THURSDAY, AUGUST 23, 1917.

NEW BOOKS ON PLANTS.

(1) *The Principles of Plant-Teratology*. By W. C. Worsdell. Vol. ii. Pp. xvi+296+plates 26–53. (London: The Ray Society, 1916.) Price 25*s*. net.

(2) *Plants Poisonous to Live Stock*. By H. C. Long. ("Cambridge Agricultural Monographs.") Pp. vi+119. (Cambridge: At the University Press, 1917.) Price 6*s*. net.

(3) *Herbs Used in Medicine (First Series), with Descriptive and Explanatory Notes*. By Mrs. J. D. Ellis. Pp. 32. (London: National Herb-growing Association, 1917.) Price 3*s*.

(4) *British Wild Flowers: Their Haunts and Associations*. By W. Graveson. Pp. xv+320. (London: Headley Bros.) Price 7*s*. 6*d*. net.

(1) IN our notice of the first volume of Mr. Worsdell's "Principles of Plant Teratology" (NATURE, February 22, 1917) reference was made to the scope of the work and to the author's views as to methods of morphological investigation. The second and final volume deals with the flower of the vascular plants, the term "flower" including not only the flower of Angiosperms, but also the "cones" of Gymnosperms and vascular cryptogams and the sporophylls of ferns.

There are three main sections, entitled "Differentiation," "Simplification," and "Adventitious Flowers." Under the first head are grouped the following phenomena: Proliferation; forking and fasciation; disruption, a term applied to the splitting of the maize-cob, a female inflorescence, into the constituent branches which are normally united to form the cob; positive *dédoublement*, including increase in number of the members of a whorl (polyphylly) and increase in number of the whorls (pleiotaxy); dialysis, splitting or dissociation of members; and metamorphosis. Simplification includes abbreviation of the inflorescence and flower, adnation of floral axes or floral leaves, cohesion and suppression. Adventitious flowers are rare: a few cases are cited, and the remarkable instance of the Nepaul barley is described.

Most of the phenomena described under Differentiation are regarded as reversionary, though a number of those due to metamorphosis are recognised as progressive. The flower is considered as evolved from an elongated leafy shoot, the cone forming an intermediate stage; hence proliferation, which involves an elongation of the axis beyond the normal, is a reversionary process. On the other hand, granting that "simplification" of the flower by means of cohesion and suppression of its members represents one of the main processes of floral evolution, teratological phenomena of cohesion and suppression are regarded as progressive in nature, while those involving dissociation are reversionary. The splitting to a greater or less degree of the corolla of a gamopetalous flower into its component petals is not unusual, as, for instance, in Campanula; this is a case of reversion, because the flower with united petals represents a higher state of evolution than the flower with free petals. On the other hand, the reverse phenomenon of union of petals which are normally distinct is progressive. But does it represent anything more than mere terminology to call one of these instances progressive and the other reversionary? And is there any reality in the suggested relationships?

The study of plant abnormalities is full of variety and interest, and rich in surprises; to have prepared a book of reference on the subject is to have earned the gratitude of one's fellow-botanists. But Mr. Worsdell's work would have claimed a higher position if fewer pages had been devoted to theorising; the *rôle* of the recorder is an eminently useful one.

(2) Mr. Long's book on plants poisonous to live stock in the United Kingdom forms a handy work of reference in a subject on which the literature is remarkably scattered. The author has brought together many facts from numerous technical reports and journals, and the compilation will be of great value to those responsible for the care and treatment of animals. The plants included are more or less common wild plants which might be eaten by grazing animals or be mixed with fodder, but reference is also made to common ornamental plants known to be dangerous, such as laburnum, rhododendron, and cherry laurel; and poisonous leguminous plants, such as Indian peas (*Lathyrus sativus*), Java beans (*Phaseolus lunatus*), and lupines, are described at length. Excepting ergot, fungi are not included.

Poisonous plants differ widely in degree of harmfulness, and it is probable that under ordinary conditions many of the plants commonly regarded as poisonous are almost or quite harmless. In a state of nature animals appear to avoid toxic or unwholesome plants and to be less readily poisoned than are domesticated animals. Individuality is also a factor, some animals having a depraved appetite for unusual and unappetising food plants. The author quotes a remark of two American writers, that "there seems to be no way of accounting for the appetite or taste of stock." This statement is perhaps especially true of sheep, which will eat greedily on one day plants which they could scarcely be persuaded to eat on the following day on the same range of hills. The toxic properties of the plant are often affected by conditions of soil, climate, and cultivation; for instance, *Solanum nigrum*, an almost cosmopolitan weed, varies so much that it has been regarded as harmless in one country and poisonous in another. Again, a plant may be poisonous in all its parts, *e.g.* meadow saffron; or one part alone may be toxic, as the seeds in corn cockle. Frequently, as with buttercups, there are variations in the poisonous character according to the season, and some parts of the plant are more toxic than others; the flowers are the most poisonous, and then the leaves and stem.

