in water and organic liquids have been gradually accumulated by the work of Blagden, Rüdorff, Coppet and Raoult, extending from about 1780 to the present time, but no general explanation of them was brought forward until Van 't Hoff advanced the remarkable theory that a dissolved substance was in a condition somewhat analogous to that of a gas, the solvent substance serving the part of the vessel in which the gas is confined, but also exerting other effects.

He further gave strong reasons for believing that substances in dilute solution obeyed the same laws that gases do—*i.e.* the laws of Boyle and Charles for temperature and pressure. Several other theories of solution, besides what may be termed the gaseous theory, have been proposed. Notwithstanding that some weighty objections can be urged against this theory, it is remarkable that we can by aid of it predict the numerical values for the fall of the freezing point of different solvents produced by the solution of other substances, provided that we know the latent heat of fusion of the solvent.

On applying the same reasoning to alloys, we find that the theory holds good, as the table below shows.[1] We see from

Observed Depression in the Freezing Point of a Solvent Metal, caused by the Addition of One Atomic per cent. of a Second Metal.

Solvent		Tin	Bismuth	Cadmium	Lead	Zinc
Depression calculated on theory of Van 't Hoff		3·0° C.	2·08° C.	4·5° C.	6·5° C.	5·11° C.
Metal dissolved	At. Wt.					
Sodium ...	23	2·8	2·0	4·5	1·2	—
Copper ...	63	2·9	1·2	3·6	6·3	1·5 (rise)
Silver ...	108	2·9	2·0	10·8 (rise)	6·6	5·15 (rise)
Platinum ...	195	—	2·1	4·5	6·4	—
Gold ...	197	2·9	2·1	1·6	6·4	3·4 (rise)
Bismuth ...	209	2·4	—	4·5	3·0	5·1

this table that in no cases are the observed depressions of the freezing points greater than those calculated from the theory, but in many cases they fall below this quantity; this latter fact admits of explanation.

On the theory of Van 't Hoff it is necessary that when a solution begins to freeze the pure solvent should separate out first. This admits, in case of aqueous solutions, of simple proof; for if we take a dilute solution of potassium of permanganate and make it freeze slowly, we find that pure colourless ice separates out on the walls of the vessel, whilst the purple permanganate is concentrated towards the centre. This experiment led Neville and myself to try if a similar state of things could be shown for metallic alloys.

We have great pleasure in bringing before the Royal Institution this evening the first announcement of the results we have obtained. For this purpose we took two metals, gold and sodium, the former being very opaque to X-rays, whilst the latter is very transparent to them. A quantity of sodium was melted in a tube, and gold dissolved in it to the extent of about ten per cent. The alloy was then allowed to cool extremely slowly, and sections (about $\frac{1}{8}$ inch thick) were cut from different parts of the solid alloy and placed between thin plates of aluminium to protect them from the air. These sections were then placed on a photographic plate, enclosed in a light tight bag, and exposed to the action of the X-rays. On developing the plate we found a complete picture of the inside of the alloy. Positives obtained from these negatives are thrown upon the screen. The sodium is seen to have crystallised out in plates, as is evident from its transparency, whilst the opaque gold is seen to have become concentrated in the mother liquor between these plates, where it finally solidified along with some of the sodium.

Very similar results are produced with other pairs of metals, such as aluminium and gold and aluminium and copper. Behrens, Roberts-Austen, Osmond and others have examined alloys, after superficial etching, with high microscopic powers, and they find a similar separation of the constituents.

We thus see that solution of metals in one another follows extremely closely the same laws that regulate solutions with which we are ordinarily familiar. I should like to state here that the matter of this lecture is largely drawn from the work carried out by Mr. Neville, F.R.S., and myself during the past six years.

[1] For the nature of this calculation, *vide* Heycock and Neville, *Chem. Soc. Jour.*, vol. lvii. p. 339. Also Neville, *Science Progress*, October 1895.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The electors to the Linacre Professorship of Comparative Anatomy will proceed to an election in the course of Hilary Term, and candidates are desired to send in their names to the Registrar of the University not later than January 31, 1899. The Board of Electors consists of the Visitor of Merton College (the Archbishop of Canterbury), the Presidents of the College of Physicians and the College of Surgeons, the Wayn-flete Professor of Physiology, the Regius Professor of Medicine, an elector appointed to represent Merton College, and an elector appointed to represent the Hebdomadal Council. The Hon. G. C. Brodrick, Warden of Merton, has been appointed by Merton College, and the Dean of Christchurch by the Hebdomadal Council.

The electors to the Sedleian Professorship of Natural Philosophy, vacant by the resignation of Prof. Price, will also proceed to an election in the course of Hilary Term, and names of candidates are to be sent in not later than January 31. The Board of Electors consists of the Vice-Chancellor, the President of the Royal Society, the Provost of Queen's College, the Professor of Experimental Philosophy, Savilian Professor of Geometry, an elector appointed to represent Queen's College, and an elector appointed to represent the Hebdomadal Council.

