and practice of psychotherapy. The methods employed include persuasion, suggestion, re-education, and various forms of analysis; no attempt is made to secure uniformity of method, since members of the staff may belong to different schools of thought, and, moreover, no rules can be made in the treatment of nerve cases. The aim in all cases is to restore the patient to social efficiency as quickly and as permanently as possible. Patients bringing a letter from their own doctor require no other recommendation, and pay if they can afford to do so. 219 patients have been treated during the year, involving 1784 interviews, lasting an average time of 50 minutes. Most of the cases treated in the children's department have been delinquents, chiefly thieving, and the results are said to have been uniformly good. Treatment has also been given for nocturnal enuresis and other disorders. Lectures and demonstrations are held for practitioners and medical students. A course on elementary psychotherapy is now being given by Dr. H. Crichton Miller, and during the coming year courses will be given by Dr. C. P. Symonds, Dr. J. A. Hadfield, Dr. E. W. N. Hobhouse, and Dr. W. A. Potts, who is the director of the children's department. Particulars of these courses may be obtained from the Hon. Lecture Secretary at the Clinic, 51, Tavistock-square, London, W.C. 1. While patients' fees and lecture fees go some way towards meeting the current expenses of the clinic, they are not sufficient to make it self-supporting, and help is urgently needed to enable the work to be carried on and extended.

CHEMICAL DISINFECTION AND STERILISATION.

IN a recent publication [1] Dr. S. Rideal and his son consider not only the various chemicals used as disinfectants and sterilisers, but also the details of their practical use, with some account of the experiments performed in connexion with their testing. A clear summary of the theory and technique of disinfection and sterilisation by chemical means will be welcomed by members of the medical profession as well as by numerous scientific workers.

Chemicals such as sulphur, copper, nitre, and numerous aromatic substances have been used from early times, but the number of suitable substances is now so large that a choice between them must sometimes be difficult. Moreover, the quantities of the steriliser to be employed, their times of action, as well as the best forms of apparatus for their production are of the utmost importance. Selection must depend largely on the nature of the object to be treated. Air may be sterilised by formaldehyde, sulphur dioxide, chlorine, and ozone. Chlorine is seldom used; formaldehyde and sulphur dioxide are mainly used for rooms, whilst ozone is suitable for large spaces. Chemicals used for food preservation must be chosen so as not to be injurious to health on consumption. There is thus only a limited choice, which is confined to those required for salting and smoking. Food in general is most commonly preserved by cold storage, milk by condensation and heat sterilisation. Water sterilisation is effected by filtration and sedimentation; ozone is sometimes used, but most frequently lime. Halogens as such or in the form of hypochlorites are also largely used. The destruction of non-bacterial parasites, such as insects, is another special problem; it is only successful when we know the life-history of the insect and is generally prophylactic in nature. The mode of action of the chemicals necessarily varies, being dependent not only on their own nature but on that of the object to be disinfected; physical processes such as ionisation, osmosis, surface tension play a large rôle. No specific action can be ascribed to chemical groupings in the molecule.

[1] Chemical Disinfection and Sterilisation. By Samuel Rideal, D.Sc. Lond., F.I.C., Fellow of University College, London; Public Analyst for the Metropolitan Borough of Chelsea; and Eric K. Rideal, D.Sc. Lond., M.A. Cantab., F.I.C., Fellow of Trinity Hall, Cambridge; Owen Jones Lecturer in Physical Chemistry in the University of Cambridge. London: Edward Arnold and Co. 1921. Pp. 313. 21s.

THE REACTION OF THE BLOOD:
THE MECHANISM OF ITS REGULATION.

BY C. A. LOVATT EVANS, D.SC.LOND., M.R.C.S.ENG.