The plants are arranged in systematic sequence under their respective families. Evidence for in-

cluding the plant as poisonous is given in each case, the toxic principle is described, as are also the symptoms, and references are given to the bibliographical list at the end of the volume. A short chapter is devoted to plants which lie more or less under suspicion of being poisonous, and there is also a brief account of the effects of wild plants on milk.

(3) Mrs. Ellis has written some useful descriptive text to a series of sixteen good coloured drawings by Miss Ethel Barlow illustrating some of the common herbs used in medicine.

(4) Mr. Graveson writes for the general reader. In a series of twenty-eight chapters he describes as many flower-rambles made between March and September. His style is discursive, but conveys some information on the life-history of the commoner wild plants. There is a good deal of "folk-lore" derived from well-known sources, and also plenty of quotations from the poets. The best feature of the book is the series of plant-sketches by Mr. J. Wood, which are included in the form of full-page plates.

IS THE ANGLO-SAXON DOOMED?

The Passing of the Great Race; or, The Racial Basis of European History. By Madison Grant. Pp. xxi+245. (London: G. Bell and Sons, Ltd., 1917.) Price 8*s.* 6*d.* net.

IN this work Mr. Grant takes up a theme which was broached by Dr. Gustav Retzius in his Huxley lecture to the Royal Anthropological Institute in 1909. In speaking of the two competing types of European—the tall, long-headed, blue-eyed Nordic type, and the short, round-headed, dark-eyed Alpine type—Dr. Retzius expressed himself thus:—

"There may lie in the circumstances to which I have called attention a very real danger of the North European dolichocephalic race not being able to hold its own. Just as it has been ousted during the past thousand years from Germany and other countries in Central Europe by the dark-haired, small-statured brachycephali, so, too, will it probably have to yield place here [England] and be reduced in numbers; perhaps by degrees disappear entirely out of the fatherland of their ancestors, by reason of the ever-increasing might and power of industrialism, with which they seem ill-fitted to cope successfully in the long run. The prospect is depressing, it cannot be denied, but the development of things in the world is not seldom harsh and unmerciful."[1]

That is the opinion which an excellent representative of the Nordic type formed of the future of his race in Europe. In a broad way Mr. Grant's book deals with the fate of the Nordic type in the United States of America, and from stray statements, which appear in a somewhat disjointed manner throughout its pages, we gather that the future of the Nordic type is as sombre in America as in Europe. "One often hears the statement made," writes Mr. Grant, "that native Americans of colonial ancestry are of mixed ethnic origin. This is not true. At the time of the Revolutionary War the settlers in the thirteen colonies were not only purely Nordic, but also purely Teutonic, a very large proportion being Anglo-Saxon in the most limited meaning of that term."

Mr. Grant evidently uses "Teutonic" as a term for men of the Nordic type inhabiting modern Germany, and forming less than a sixth of the population of that Empire, but as "Teutonic" in ordinary language has come to be equivalent to German, it would be a scientific gain if anthropologists could agree to apply the term "Teutonic" for the designation of the round-headed, fair-haired non-Nordic prevalent and predominant German racial type. That, however, is a side-issue; the main matter is that everyone who has investigated the problem will agree with Mr. Grant that the men who secured the United States (and Canada) as a home for white men were almost a pure embodiment of the Nordic type. We expected Mr. Grant to give us the results of systematic inquiries and exact figures as to the prospects of the type in the modern population of the United States. We know how in recent years millions of the competing dark-haired, round-headed type have left Central Europe and crowded into the manufacturing centres throughout North America. "Our immigrants now," says Mr. Grant, "largely represent lowly refugees from persecution and other social discards. . . . European Governments took the opportunity to unload on careless, wealthy, and hospitable America the sweepings of their jails and asylums."

Races from the shores of the Eastern Mediterranean are crowding into the Southern States; the negro is more prolific than the native white man. "As in all wars since Roman times," so Mr. Grant avers, "the little dark man is a winner from the breeding point of view." There are ample and trustworthy statistics to prove that the descendants of the original colonists are much less prolific than other and different human stocks which have recently arrived in America. It must be admitted that there is a danger of the fair heritage gained by the enterprise and courage of the Nordic pioneers—a heritage in which the best traditions of Anglo-Saxon life were established—passing to a type of man that the early colonists would not have shed a drop of their blood to save. It is just for that reason we wish that the author of this book had stated his case somewhat differently in a work which has the alluring title, "The Passing of the Great Race." A. K.

[1] Journ. Roy. Anthrop. Institute, 1909, vol. xxxix., p. 300.