Prof. Elliot and Prof. Rücker have been chosen as the last-mentioned electors.

THE Calendar of University College, London, for the session 1898–99, has just been received. The purpose of the College, as expressed in the Act of 1869, whereby the College was re-incorporated with additional powers, and divested of its proprietary character, is "to afford at a moderate expense the means of education in literature, science, and the fine arts, and in the knowledge required for admission to the medical and legal professions, and in particular for so affording the means of obtaining the education required for the purpose of taking the degrees now or hereafter granted by the University of London." During last session the following new departments were created: Laboratory of Experimental Psychology, Pender Chair of Electrical Engineering, the Edwin Chadwick Chair of Municipal Engineering. It is interesting to note that in the department of applied mathematics, Prof. Pearson gives, in the place of advanced class examinations, subjects for dissertations referring to the mathematical theory of statistics.

MR. W. C. MCDONALD'S benefactions to the McGill University, Montreal, have often been the subjects of notes in these columns, and last week we recorded that he had received the honour of a knighthood in recognition of his gifts to philanthropical and educational objects in Canada. Mr. McDonald's princely gifts to the McGill University include 20,000 dollars to the Workman endowment for mechanical engineering; the erection of the W. C. McDonald engineering building, valued, with its equipment, at 350,000 dollars, and an endowment for its maintenance; the endowment of the chair of electrical engineering with the sum of 40,000 dollars; the erection and endowment of the physics building, valued at 300,000 dollars, and two chairs of physics with endowments amounting to 90,000 dollars; the endowment of the faculty of law with 150,000 dollars; the endowment and equipment of the chair of architecture; a further sum of 150,000 dollars for the maintenance of the engineering building; 50,000 dollars towards the endowment of the pension fund; and the erection of a new building for the Department of Chemistry, Mining, and Agriculture, at a cost of 500,000 dollars, making the total amount contributed to the institution upwards of 1,600,000 dollars.

THE Executive Committee of the Central Welsh Board have unanimously passed the following resolutions, among others, referring to the Board of Education Bill, and have forwarded copies to the Education Department and the Charity Commission, with an intimation that they will be brought before the

Central Board at their half-yearly meeting in April next. "That Clause 1 (2) of the Bill should be amended by omitting the words 'one other person,' in order to insert the words 'two other persons, one of whom shall be a person well acquainted with the conditions of Wales and the wants of the people.'" "That considerable difficulty might arise in the future from the apparently concurrent jurisdiction of the Board of Education and the Charity Commission foreshadowed in Clause 2 (2) and (3), and that it is important therefore that the Bill should be so amended as to provide for a completer fusion of these two bodies." "That the Bill should be so amended as to indicate clearly that there will be no interference with the present organisation of intermediate and technical education in Wales and Monmouthshire under the Welsh Act, and that provision should be made for preserving to the Central Welsh Board the functions exercised by it under its scheme, and under the Treasury regulations already in force, for the inspection and examination of schools in the Principality." "That the Central Welsh Board might properly be regarded as a Consultative Committee, to which matters specially connected with Welsh education might be referred by the Board of Education for consideration and report."

SCIENTIFIC SERIALS.

American Journal of Science, December.—Another episode in the history of Niagara Falls, by J. W. Spencer. The first episode of the river was characterised by a cascade comparable in size to the American Falls, draining the Erie basin alone. The commencement of the second episode was marked by an increase in the volume of water, owing to the drainage of all the upper lakes being turned into the Niagara. Subsequently the fall was increased from 200 to 420 feet. Instead of continuing until reduced to its present height of 326 feet, the author now believes that it was reduced to a lower amount, 250 feet, and subsequently increased. This additional episode accounts more fully for the narrows of the gauge than any previous explanation. The age of the Falls will probably come out a little different from 32,000 years, but their fate will be the same. They will disappear by the lakes being drained into the Mississippi basin by way of Chicago.—An apparatus for measuring very high pressures, by A. de Forest Palmer, jun. The pressure in a Bessemer steel cylinder filled with heavy oil compressed by a tinned-steel screw is measured by a thread of mercury in a capillary tube whose resistance alters with the pressure in a manner previously determined by the author. Pressures upwards of 4000 atmospheres may be thus measured.—The application of iodine in the analysis of alkalies and acids, by C. F. Walker and D. H. M. Gillespie. The reaction between iodine and hydroxides of the alkalies and alkaline earths in hot solution is regular and complete under analytical conditions, not being appreciably affected by the mass action of considerable excesses of iodine. The reaction is best applied in analysis by titrating the alkali with an excess of iodine, removing this excess by boiling, and estimating the iodine in the residue.—Some new tertiary horizons discovered near Punta Arenas, Chile, by A. E. Ortmann. These beds, examined by Mr. J. B. Hatcher, represent two new horizons different from and older than the tertiary beds known as Patagonian, containing a marine fauna completely new to science.—A biotite-tinguaite dike from Manchester-by-the-Sea, Essex Co., Mass., by A. S. Eakle. This dike cuts through the augite-syenite of Gales rock near Manchester. It is six inches wide, and exposed for twenty feet. It is very difficult of access, and is only exposed at low water. The rock has a greenish-grey colour and a slightly greasy lustre, like tinguaites and rocks rich in nepheline. Small phenocrysts of felspar are visible in the somewhat compact ground mass, and also much magnetite, mixed with biotite, occurs in brownish-black patches, giving the rock a mottled appearance.

