The final contribution to the general discussion was a series of tables concerning human needs and related vital statistics, presented by Dr. B. Woolf of the University of Birmingham. He had prepared lantern slides beforehand, and his running commentary on each table of figures thrown on to the screen introduced a touch of light comedy into the proceedings. It was not perfectly clear whether his remarks were to be taken seriously, for he questioned in turn estimates made by Sir William Beveridge, Mr. Rowntree, Prof. Bowley, the British Medical Association Committee on Nutrition, and others, hitherto accepted as authoritative. The present writer, in the course of a paper comparing the relative amounts of family expenditure allotted to food and other commodities, had applied a slightly amended estimate of Sir William Beveridge's subsistence scale to determine the bare cost of living of a family of four persons. The estimate for food, criticized by Dr. Woolf, was based on the scale recommended by the League of Nations Technical Commission on Nutrition as interpreted in the Beveridge Report.

As Dr. Bransby pointed out later in discussion, practical and reasonable diets were drawn up in conjunction with dietitians to conform to this scale, and the diets were costed on the basis of the Ministry of Labour food prices in 1938. If such figures are not accepted, where do we stand ? In the same paper an attempt was made to focus particular attention on a practice which is perhaps not generally recognized. In estimating a subsistence standard, only the cost of food is based strictly on need ; the other figures are determined by what is customary rather than by what is strictly proved from first principles to be necessary. The cost of items other than food in the above-mentioned paper was, in fact, closely related in each case to what the poorer families in the towns of Great Britain actually do spend (not what hard-hearted statisticians think they ought to spend) on these items, judging by the best available evidence, namely, the extensive and representative sample of household budgets collected by the Ministry of Labour in 1937–38.

Sir John Orr, at the end of the meeting, reviewed the difficulties involved in making dietary surveys. On the basis of experiment there could be no doubt as to the benefit children received when protective foods were added to their diet, and the British Government is committed to the task of improving nutrition to an optimum health level. The desired standard could not be reached for some years. We should need to produce more food ourselves and to import more. The whole problem of the organization of agriculture and the prices of foodstuffs must be settled. How much will the country have to pay the farmers to produce what is necessary ? Furthermore, in estimating needs we must not be too academic. People cannot be blamed for choosing to spend on other pursuits, to enliven dreary lives, part of the weekly income which might otherwise be spent on food. The solution, he suggested, is so to adjust finance and wages that there would be enough money for all to buy food and other necessities and to leave a reasonable margin for pleasure.

The Conference is to be resumed in May to discuss the results of the analysis of diets consumed in institutions, also various methods used in the preparation and cooking of food, and the laboratory assessment of the nutritional value of meals.

D. CARADOG JONES.

OBITUARIES

Prof. Yandell Henderson

YANDELL HENDERSON, whose death at the age of seventy occurred on February 18, held in succession the chairs of physiology and of applied physiology at Yale University. Although his investigations embraced many aspects of the physiology of the circulation and respiration, he will probably be best remembered for his advocacy of the value of carbon dioxide as a respiratory stimulant in a variety of clinical disorders.

Early in his career, Henderson's attention was attracted to the problem of surgical shock and to the failure of the circulation associated with this. This, he saw clearly, must be due to failure of the venous return to the heart, but the generally accepted idea that this was dependent on failure of the vasomotor control of the arterioles afforded him no adequate explanation. He noticed, too, that the venous return and the output of the heart could be greatly diminished by undue reduction of the carbon dioxide content of the body brought about by over-ventilation of the lungs, and that the venous congestion in the alimentary tract, and the paralysis of normal peristaltic movement when the abdomen was opened and the intestines exposed, was dependent on serious loss of carbon dioxide from the tissues by diffusion into the surrounding air. He was thus led to develop his theory of a veno-pressor mechanism independent of, but supplementary to, the arterial vaso-motor system, a mechanism which was dependent on the maintenance of an adequate concentration of carbon dioxide in the tissues. Although at first he was inclined to think that the explanation of this mechanism might be found in the effect of carbon dioxide on the veins, he soon developed a much wider theory, namely, that the maintenance of an adequate venous pressure was essentially bound up with the maintenance of normal reflex muscle tonus, and the support given by this to the veins and capillaries; and that anything which interfered with muscle tonus must lead to failure of the venous return to the heart.

Henderson had a profound admiration for J. S. Haldane, but it was not until 1910 that the two met for the first time at the International Physiological Congress held in Vienna. Here they planned an expedition to Pike's Peak, Colorado, to study the effects of high altitude and the factors involved in acclimatization, and this expedition was successfully undertaken in the following year. Thenceforward Henderson and Haldane maintained a close friendship, and Henderson's frequent visits to Europe brought him into contact with others, such as Barcroft of Cambridge and Krogh of Copenhagen, whose scientific interests were similar to his own.

The publication of Haldane and Priestley's classical paper in 1905 had already established the fundamental facts of the chemical regulation of the breathing, and had emphasized the physiological importance of carbon dioxide in this connexion. The significance of this work was fully appreciated by Henderson. It was indeed in harmony with his own work on the part played by carbon dioxide in the regulation of the circulation, and in a succession of papers he made a considerable contribution to the problem of the regulation of the acid-base equilibrium in the blood, with which respiration was closely connected. This in turn led him directly to a study of methods of resuscitation in cases when, for one reason or another, the

respiratory centre in the brain was showing signs of failure.