ANOTHER TEXT-BOOK OF HISTOLOGY.

A Text-book of Histology. By Prof. H. E. Jordan and Dr. J. S. Ferguson. Pp. xxviii+799. (New York and London: D. Appleton and Co., 1916.) Price 15*s.* net.

THE appearance of another text-book dealing mainly with human histology and obviously designed chiefly for medical students naturally

invites attention to the points wherein it differs from previous text-books on the same subject. Although histology, like every other branch of biology, continues to progress, yet in such a limited and well-explored field as human histology a nearer approach to finality has been reached than in any other branch of biology, and therefore the need for a new text-book is less obvious.

We may say then at once that Prof. Jordan and Dr. Ferguson have produced an eminently *handy* text-book. Its bulk has been limited not only in the matter of number of pages, but also in the not less important respect of size of page, and its weight is still further reduced by the type of binding adopted, which, oddly enough, resembles that which has long been popular in the case of copies of the Bible. The plan of the book follows the well-known lines familiar in most text-books of histology, viz. the various types of tissues are dealt with seriatim and then an account of the structure of the principal organs of the body is given. Since, as we have already noted, there is an evident determination on the part of the authors to keep the size of the book within modest limits, the essential facts are stated as shortly and succinctly as possible, and although the student is made aware of conflicting views on points where uncertainty exists, yet no space is wasted in prolonged discussion of such disputes.

What, however, is more prominent in this work than most similar text-books, and what strikes us as wholly admirable, is the presence of numerous explanations of the *functions* of the structures described. After all, one main reason why histology is studied is for the purpose of elucidating function, and what might easily become a mass of wearisome detail to the student becomes lighted up with interest when he is made to understand what the structures are for.

A feature of great importance in any text-book of histology is the nature of the illustrations, and in this matter we regret to say that in our opinion the authors have followed a wrong method with regard to many of these. A large proportion consist of half-tone reproductions of photographs of actual sections. Such figures are in our opinion most unsatisfactory, for there is inevitably much blurring of outlines. If it be urged that it is important to represent what a student will actually see in the specimen and not the teacher's interpretation of it, we may rejoin that this is precisely what photographs do *not* show. The distinctions produced by differential staining are lost, and no one ever looks at a section without continually turning the fine-adjustment screw of the microscope and bringing various levels of the section in turn into sharp relief, whereas the best photograph reproduces clearly only the structures that lie at a single level. The large proportion of the photographic figures seriously detracts from the merits of the book. On the other hand, the insertion of a considerable number of simple outline explanatory diagrams, such as those of the embryonic development of the pancreas and the descent of the ovary, are of great assistance. As is perhaps natural in American authors, the references cited relate too exclusively to the results of American workers. On the whole, however, the clearness of the descriptions, the emphasis of essential points, and the neglect of secondary details combine to make this in our opinion a valuable text-book.

E. W. M.

OUR BOOKSHELF.

A Pocket-book for Chemists. By T. Bayley. Eighth edition. Edited by R. Ensoll. Pp. xvi+425. (London: E. and F. N. Spon, Ltd., 1917.) Price 7*s.* 6*d.* net.

THE "Chemist's Pocket-book" by T. Bayley, of which the last and seventh edition was published in 1900, has served for many years as a useful laboratory companion. In this new issue, edited by R. Ensoll, the contents of the previous edition have been rearranged, much obsolete matter has been omitted, and a number of tables have been added.

The subject-matter is grouped under the headings of (1) mathematical data; (2) weights and measures; (3) physical data; (4) general analysis; (5) gravimetric analysis; (6) volumetric analysis; and (7) miscellaneous. The first three sections contain a comprehensive series of useful data of reference, conveniently arranged in tabular form. In the section on general analysis the methods described are restricted to the analysis of sugar, wine, beer, spirits, and milk, and to a number of examples of indirect analysis, a selection which seems to bear but little relation to the requirements of the average chemist. The tables of factors included in the section on gravimetric analysis have been carefully chosen and are well arranged. Some of the methods of standardisation described in the section on volumetric analysis could be revised with advantage, as they are not fully in accord with those of modern analytical practice. The concluding section, "Miscellaneous," contains a number of data, such as instructions in bending and cutting glass tubing, cleaning laboratory vessels, etc., which seem peculiarly out of keeping with the proper objective of the book. In future editions the space thus occupied could be advantageously made use of to extend other portions of the contents. This re-issue, which is published in the form of a handbook, has been very carefully edited and is likely to maintain the utility of the earlier editions.

C. A. K.

Food. By Dr. A. Hill. ("Manuals of Health," No. 1.) Pp. 64. (London: S.P.C.K., 1917.) Price 9*d.*

FOOD is a subject of predominant interest at the present time, and it is important that sound knowledge concerning its use and function should

be widely and assiduously disseminated. In the main Dr. Hill's book is a useful contribution towards this object.