THE questions of the reaction of the blood and the mechanism of its regulation have attracted the attention of laboratory investigators for several years past. Numerous definite results, some of which may prove to have a practical application to clinical problems, have accrued from this originally purely academic line of investigation. Their application is, however, largely a matter for future clinical investigation to reveal. It has long been known that blood, like most other tissues, normally has a slightly alkaline reaction, which it owes to the presence in it of sodium bicarbonate. Despite the fact that the circulating blood is the receptacle of very variable amounts both of acids and bases—waste products thrown into it by the active tissues of the body—its reaction is subject to surprisingly little variation in health or even in many pathological conditions. The liver and kidneys contribute a great deal to the regulation of the reaction of the blood, and the lungs, by removing carbon dioxide, constitute a valuable fine adjustment mechanism, but a still finer means of regulation than any of these resides in the blood itself. Blood is much more than a mere carrier of oxygen, food materials, and waste products; it is a valuable means of governing the reaction of all the other tissues in the body, the relation being mutual.

The Modern Meaning of "Reaction."

Let us first consider the modern meaning of reaction without looking too deeply into the physical chemistry of the matter. The theory of electrolytic dissociation teaches that water is to a very small extent decomposed into two ions, the hydrogen-ion (H) and the hydroxyl-ion (OH), the former bearing a positive and the latter an equal negative electric charge. Further, acids when dissolved in water add hydrogen-ions thereto, whereas bases by producing hydroxyl-ions lower the hydrogen-ion content. By the reaction of a fluid is meant the concentration of hydrogen-ions in it, and this can be expressed in terms of grammes of hydrogen present in the ionic state per litre of the fluid. Water itself, the standard of neutrality, contains 1 g. equivalent (i.e., 1 g.) of hydrogen-ion in 10 million litres; it is exactly neutral because it also contains in the same volume 1 g. equivalent of hydroxyl-ion. Water, then, may be regarded as either a 10-millionth normal acid or a 10-millionth normal alkali. All acid solutions contain more and all alkaline solutions contain less than 1 g. of hydrogen-ion in 10 million litres. The concentration of hydroxyl-ion is usually disregarded, because it always varies in the opposite way to the hydrogen-ion in such a manner that the product of the two concentrations is constant for all aqueous solutions whatsoever, neither ion ever quite vanishing. A simpler way of expressing hydrogen-ion concentration is to say that pure water has a H-ion concentration of 1/10,000,000 g., or more simply 10^{-7} g. per litre. Similarly a 1/1000 normal acid has a H-ion concentration of 1/1000 g. or 10^{-3} g. per litre; while a 1/1000 normal alkali has a hydrogen-ion concentration of 1/100,000,000,000 or 10^{-11} g. per litre. Since the expression 10^{-7} means 1 divided by 10^{7} or 10,000,000 and 10^{-3} means 1 divided by 10^{3} or 1000, this way of expressing fractions is very convenient; still more convenient for the expression of hydrogen-ion concentrations is the convention of omitting the 10 and the minus sign and prefixing the letters pH, writing pH 7·0, pH 3·0, and so on. The symbol "p" means "that *power* to which 10 must be raised to give the concentration in grammes of hydrogen-ion per litre" of the fluid in question. Since it is always negative for solutions weaker than N/1 acid, the negative sign is omitted by a convention. By a further convention, H in pH stands for the hydrogen-ion, and not the element, though usually the ion is designated by H^+, or more simply H·. This so-called

pH nomenclature is almost universally employed at the present time for designating hydrogen-ion concentrations; it must, however, be constantly borne in mind that when the hydrogen-ion concentration of a solution—that is to say, its acidity—is increased its pH number is diminished, and vice versa; all solutions on the acid side of neutrality have a pH smaller than 7 and all alkaline solutions have a pH greater than 7. It must also be remembered that pH numbers are in reality logarithms, so that a given difference in the pH of two solutions does not represent any actual difference but only a proportional difference between their hydrogen-ion concentrations; thus the difference in hydrogen-ion concentration between pH 6·0 and 6·3 is 100 times greater than the difference between 8·0 and 8·3, though in both cases the second value is half the first (1/1,000,000; 1/2,000,000 and 1/100,000,000; 1/200,000,000 g. per litre respectively). Provided these peculiarities are borne in mind, the pH nomenclature can easily be employed by anyone without any knowledge of logarithms, and the determination of pH can be readily made by methods which are soundly based on theory, are of easy application, and require no special calculation.

