

theory more than held its own. It was claimed by Prof. A. W. Porter that this theory is the only one which gives directly the experimentally obtained values for dilute solutions; that it has now been placed on a sound experimental basis as a result of Perrin's investigations, which show that particles suspended in a liquid, and therefore also the molecules of the solute, are in rapid motion to the precise amount required by the theory; and that any other theory of osmotic pressure must not only be competent to account for the observed facts, but must explain the absence of the effects that we have a right to expect from the molecular agitation of the solute. These claims were not seriously shaken by the criticisms of subsequent speakers, and towards the close of the meeting the chairman expressed his general agreement with the arguments put forward in favour of the kinetic theory.

Mr. W. R. Bousfield's contention that it is the solvent and not the solute which is active in osmotic pressure may be met, as Sir Oliver Lodge pointed out, in a simple and therefore necessarily incomplete way as follows. Imagine a closed vessel full (or practically full) of water, and divided into two compartments by a semipermeable membrane. The pressures on the two sides of the membrane compensate each other, but if a little sugar is dissolved in one compartment an *additional* pressure, due to the presence of the solute, is set up on that side. The contention that it is necessary to look to the solvent, and the solvent only, as the source of the pressure is therefore not established, but Bousfield's view that osmotic pressure is connected with the presence of solvent vapour (approximately obeying the gas laws) in the molecular interspaces deserves consideration on its merits.

It will not be denied that there are difficulties in applying the kinetic theory to relatively concentrated solutions (more particularly as regards the correction for the volume of the solute), just as there are difficulties in the application of the kinetic theory to compressed gases. It is remarkable that the deviations from the simple gas laws are smaller for solutions than for gases, and in one case at least (compare Sackur and Stern, *Zeitsch. physikal. Chem.*, 1912, vol. lxxxi., p. 441) this has been shown to be in accordance with the kinetic theory of osmotic pressure.

Both Prof. Porter and Mr. Bousfield ascribe the deviation of osmotic pressure from simple laws solely to hydration of the solute, and proceed to calculate the degree of hydration of the solute particles on this assumption. As, however, such simple laws do not hold for the gaseous state, in which hydration is necessarily absent, these "hydration numbers" do not inspire much confidence, more particularly as the variation of some of them with concentration in relatively dilute solution appears difficult to reconcile with the law of mass action. Unfortunately they cannot be independently tested, as no satisfactory method of measuring hydration in solution has yet been discovered.

Although the magnitude of the osmotic pressure, as equilibrium pressure, is independent of the nature of the membrane provided the latter is truly semipermeable, the mechanism of osmosis, including the part played by the membrane, is of great interest and importance. The very suggestive investigations of Adrian Brown and Tinker on the permeability and other properties of membranes have already added substantially to our knowledge of these questions. As regards the bearing of theories of osmotic pressure on osmosis, the suggestion of van Laar that the pressure of the sugar molecules as postulated by the kinetic theory would prevent water flowing inwards does not appear well founded. The most satisfactory picture of the process is probably obtained by analogy with

Ramsay's well-known experiment with a cell provided with a palladium membrane permeable for hydrogen, but not for nitrogen. Although the cell contained nitrogen at half an atmosphere pressure, when it was surrounded by hydrogen the latter entered until its partial pressure inside was practically equal to its pressure outside.

G. S.

#### ECONOMICS OF LIFE INSURANCE.

SIX papers relating to problems of life insurance, read to the Economic Section of the American Association for the Advancement of Science last December, are printed in the *Scientific Monthly* for April. Of these, the most important, in view of what has happened since it was read, is that by Prof. Huebner, of the University of Pennsylvania, on "Life Insurance and the War." For all the belligerents he finds that the financial effects of the war on the companies by depreciation of investments have been serious. For England and Canada the war claims have been between 11 and 12 per cent. of the total claims, which is a favourable experience; for the enemy countries little information is to be had. The same observation applies to the terms upon which companies undertake war risks. The after-effects of the war on the health of survivors must not be overlooked. The author urges that the companies should have latitude to charge such extra premiums as may be necessary, but that the burden should to some extent be borne by the community as a whole.

Prof. Huebner submits for consideration by the companies proposals for refunding any excess extra premium at the close of the war, and for reinstatement of the policy where the insured, owing to the war, is unable to produce evidence of good health. These proposals will no doubt be attractive, but they are open to the objection that contracts based on a calculation of averages cannot be modified by after-results in individual cases.

A paper by Mr. E. E. Rittenhouse shows that the life insurance companies of New York State have increased their new insurances in the thirty years 1885-1915 from 65,000,000*l.* to 385,000,000*l.*, and that the proportion of insurances lost by lapse and surrender during that period is a little more than 40 per cent., and tends to diminish.

Three of the papers relate to a recent development of the functions of life insurance companies in the United States. Dr. Fisk, as medical director of the Life Extension Institute, a body organised in 1914, urges health conservation as a duty incumbent upon these companies. Mr. Cox, who represents an influential association of life insurance presidents, asserts that nearly every large company in the United States is doing something intended either to prolong the lives of its policy-holders or of the people generally. Mr. Haley Fiske gives particulars of the work of a life extension bureau for medical examination of insured persons and of other comprehensive measures adopted by the companies for the preservation of the health of the insured.