In chap. i., on "The Need of Food," the author has put the case clearly, though some improvements might be suggested. The calorimeter illustrated, for instance, is far removed from that actually used. Nor is it strictly accurate to say that the body must receive as much nitrogen as the kidneys excrete in urea. What really happens is that the kidneys excrete as much urea as is presented to them to be eliminated, this amount being no trustworthy measure of the nitrogen needs of the body.

In chap. ii. an attempt is made to give a simple account of the chemistry of food. It is doubtful if it is worth its place.

The main part of the booklet is devoted to a consideration of the nourishing value of various foods. The information is on the whole sound, though in many ways this chapter could be shortened with advantage. Some statements also require qualification, such as that the presence of sugar with protein in the stomach leads to a formation of uric acid in the system; that "gelatin cannot take the place of protein" (p. 35); that "gastric juice does nothing to break up the fat-saturated lumps" of flour and butter in pastry (pp. 36 and 37); and that no other kind of food gives so good a return for its cost as cheese.

Too much stress also is laid on the content of protein in a food as a measure of its nutritive value, and the author argues too rigidly from the assumption that a working man requires 4 oz. (113·5 grm.) of protein per day in his diet.

On p. 13, by oversight, a man's weight—75 kilos—is translated as 13 st. 9 lb., whereas it should be 11 st. 11 lb.

The booklet should prove useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Terminology of Parthenogenesis.

THE word "parthenogenesis" has become established in biological science to signify the production of offspring by a virgin mother. The term does not embrace reproduction by buds or by fission, but refers to parentage by a mother who produces egg-cells similar to those which are, in the vast majority of instances, fertilised by male sperm-cells before proceeding to develop. In these instances (distinguished as instances of "parthenogenesis") the egg-cells proceed to develop without fusion with the male reproductive element or sperm-cell.

Parthenogenesis may accordingly be defined as an exceptional and historically super-induced modification of the normal process of sexual reproduction or gamogenesis in which the female gamete or egg-cell does not unite with a male gamete or sperm-cell to form a "zygote," but proceeds to develop independently.

The term should not be applied to reproduction by unfertilised unicellular "spores" common in the lower plants and protozoa, nor to any cases except those in which the "parthenogenetic" reproductive cell is *either* (1) a normal egg-cell capable of sexual zygosis, *or* (2) demonstrably a comparatively recent modification of such an egg-cell. The latter is an important special group, and at one time these modified egg-cells—*incapable of fertilisation*—were incorrectly described as "pseud-ova" (Huxley). The egg-cell thus independently developing may be described as "autoblastic" and the process as "autoblastesis." And again the autoblastic egg-cell may be described as "lipospermic" and the embryonic history as one characterised by "lipospermy" or "lipospermia."

A difficulty of nomenclature has lately arisen in describing and discussing the offspring so produced—for instance, when the eggs of the frog have been experimentally induced by the mechanical method of Bataillon (scratching with a needle) to develop so as to give rise to tadpoles, and even adult frogs, without fertilisation by sperm-cells. By oversight the tadpoles so produced have been referred to as "parthenogenetic," and by a similar error the broods of greenfly produced without the intervention of a male parent have been called "parthenogenetic young." Clearly the word "parthenogenetic" has been, and must be, used to describe the virgin mother, and therefore cannot at the same time be applied to her offspring without causing confusion. It seems to me that the word "impaternate," or "fatherless," should be used for the offspring. I have failed to excogitate any other term which will so well meet the case.

If we call individuals so produced "autoblastic"—a term applicable to the egg-cells which give rise to them—we leave it doubtful as to whether we may not be referring to their *future* reproductive capacity rather than to their origin; and if we call them "lipospermic" we may possibly intend by this word to indicate that they are devoid of male reproductive gonads, and not merely that no sperm-cells were concerned in their genesis. The term "impaternate" is readily intelligible and admits of no such ambiguity.

A further difficulty in regard to the nomenclature of virgin reproduction or parthenogenesis is that the word "virgin" and its Greek equivalent refer to the condition of the *mother*, and not to the history of the *egg-cells* which she produces and passes from her body. The "virgo intacta" is an adult female who has not been "covered" or "impregnated" by a male, or, to use another term, has not been "mated." In most species of frogs and fishes, and in many other aquatic animals, *the female parent is always a "virgo intacta."* Such females are always "parthenogenetic" in the strict sense of the word. The fact that the eggs are not "autoblastic," but are fertilised after they leave the mother's body, does not alter *her* physiological condition or "status" in any way as compared with that of a mother whose eggs on being deposited by her are capable of "lipospermic" embryogenesis. She is never "mated" or "impregnated." The difference between her and the more familiar impregnated or fecundated mother arises from the persistence in the one case of the original and primitive method of free discharge of both the female and the male reproductive cells into the water in which the parents live, and, by contrast, the secondary development in the other case (comprising a vast variety and number) of arrangements for the fertilisation of the egg-cells while still actually within the *protective* body of the mother or in close contact with it. These secondary develop-

ments are determined by the fact that they favour both economy and certainty in the operation of the male gametes or spermatozoa, and by their provision of advantageous maternal protection to the minute egg-cells and the early stages of their growth when fertilised. In non-aquatic animals intra-maternal fertilisation of the egg-cells is obligatory.