Methods of Determination of pH.

The simplest of these methods is the indicator method; according to recent work it is more accurate where body fluids are concerned than more elaborate methods. It depends on the principle that certain indicators, such as neutral red or phenolsulphonephthalein, show a progressive change in colour as the pH of a solution containing them is altered, each tint being associated with a particular reaction. As it is quite easy to prepare standard solutions of known pH, all that is necessary is to find which of these standards gives the same tint as the unknown solution, when equal amounts of the indicator are added to each—in practice this is a very simple matter which need not be described in detail here. When, as with blood, the original solution is coloured, the method is slightly modified by dialysing the blood and finding the reaction of the colourless dialysate; provided that precautions are taken to prevent loss of carbon dioxide in the course of the dialysis, the dialysate has the same reaction as the blood from which it is derived, because it merely represents a diluted protein-free plasma, and it can be shown that neither moderate dilution nor removal of proteins alters the reaction of blood plasma. The exclusion of the corpuscles also has no influence, because by the reaction of blood we mean the reaction of the plasma alone; if no carbon dioxide is removed the reactions of whole blood and of the "true plasma" drawn from that blood are the same.

It would perhaps seem at first sight to be much simpler to titrate the plasma or its dialysate to a definite end-point with some chosen indicator and a standard acid and have done with the matter: to determine its alkalinity in other words. Such a procedure gives valuable information, it is true, but it tells nothing at all about the reaction of the blood; the same is true of determinations of the "alkali reserve." Both of these determinations give the bicarbonate content of the plasma, but the reaction of the plasma depends not on this alone, but also on the carbon dioxide pressure of the blood; it is, in fact, determined by the ratio between the two, the hydrogen-ion concentration varying directly as the ratio $\frac{CO_2}{NaHCO_3}$ and the pH varying as the logarithm of the ratio $\frac{NaHCO_3}{CO_2}$. The bicarbonate content of plasma may be reduced to half the normal amount, but if the carbon dioxide pressure is also half the normal, the reaction of the blood will be normal. Determination of the CO_2 of the alveolar air gives (in normal individuals at all events) some measure of the CO_2 pressure of the blood, and this, together with a knowledge of the alkali reserve, does enable one to arrive at some idea of the reaction of the blood: direct determination of the pH must, however, be regarded as far more satisfactory, and now that the technique of arterial puncture has been worked out there is no reason why it should not be made.

Buffer Substances.

The reaction of normal arterial blood is about pH 7·6, and this reaction is pretty steadily maintained under very varying conditions, owing to the presence of buffers in the blood. Buffers are substances which absorb acids without much alteration of reaction; this influence of buffers in "mopping up" acids is well seen in the case of blood plasma. Suppose one takes 10 c.cm. of blood plasma, and a similar amount of very dilute caustic soda solution of the same pH as the plasma, and adds to each solution 1 c.cm. of 1/100th normal hydrochloric acid, and, after well shaking, compares their reaction by means of indicators. It will be found that while the blood plasma has altered very little in reaction, the reaction of the soda solution has been changed to about pH 3. The principal or primary buffer of the blood plasma is its sodium bicarbonate, but whole blood is much more highly buffered even than separated plasma because, under all circumstances which tend to render the blood more acid, the corpuscles effect a counteracting change in the plasma by causing its bicarbonate content to be raised (secondary buffering); conversely, any change tending towards a more alkaline plasma leads to a reduction of its bicarbonate content by the agency of the corpuscles. We can conveniently regard the corpuscles as adding or abstracting bicarbonate to and from the plasma, though what actually happens is more complicated than that. The consequence of this action of the corpuscles is that whole blood has a most remarkable buffering power, towards both acids and alkalies; this secondary buffering of the plasma brought about by the agency of the corpuscles can best be judged from some actual figures, obtained from blood in vitro; when blood was exposed to air containing 0·13 per cent. of CO_2, the plasma contained 0·151 per cent. of $NaHCO_3$, and when saturated with air containing 12·5 per cent. CO_2 the bicarbonate of the plasma rose to 0·32 per cent.