Dr. Hoffman, statistician to the Prudential Insurance Company of America, improves the occasion offered by these recent developments to expose some fallacies of compulsory health insurance. He considers that voluntary effort can be relied upon to bring about all the benefits that could be expected from compulsory measures. He meets the argument that compulsory insurance has had good effect in Germany and in England in the fight against tuberculosis by statistics showing that Massachusetts has reduced its mortality from that cause by 23.8 in 10,000, while the corresponding reduction in Germany has

been only 17.6 in 10,000, and in England even less. He contends that compulsory health insurance is primarily a question of taxation, as 20 per cent. of the cost is to be paid out of general revenues for the specific benefit of a selected group, which is merely poor relief under another name, and is indirect taxation in its most pernicious form, and contrary to the fundamental principles of republican government.

### THE UNITED STATES NATIONAL RESEARCH COUNCIL.

AN important feature associated with the April sessions of the National Academy of Sciences at Washington, D.C., was the meeting of the National Research Council. The Research Council is made up of eminent men of science who are members of the academy, and of representatives of the military bureaux of the Government, and it co-operates with the United States Government in the solution of scientific problems.

Dr. G. E. Hale, of the Mount Wilson Solar Observatory, chairman of the council, presided at the meeting, and reports were presented by Dr. C. D. Walcott, secretary of the Smithsonian Institution, for the Military Committee; Dr. R. A. Millikan, of the University of Chicago, for the Physics Committee; Dr. M. T. Bogert, of Columbia, for the Chemistry Committee; and Dr. V. C. Vaughan, director, Medical Research Laboratory, University of Michigan, for the Medicine and Hygiene Committee.

In connection with the work accomplished by the Military Committee, Dr. Walcott, who is also a member of the National Advisory Committee for Aeronautics, stated that investigations had been conducted with noxious gases as employed for military purposes; problems connected with all forms of signalling had been studied; the utilisation of opium for obtaining a supply of morphine for medical purposes had been considered; and improvements had been suggested in the service Army blanket, which is not thought to be warm enough. Other work for military establishments of the Government is confidential. The Army was represented by Maj.-Gen. W. C. Gorgas, Brig.-Gen. William Crozier, and Brig.-Gen. George O. Squier, the chiefs of the medical, ordnance, and aviation divisions of the Army. Representatives of the Navy are:—Rear-Admiral D. W. Taylor, chief constructor; Rear-Admiral R. S. Griffin, engineer-in-chief; and Dr. J. Gatewood, medical director, Navy Medical School. The other members of the committee are:—Dr. S. W. Stratton, director of the Bureau of Standards; Mr. Van H. Manning, director of the Bureau of Mines; Prof. C. F. Marvin, chief of the Weather Bureau; and Mr. H. E. Coffin, Council of National Defence, Naval Board, and Research Council.

In reporting for the Committee on Physics, Dr. R. A. Millikan stated that they were co-operating with the National Society and the American Association for the Advancement of Science in an effort to find the men and the means for attacking certain physical problems which are now confronting the National Government. While no information as to the exact nature of these researches was announced, the chairman stated that four or five of them were submarine problems, several pertained to aeronautics, and some were optical, having to do with range-finding devices and the production and use of optical glass. Experiments with X-rays are being conducted for the Government, as are studies in thermal conductivity, atmospheric electricity, as encountered by airships, and even the manufacture of guns:

The study of these problems has brought to life the vital need for a central co-ordinating body, such as the National Research Council. For example, certain questions concerning the submarine were being considered separately by a naval investigating board, three of the industrial research laboratories, and a number of universities before the solution of its various phases was undertaken and distributed by the council. Encouraging results have been secured as the committee has become familiar with the general lines of attack of each investigation. An important problem, which on April 1 was in a discouraging condition, is now well under way towards solution. The members of the committee include: Dr. F. P. Jewett, Western Electric Company; Prof. T. Lyman, Harvard; Dr. I. Langmuir, General Electric Company; Prof. C. E. Mendenhall, University of Wisconsin; Prof. E. Merritt, Cornell; Dr. P. N. Pupin, Columbia; Dr. S. W. Stratton, Bureau of Standards; Brig.-Gen. George O. Squier, U.S.A.; Prof. A. G. Webster, Clark University; and Prof. R. W. Wood, Johns Hopkins.

Other committees of the council are on educational institutions, nitrate supply, census of research, astronomy, botany, zoology, agriculture, physiology, geography, geology, and anthropology. Another special co-operating body, the Engineering Foundation, established to promote scientific and engineering research, and representing several American engineering organisations, is giving the entire available income from its endowment to the work of the National Research Council.

The purpose of the Research Council is to pursue organised investigation for the Government when such investigation is needed, in co-operation with the department desiring the experiments or data. It brings into co-operation existing governmental, educational, industrial, and other research organisations.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The executors of the late Sir Charles Holcroft, Bart., have informed the University Council that the deceased baronet bequeathed to the University the sum of 5000l. upon trust, to apply the income thereof to the promotion and encouragement of research work in connection with any of the following subjects, viz. physics, chemistry, zoology, botany, geology, engineering, mining and metallurgy. Sir Charles Holcroft contributed, during his lifetime, about 100,000l. to the University.

The Rev. John Howell has presented to the Odontological Museum a further collection of skulls and teeth from the Congo region.

PROF. W. R. SCOTT, of the University of Glasgow, will deliver the Jevons Memorial Lectures on "Economic Problems of Peace after War" at University College, Gower Street, on Tuesdays and Fridays, beginning on Tuesday, May 15. The subject of the first lecture will be "The Economic Man and a World at War." The lectures will be free to the public.

DR. WILLIAM PRICE, of Southerndown, Glamorgan, at one time an active member of the council and court of governors of the University College of South Wales and Monmouthshire, died at Southerndown on January 11 last. By his will, of which the principal of the college is one of the executors and trustees, it is provided that the residue of his trust estate, after payment of certain legacies, annuities, gifts, and devises, shall be bequeathed to the council of the college to be devoted to the medical department of the college.