The egg-cells which are freely discharged and fertilised by free-swimming sperm-cells "in the open" may be called "*planktogamic*" (plankton = freely swimming), whilst egg-cells which are subjected to the secondary protective arrangements may be called either "*hysterogamic*" (hysteron = uterus), if fertilised within the oviductal chamber of the mother, or "*propylogamic*" (propylon = a gateway), if fertilised on the surface of the mother's body or in immediate relation thereto (as in the case of many Crustacea and of some Amphibia).

There is no word in use to indicate the physiological status of an adult female which is no longer a "virgin," but has been "mated" or "covered," and has received into her oviduct sperm-cells from a male. We might designate such a female as a "mate" in contrast to a "virgin," but "mate" is in ordinary use for any kind of comrade. Though the words "wife" and "spouse" have too definite a reference to human legal and social status, yet the Latin word "conjux," implying as it does a "conjugium" (the significance of which is given in Virgil's account of wind-fertilised mares, "sine ullis conjugiis vento gravidæ"), might well be used as the antithesis of "virgo." Any female bearing hysterogamic egg-cells is accordingly a "conjux," whilst one discharging "planktogamic," or it may be "propylogamic," egg-cells is a "virgin."

The existence of "hysterogamesis" leads on to that phenomenon which was by Aristotle regarded as a highly important "differentia" in the classification of animals, and is loosely described as "viviparity." Animals which pass a large part of their embryonic growth within the mother's body and are born naked and with much of the shape and locomotive capacity of the adult are called "viviparous." But really all animals are viviparous, for the birth-product is a living thing whether it is a naked egg-cell or more or less advanced in development. The enclosure of the birth-product in a shell or case, which has given rise to the term "oviparous," is not of any value as indicating the real degree of development of the young at birth, for in some cases unfertilised egg-cells, in others mere discs of developing embryonic cells (as in birds, etc.), and in yet other cases well-shaped young ranging from the early larva of some invertebrates up to the completely formed miniature of the adult, as in some of the shell-bearing snails, may be enclosed within an eggshell when "laid" by the mother. There is accordingly no great *general* importance to be attached to the distinction between "viviparous" and "oviparous" animals. The eggshell has, of course, its protective value, but the exact phase and nature of the living thing within it must be considered in any comparison of the reproductive processes of different animals.

I may now show how far the considerations and the descriptive terms here suggested apply to certain typical cases of what is usually called parthenogenesis, but is better designated "autoblastesis" or "lipospermia."

(1) The greenflies, or Aphides, are, as are all insects, characteristically hysterogamic. They are propagated by males and mating females (conjuges) in autumn. But the spring and summer broods are females only. They are virgins, and produce true egg-cells which are autoblastic and develop into several succeeding generations of impaternate females (lipospermia or parthenogenesis). The egg-cells of these virgin mothers are modified so as to be incapable of zygosis, whilst the maternal structures connected with hysterogamesis (maternal fecundation) are aborted, although the intra-uterine gestation is retained and the young are born naked in a fully formed condition, whence they are said to be "viviparous."

(2) The phyllopod Crustacean Apus normally gives birth to egg-cells encased each in a delicate eggshell. These are autoblastic, and produce with very rare exceptions only impaternate females. At rare intervals, owing to conditions not ascertained, a few impaternate males are hatched from some of the eggs, and "propylogamic" fertilisation of the eggs of some of the virgin mothers of the same generation then takes place.

(3) The breeding queen bee (Apis) and the breeding queens of some other hymenopterous insects are at the same time both parthenogenetic and gamogenetic! They are definitely "conjuges," or mated females, but some of their eggs are hysterogamic and give rise to females only, whilst others are agamic (lipospermic) and give rise by autoblastesis to impaternate males (drones) only. This remarkable double character of the "queen" is due to the fact that the sperm-cells of the drone received by her into her spermatheca can be withheld from contact with the egg-cells about to be laid or admitted to them according to circumstances. Fertilisation of the egg-cell is (to use a French term) "facultative."