Wiedemann's Annalen der Physik und Chemie, No. 12.—Genesis of the electric spark, by B. Walter. The author mounts a long sensitive plate on a little car moving on rails and driven by a falling weight. The discharge from an induction coil is so timed that at least two sparks are recorded. The negatives show that each spark consists of several successive discharges in the same direction, at intervals of $2\cdot7 \times 10^{-4}$ secs. The spark is invariably preceded by brush discharges, and in places where the spark is bent, a small brush-like appendage appears, showing that the spark changed its direction in consequence of too large a resistance.—Genesis of the point discharge, by E. Warburg. When a needle-point is mounted in the centre of a metallic sphere and charged to a certain minimum potential, a continuous discharge passes from the point to the sphere. The author finds that the discharge sets in about 0·007 seconds after the potential has attained the proper value.—Properties of the stratified brush discharge in the open air, by M. Toepler. When the current intensity of an influence machine discharge is raised from zero to a high value, the discharge, at first an ordinary brush discharge, takes the form of sparks, and is eventually converted into a stratified "brush light arc," showing white kathode light, scarlet positive light, and anode glow. This is another proof of the essential identity of open-air and vacuum discharges. If the gap is very small, only the spark discharge can be produced.—Tuning-plates as a substitute for tuning-forks at high pitches, by F. Melde. Small square Chladni plates, say 5 cm. wide and 0·5 cm. thick, give high notes whose pitches can be safely calculated from their dimensions. They can also be experimentally determined by the author's resonance method, being made to transfer their vibrations to a rod whose length is adjusted until distinct nodes are formed, made visible by sound. Notes of pitches up to 30,000, and quite inaudible to most ears, can thus be produced and studied.

The Quarterly Journal of Microscopical Science (November) contains papers on the development of the pig during the first ten days, the structure of the mammalian gastric glands, certain green (chlorophylloid) pigments in invertebrates, a larva in the metanauplius stage, and the nephridia of the Polychæta (Part ii.).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"'Nitragin' and the Nodules of Leguminous Plants." By Maria Dawson, B.Sc. (London and Wales.) Communicated by Prof. H. Marshall Ward, F.R.S.

A study of the nodules found upon the roots of leguminous plants has led the author to an unhesitating confirmation of the parasitic nature of both the filaments and the bacteroids contained in these organs. The filaments, it was found, have no such constant relation to the nucleus of the cells, as was represented by Beyerinck in 1888. By plasmolysis of the root-hairs, the infection tube is shown to have grown into the hair, and not to correspond with the primordial utricle of the hair, a result which proves that Frank was mistaken in regarding the tube as formed from the contents of the hair mingled with fungal protoplasm. By staining with aniline blue and orseillin these tubes and the filaments in the cells were shown to consist of strands of straight rodlets, lying parallel to the longer axis of the filament, and embedded in a colourless matrix. This matrix does not consist of cellulose, chitin, or any form of mucilage. The swellings upon the filaments occur at places where the rodlets have become heaped up, and at such places the filaments eventually burst, liberating the rodlets, whilst they themselves remain as pointed portions, directed towards each other in the cells. After liberation from the filaments, the rodlets become transformed into X, V, and Y-shaped bacteroids. This variety of shape does not occur when these organisms are cultivated outside the plant on a solid medium, but in liquid pea extract, the change from straight rodlets to "bacteroids" occurs in a few days. By cultivating these organisms in drop cultures under constant observation with high powers, these rodlets are seen to multiply by division into equal, or sometimes slightly unequal, halves. By this method the author hopes also to determine whether the change in shape arises from fusion of two or more individuals or by branching. Their multiplication by division leads to the conclusion that these organisms are members of the Schizomycetes; whether or not they are true bacteria must, however, still be undecided until the final stage in their life-history has been fully followed.

The X, V, or Y-shaped bacteroid, when once formed appears to be incapable of further growth. These organisms are aërobic in character, their power of fixing atmospheric nitrogen is to be tested in connection with their growth on silicic acid gelatin.