The lower the corpuscular content of blood the smaller is the influence of this secondary buffering; anæmic blood, then, has a much smaller range of secondary buffering than normal blood; as a partial compensation for this the primary buffering of the plasma is not infrequently raised in secondary anæmias. It is more probable that the breathlessness of anæmic subjects is due to the less perfect buffering of their blood than to deficient oxygen supply, and, except in extreme cases, this applies to other states in which "air-hunger" occurs. But if in addition the oxygen supply is deficient, the condition becomes very much worse, because large amounts of fixed acids will then be thrown into the blood by the partially asphyxiated tissues, the plasma bicarbonate will be partially neutralised, and any compensation by increase of the primary buffering will thus be lost.

"Acidosis."

A little reflection on the mode of regulation of the reaction of the blood suffices to reveal a difficulty which is becoming daily more apparent; lowered bicarbonate content of the plasma by itself, or lowered alveolar carbon dioxide by itself, gives no information at all regarding the reaction of the blood; yet these are often accepted as evidence for the existence of a state called "acidosis." Nor does the plea that the term "acidosis" is justified in these cases on the ground that there is evidence that fixed acids have been formed and that these have neutralised part of the bicarbonate, carry any weight, because an increased excretion of alkali by the kidneys would also lead to a reduction in the plasma bicarbonate. A more acid state of the blood can only be inferred from such observations when we know both the carbon dioxide pressure and the bicarbonate content of the arterial blood, and the former can only be obtained from alveolar air analyses when it is

certain that there is complete equilibrium between the alveolar air and the arterial blood; this certainty is lacking in many pathological conditions. The deductions from this line of argument are important and inevitable. Firstly, that the nomenclature of the whole subject of acidosis presses for revision[1]; secondly, that alveolar air examinations are not above suspicion; and lastly, that direct determination is the only satisfactory way of finding the reaction of the blood. It may be that blood reaction will, after all, be shown to be of secondary importance—that the body can tolerate a greater variation of hydrogen-ion concentration than has been previously supposed; it may be found that the all-important factor is the bicarbonate content of the plasma, or it may be that the carbon dioxide pressure is of most consequence. But these questions can only be settled by clinical research in which all three factors—namely, the reaction, bicarbonate content, and carbon dioxide pressure of the blood are measured.

PARIS.

(FROM OUR OWN CORRESPONDENT.)

Revision of the Children Act, 1874.

THE provisions of the French Children Act, 1874, are specially designed to promote physical health of children and to reduce infantile mortality. Mr. P. Strauss, member of the French Senate, now proposes to amend and consolidate it. In Part III. of his Bill it is suggested that at the time of the notification of birth a special nursing and maintenance booklet should be provided for all children without exception. The following notes would be compulsory: (1) birth registration particulars; (2) feeding, in the case of breast-feeding not being possible, the mode of artificial feeding should be indicated; (3) periodical weight records, the periodicity being determined by a Public Health Act; (4) minutes of periodical medical examinations by family doctor, or by medical officers who act as medical inspectors under the present Children Act, who would visit free of charge the children of poor people; the results of examinations could also be recorded by the medical officers of various charitable medical institutions; (5) vaccination. At the end of the month following birth, the book would be handed over to the local authorities, and again every three months during the first year and twice a year during the second year. Each time the book would be produced a visa would be apposed. If at any time the reading of the book shows that the child has not been under the regular medical attendance of a family doctor or under the supervision of a public or private institution, the local authorities will report the fact to the county medical inspector whose duty it will be to have the child medically examined. In the case of a second offence, the county medical inspector, after referring the fact to a special local commission, will have the privilege to have the child admitted to any special institution for the protection of infants. In the event of the parents protesting against such a decision, the county council authorities will enact without appeal, acording to the results of the inquest of the justice of peace. This proposed amendment to the Children Act has aroused great interest in medical and political circles over here.