(4) Silkworm moths and some other female Lepidoptera sometimes lay eggs without having mated or come into contact with a male. Not infrequently these eggs, which in normal conditions should be hysterogamic, proceed to develop by autoblastesis, and produce impaternate males and females. This lipospermic reproduction is stated to have been experimentally carried out through three successive generations. The autoblastesis can be favoured, if not determined, by brushing the shell of the egg with a camel's-hair pencil.

(5) The female of the common frog is, like that of nearly all bony fishes, in all circumstances a "virgin." Her eggs are planktogamic. Other Amphibia may be propylogamic or even hysterogamic. When received into carefully purified water, the unfertilised eggs of the common frog, which are naturally enveloped, each in a jelly-like coat, can be caused to enter upon the curriculum of cell-division and embryonic growth by scratching the surface of the dark-brown egg-cell with a needle. The impaternate offspring thus produced have been reared to late stages of the tadpole phase, and more rarely to the adult form. The impaternate or fatherless young thus reared have, so far as at present recorded, always proved on examination to be males.

Other cases of lipospermia or autoblastesis, such as those revealed by the experiments of Loeb, Deslages, and others, could, I think, be with advantage summarised by the use of some such nomenclature as that here suggested. Autoblastesis is contrasted with gamoblastesis, but its occurrence is not "spontaneous." It depends upon either mechanical or various chemical conditions which could be enumerated and classified.

E. RAY LANKESTER.

The Scandinavian Languages.

IN the scheme of examination (see NATURE, vol. xcix., p. 475), it is curious to see Norwegian and Danish, which have the same dictionary, separated by the very different Swedish language.

T. R. R. S.

August 14.

THE CIVIL AERIAL TRANSPORT COMMITTEE.

NO time is going to be lost in facing the new problems arising from the war, and in setting to work on them at once at the earliest favourable opportunity.

The title, "Civil Aerial," of the committee shows how the experience of the novel warlike conditions are to be utilised in peaceful application, in a flying post at least of an airplane, and possible extension to the large airship for passenger service across the sea.

Throwing intellectual timidity overboard, we no longer await the sequence of events, watching the progress of the rest of the world to see what is best, and reap the advantage of waiting and at no expense. The economy of this *cunctando* policy has proved illusory.

Unlimited money, poured out in war like water, has solved these problems, and the leisurely hesitation of official timidity has been flung aside on the scrap-heap of unloading initiative and expense of experiment on private enterprise.

Going back in human imagination as far as history can carry us, we always find the obsession of the poet and artist dreamer for human flight.

In Chaldæan, Assyrian, and Babylonian ages we have only the sculptured representations to go by; but Homer, Æschylus, Plato describe the flight of the gods through the air as a matter of course, and blame the engineer inventor, Prometheus, for being so slow to put the idea into action for his fellow-men, Dædalus and Icarus, as Jules Verne has blamed us of his own time by implication.

In the Greek play Old Ocean arrives at the wings as the *deus ex machinâ*, a flying machine, dismounting from his mechanical four-footed bird, an Arimaspian griffin, after a single flight to the Caucasus from the Pillars of Hercules—Gibraltar and Jebel Musa. This is his radius of action, as the bird is said to be anxious to return to the perch in his cage. The daughters of Ocean have already put in an appearance as Chorus on their winged chariot, careful, they tell us, to lighten the load by removing their sandals, and so reluctant to put their bare feet on the ochreous earth of the volcanic mountain-top of the Caucasus.

Such details of scientific interest escape the attention of the classical schoolmaster, absorbed in the grammatical parsing; and he would hate to be told of their existence, for fear the inquiring scientific boy should start asking questions he could not answer himself.

Not only in Chaldæan, Babylonian, Hebrew, Chinese legends, of Ishtar, the prophet Habakkuk, and the Bronze Dragon, but in Greek art also, the mysterious *rôle* of the fabulous griffin can be traced, such as the supporters of the theatre stall in Athens of the priest of Dionysus; also in the bas-relief in St. Mark's, Venice, representation of the legend of Alexander, as told by Callisthenes, flying in his chariot of sixteen-griffin power, but room only for two in the sculpture (reproduced in the photograph); capable of being used also as a submarine. The artist has followed closely the description of Callisthenes in giving Alexander a long stick in each hand to steer the unbridled griffins. A savoury lump of meat is fixed on the end, and the griffins follow this with their eyes and fly after it.

LA LEGGENDA DI ALESSANDRO.

Many similar sculptures could probably be traced in our own cathedrals if only a trained search was made.

