engaging qualities of the *méridional*, this was hard to bear. My sympathy with him in his troubles, which were often not small, was certainly sincere, but I am afraid often seemed to him phlegmatic. In any case, the worries of administration pressed hardly on him and, notwithstanding the counsels of common friends, diverted him from the scientific work which we all expected of him, and which his really brilliant powers entitled us to expect.

At the moment that Cornu entered on his new duties, France had turned its attention anew to the field in which, in the past, it had done so much—colonial enterprise. Cornu's ambition—and it was a legitimate one—was to utilise the somewhat dormant resources of the Jardin des Plantes in the work, much on the lines of Kew. For my part it was more than a pleasure to give him all the assistance in my power. Agriculture is the great civilising agency. To reduce nomadic and predatory tribes to cultural pursuits is perhaps one of the most effective of missionary enterprises. Cornu threw himself into the work with little short of passion. What he accomplished, both for the French colonies and for the enrichment of the gardens of his own country, with resources more limited than we have at our disposal in England, is to me surprising. But, unhappily, at the moment when he had attained some measure of success his forces failed him, and he was not allowed to see his work fully crowned with accomplishment.

Cornu was the most loyal of Frenchmen. Had he been less so, he would not have sacrificed to the interests of France the career he might have devoted to science. I cannot but fear that while he lived the sacrifice he made was not fully appreciated. Many of us have wondered that a man who had done so much had never been admitted to the Institute. But that recognition could not have been long delayed, and this adds another regret to his untimely death.

W. T. THISELTON-DYER.

NOTES.

M. MAUPAS, of Algiers, has been elected a correspondant of the Section of Anatomy and Zoology of the Paris Academy of Sciences, in succession to the late M. Marion.

THE Harben medal of the Royal Institute of Public Health will be presented to Prof. Koch at a dinner to be held on July 24. Tickets may be obtained from the honorary secretary, Dr. W. A. Bond.

THE ethnographical collection of shamanistic implements, bead-work, musical instruments, &c., presented by Miss Owen to the Folklore Society, is on exhibition for a few days at the rooms of the Anthropological Society, 3 Hanover Square, W.