Mental Diseases and Syphilis.

The Comité de la Propagande d'Hygiène et d'Education Prophylactique, with a view to publishing statistics of the connexion between syphilis and various psychoses as well as neuroses decidedly allied to general paralysis of the insane, proposes to open an investigation especially amongst medical officers in charge of asylums and physicians who are specialised is the study of mental diseases. The investigation is made from both a prophylactic and therapeutic point of view. Physicians will be asked to detail their observations as follows:—(1) Mental diseases caused by acquired syphilis: (*a*) mental conditions caused by syphilis alone and occurring together with other syphilitic stigmata; (*b*) mental diseases caused by syphilis and associated with psychopathic inheritance; (*c*) pathological findings in repeated lumbar punctures in cases of syphilis, and more especially in those complicated with tabes and encephalitis. 2. Mental disorders in cases of inherited syphilis, abnormal infancy, idiocy, epilepsy. 3. Frequency of mental disorders of syphilitic origin: (*a*) any personal statistics recording the frequency of mental disorders amongst syphilitics, as well as statistics giving the number of cases of mental disorders due to syphilis amongst any group of patients treated for all kinds of psychoses; (*b*) statistics showing the importance of the factor syphilis proportionally to the other causes of insanity (alcoholism, over-work, &c.); (*c*) the results of the routine use of the Wassermann reaction and of the cytological examination of the cerebro-spinal fluid of patients interned in various asylums. 4. Therapeutic results: statistics of results obtained by routine prolonged treatment with mercurial compounds and novarsenobenzol and similar drugs in various cases of mental disorders in which syphilis has been or has not been detected.

Paris Physicians and Surgeons at Strasbourg.

The fifteenth French Congress of Medicine, the thirtieth French Congress of Surgery, the twenty-first French Congress of Urology, and the third annual meeting of the Société Française d'Orthopédie were held at Strasbourg from Oct. 3rd to 8th. Amongst the congressists were some of the leading Paris physicians and surgeons. Prof. F. Widal, Mr. P. Abrami, and Mr. Pasteur Valery-Radot gave their views on anti-anaphylaxis; MM. L. Ambard and H. Chabanier reported on glycæmia; Mr. C. Lenormant, with Mr. H. Billet, described the results of the treatment of epilepsy consecutive to cranial traumatisms; MM. M. Chevassu and F. Rattery reported their views on anæsthesia in urinary surgery; Mr. L. Ombredanne reviewed various arthrodeses performed on the lower extremity.

Oct. 9th.

BUDAPEST.

(FROM OUR OWN CORRESPONDENT.)

Reform of Nutrition and Alcohol Consumption.

IN a recent lecture Dr. Dóczy, President of the Hungarian Order of Good Templars, said that according to his own experience and that of other investigators, the largely vegetable type of diet now customary in Hungary has lessened the desire for alcoholic drinks. The principles of modern nutrition, application of which resulted from the war scarcity of food, have great economic advantages; many people are both spending less on food and becoming capable of better work. The supplying of food to the army has also become much cheaper.

Infant Welfare in Budapest.

The Society for the Promotion of Infant Welfare has under consideration the adoption of the welfare scheme in force at Lübeck (Germany), the main provisions of which are as follows: Care of children is a duty of the State; all illegitimate children must be brought up under medical supervision; infants' homes are placed in charge of Roman Catholic sisters; notification of births of illegitimate children is a duty of midwives, and the sisters thereupon call at the mother's dwelling. When a birth is reported, pamphlets are issued to the mother, which contain information concerning the care of infants, together with a list of the infants' homes. The medical staffs of infants' homes are paid by the State.

Duties of Medical Men in Bulgaria.

For two years Bulgaria has been ruled by a peasant Government, and the new law by which everyone in

[1] The need for a revision was definitely expressed in the course of a discussion on Acidosis at the 1920 meeting of the B.M.A.