So the griffin is the crest to be selected appropriate for the Civil Aerial Transport Committee, and not a winged figure as Icarus, which never would work mechanically except on the small scale of the dragon-fly. *Pennae non homini datae.*

The romantic history of the subject is too vast to be followed up here any further. And the jaunty poetic imagination has never ceased to reproach the engineer descendants of Prometheus for declaring the problem impossible mechanically. To-day they can turn on him with the unanswerable—"I always told you so." But mankind had to wait all these previous æons for the motive power, not the mere power of the imagination,

but of a real machine strong and light enough to raise itself in the air with a man astride. This was the gift ready-made by the motor-car, of the petrol engine and no boiler. Twenty-two years ago a valiant attack was launched by Maxim (NATURE, August, 1895), but he was obliged to make his machine big enough to take up a boiler in it, and here he was beaten. If Maxim failed then, it was certain no one else had a chance of success in a flying machine—

He that it wroghte couth ful many a gin.

The committee is well provided with the imaginative element, ready to go one better than Jules Verne and Peter Wilkins; and the historian of it must take in hand an adequate account of artificial flight before it came to birth less than ten years ago. A beginning has been made in "Flugprobleme in Mythus Sage und Dichtung," published by the I.L.A. in 1910, and produced under Government encouragement years before we made a start. But the most important epoch in actual history was July 25, 1909, when Bleriot made the Channel passage, about the time Chavez was unfortunate in meeting his death in the moment of victory of crossing the Simplon in the air.

The imaginative talent of the committee must be supplemented and checked by a Lardner genius, to work out the sober arithmetical details as a guide in the actual design, similar to those required by the Committee on Steam Communication with India, 1830, and entrusted to the original Lardner.

The reckless optimism of a Brunel and Scott Russell must be discounted to its true value by the criticism of sober figures, as in Lardner's report to the Liverpool Chamber of Commerce, 1835, in pointing out the commercial fallacies of wild-cat schemes, and the need for a Government subvention, demanded already for aerial transport to make a start in the commercial aeronautics discussed by Mr. Holt Thomas before the Aeronautical Society, and reported in the *Morning Post* of May 31 last.

However learned he may be in Geometry, the poet and artist has never studied so far as into Mechanical Similitude. The artist paints his angel Michael with graceful wings in full flight, and invites us to imagine his diminutive figure, of dragon-fly scale in the picture, as enlarged to life-size. On the small scale of the picture, flight may be possible with the wing and horse-power available. But when the linear scale is enlarged tenfold the weight mounts up a thousandfold, but only a hundredfold in wing area, and the lift is ten times too small at the same speed, or, say, three times too small if the speed is increased on Froude's law.

In the airship design, for a given diameter of action, say, across the Atlantic, or radius of action, as in a joy ride to the North Pole and back, an immediate application can be made of Froude's law, as in the *Engineer* for May 19, 1916.

The laws of mechanical similitude are not quite so simple for a flying machine heavier than air, but a calculation can be made on the basis that in a given flight the horse-power-hours and petrol will vary inversely as the square of the speed, so that half the petrol will serve if the speed is increased 40 per cent., or that the same supply will carry over a double flight.

No difficulty will be felt of tide or draught of water at the terminal port, and the height of the course can be varied so as to choose the favourable current of air. But we must not anticipate further the labours of the scientific members of the committee, as they will prefer to carry out these calculations unassisted.

An aerial postal service between Italy, Sicily, and Sardinia has already been established, as we read in the *Journal of the Society of Arts*, August 3 (see NATURE for August 16, p. 490).

The commercial success of an Atlantic airship service is well within sight. Meanwhile, to begin with, a pleasure trip to the North Pole may be contemplated here, as likely to attract the patronage of the enterprising traveller and give confidence to the public. Advertised to leave Bergen in latitude 60° early on a Saturday morning, the airship, at fifty-knot speed, would be over the North Pole at midday lunch on Sunday, and back again to land the passengers on Monday night.

How does the pilot know when he is over the Pole; and when there, how can he find his way back by compass? These are questions for the new navigation required in aerial transport, still to be written.

An important course, such as that to America or Japan, taken on the great circle, will pass very close to the Pole, so that a slight detour to please the passengers need not add appreciably to the mileage. Here the old method of Lunars will come to the front again, displaced in ordinary low latitude by the superiority of the chronometer.

Nansen lost his way back from the Arctic Circle when his chronometer had run down, although the moon stared him in the face, inviting a lunar distance observation, which he could have taken with accuracy enough by a piece of string and the assistance of the nautical almanac, as described in Lord Kelvin's lectures—a revival of ancient methods of navigation such as were employed by Ulysses. G. GREENHILL.

THE "ISLE OF WIGHT" BEE DISEASE.

THE mortality among bees which passes by the name of "Isle of Wight" disease continues with unabated severity, and has now spread to nearly every district in England, destroying innumerable colonies in its progress and threatening to annihilate, or at least reduce to insignificant proportions, the bee-keeping industry in this country. Even in time of peace and unrestricted import, this would be a grave misfortune; at the present time, when sugar in every form is needed for human food and is steadily becoming scarcer, it is a national disaster which for some unaccount-

able reason appears to have escaped the attention of the authorities.