An outstanding instance of Henderson's shrewdness in the application of knowledge gained in the laboratory to the solution of practical problems in everyday life is afforded by his work on carbon monoxide poisoning. In severe cases of carbon monoxide poisoning, the best method hitherto advocated for treatment was by inhalation of oxygen; yet this was often disappointing since, as he showed, the respiratory centre had already begun to fail owing to the serious deficiency of oxygen to which it had been subjected because of the displacement of oxygen from the hæmoglobin in the blood by carbon monoxide. By adding 5 per cent or more of carbon dioxide to the oxygen inhaled, he found that the increased stimulus to the respiratory centre antagonized its failure, and with the maintenance of effective breathing the rate of elimination of carbon monoxide from the blood was greatly accelerated and a far better opportunity afforded for the eventual resuscitation of the victim. Oxygen – carbon dioxide inhalation is now universally recognized as the best treatment for carbon monoxide poisoning.

Henderson showed, too, that similar treatment might have a far wider application in clinical medicine when stimulation of the breathing or the maintenance of hyperpnœa might be requisite, for example, in the resuscitation of the new-born baby, in accelerating the elimination of volatile anæsthetics through the lungs after surgical operations, or in improving the breathing and reducing the risk of atelectasis in inflammation of the lungs. He had, however, an uphill fight before his views gained acceptance. Many regarded carbon dioxide as a poison the elimination of which from the lungs ought to be promoted and not hampered, and it took time to bring home the idea that carbon dioxide was also a natural stimulus to the breathing and could rightly be used for this purpose in clinical medicine.

Henderson's wide knowledge of the general physiology of respiration introduced him to many other practical problems. He was associated with the U.S. Bureau of Mines in the design of mine rescue apparatus and in the detailed investigation by which standards of ventilation were fixed for the ventilation of the Holland Tunnels between New York and New Jersey so as to prevent any risk of carbon monoxide poisoning caused by the heavy motor-car traffic. During the War of 1914–18, he worked on the physiological problems of aviation, and, after the start of gas warfare, on the properties of poisonous gases and means for securing protection against them; this led to the publication in 1927, in collaboration with H. W. Haggard, of his well-known book "Noxious Gases", a monograph which was to serve as the basis for the treatise "Schädliche Gase" by Flury and Zernik, which was published in 1931 in Berlin.

Much of Henderson's work is summarized in his book "Adventures in Respiration", published in 1938, and this affords an insight into the way in which his ideas developed and the difficulties that he faced and overcame.

A stout friend and a doughty opponent, Henderson retained throughout his working life the enthusiasm and the vigour of his youth. He had the courage of his convictions and really enjoyed a battle of words and wits, and he could speak bluntly in argument. But whether one agreed or disagreed with him, his views were always worthy of serious consideration. That he made mistakes is no doubt true, for no one is infallible; but there is no question that he played a great part in the development during the present century of our knowledge of the wide field of physiology embraced in the term 'respiration', and in the application of this knowledge to practical problems. It can rightly be claimed that his work on resuscitation has saved many lives that would otherwise have been lost. C. G. DOUGLAS.

Mr. H. H. Brindley

BY the death on February 18 of Harold Hulme Brindley, science lost a great personality. He was born at Highbury on June 17, 1865, the son of the then recorder of Hanley. Educated at Mill Hill School, he entered St. John's College, Cambridge, in 1884. Here he shared in all undergraduate activities, rowing in the boats, lieutenant in the Volunteers, president of the Debating Society, finally taking honours in the Natural Sciences Tripos in 1888. Careless of examinations, he obtained inspiration by aiding Weldon and Bateson in a period which was largely devoted to measurements designed to ascertain the technique of natural selection. An article on variation in the number of joints in the cockroach's tarsus greatly influenced Bateson, for it showed perfection with no intermediates whether there were four or five joints, each a 'normal' form, a 'discontinuous and total variation'. The facts were contested, as in regeneration a four-jointed tarsus is common, but he maintained his position, finding a case of four-jointed tarsi on all six legs. This led him later to a study of regeneration in general, especially in insects and vertebrates. His experiments on the different instars of Lepidoptera were particularly interesting.

Brindley then turned to the earwigs, with their long and short forceps. He scouted the idea that they were distinct species, a view extended to Xylotrupes beetles, two forms each with its fluctuations yet markedly discontinuous. For many years he kept cages of earwigs to experiment on their feeding habits and reactions. He found that their capture of insects by their forcipes in their nocturnal excursions was important, but they could live healthily on purely plant-food, though preferring dead animal matter. Dahlias and roses were mainly of use as hiding places, though their petals were agreeable. For their natural control, birds, except starlings, were unimportant. For proportions of sexes and other enumerations, he collected in the Scilly islands, but we recall with most interest his study of their parasitic infections. Clepsidrina abounded in the hind gut, while gordiid thread worms up to 50 mm. long often destroyed the whole gut; there were also acarine mites and fungoids, but parasitism did not produce any difference in respect to high and low males.

While collecting earwigs all over Cambridgeshire, Brindley also took the molluscs, obtaining more than a hundred species, and he observed that the progressive drainage of three centuries had not resulted in any marked invasion of Wicken Fen by terrestrial forms. Annual excursions to Arcachon were for the purpose of studying the larval processions of the moth, Cnethocampa, these first described by Réaumer. He broke up natural into artificial processions, but the question of direction is still undetermined. Mass attacks for oviposition were continuously made by tachinid flies, countered largely by the urticating properties of the larval hairs. During all these periods, indeed for fifty years, he had charge of the