The mortality which has acquired the popular name of "Isle of Wight" disease from the fact that it was first observed about twelve years ago in that island and for some time was practically confined to it, is in reality not so much a disease as a group of diseases, all of which are fatal and produce the same macroscopic symptoms in the affected insect. The condition known as "crawling"—that is, the inability, more or less pronounced, to fly in spite of desperate efforts—the distortion of the wings, the fæcal discharge known as "dysentery," the dwindling of the numbers of the worker bees, and their sudden and apparently unaccountable death in large numbers are considered by the average bee-keeper to justify him in declaring his bees affected with "Isle of Wight" disease, but none of these symptoms are truly diagnostic.

The honey bee, as was pointed out in an article in NATURE of March 2, 1916, has singularly little power of expression, and the writer of the present article has observed the distortion of the wings at one time supposed to be characteristic of the disease in an apparently healthy bee killed in an entomologist's "killing bottle." Some, if not all, of the symptoms referred to may be present whenever bees die of a virulent disease, while there are at least three natural agencies, and possibly more, which cause the "sudden death of bees in large numbers," which Zander[1] says is the most obvious way by which bee disease can be determined. These agencies are (*a*) *Nosema apis*, (*b*) amœboid parasites, and (*c*) certain yeasts present in fermenting pollen.

The first of these alone causes microsporidiosis, the true infectious "Isle of Wight" disease, but the outcome of the confusion of all these maladies under one name has been a vast amount of loose talk and unscientific remedies, to use no harsher term. A preparation of coal tar, a combination of several germicides, hydrogen peroxide, sulphate of quinine, and even pea-flour have all been put forward as sovereign remedies and extensively sold to distracted beekeepers. Confident claims that this or that race of bees is immune to the disease have been put forward from time to time, and well-meaning but wholly unscientific attempts have been made to resuscitate the waning industry in places where the mortality has been highest by the introduction of new stocks either of alleged resistant strains or of healthy, but of course susceptible, colonies from some district supposed to be free from infection. The result has generally been disastrous, and there are now many parts of England, where formerly there were hundreds of colonies, in which the industry of bee-keeping has been almost abandoned in despair and a honey bee is a rare insect.

What then is the remedy? Without conceding all the claims that bee-keepers have made as to the value of their charges in fertilising the blossom of fruit trees—for it must be admitted that in the absence of honey bees the work of pollination is performed by other insects—it is allowed that bee-keeping is an important national industry. The nectar in flowers, if not collected and turned into honey by bees, is lost to the service of man, and now more than ever it is desirable to accumulate and utilise every kind of food that can be produced at home.

At the same time, the individual bee-keeper is helpless. Even in the rare cases where he is a man of science, he has no means of effecting a cure if his bees are attacked; still less has he the means of preventing infection. The control, and where possible the eradication, of contagious disease is a matter for Government intervention, but the Bee Diseases Bill which was twice introduced into Parliament by the Board of Agriculture was abandoned owing to the active opposition of a certain section of the bee-keeping community. The Government can scarcely be blamed for relaxing its efforts to control the disease in view of the lukewarm support it has received from the persons who would have benefited had those efforts been successful. The only hope appears to be in the universities, the National Agricultural and Horticultural Societies, or in the last resort the wealthy benefactors, who might conjointly form a National Bee-keeping Institute for the improvement and development of the industry, the study of disease, and the improvement of the breeds of bees kept in the British Isles.

The lines on which further research should be conducted are more or less indicated by the results already achieved. The organism that causes microsporidiosis is known, its life-history is fairly well understood, and the conditions under which Nosema flourishes and the principal means of infection have been ascertained. What is now desired is a suitable treatment and a study of the conditions under which recovery can best be secured. It is, of course, unwise to reason too closely from analogous diseases in other animals, but it is at least possible that the investigations that are being made into amœbic dysentery in man may give some clue to the discovery of a method of dislodging the parasite from its home in the cells of the bee's stomach, or of paralysing the activities of the "planont" before they are able to effect their lodging there. At the present time scientific research in bee-keeping is almost at a standstill, and a new departure is needed. Is it too much to hope that some of those who have devoted themselves to the study of epidemic diseases in man should apply their experience in the service of a humble but useful form of husbandry?

[1] "Handbuch der Bienenkunde," vol. ii.

NOTES.

WE learn from *Science* that Dr. R. A. Millikan is acting as the representative of the U.S. National Research Council in general charge of scientific questions referred to the council, that Dr. C. E. Mendenhall is in charge of the development of the various instruments used in connection with aeroplanes, and that Dr. A. Trowbridge has organised an important branch of scientific service for the U.S. Army in

France. The Carnegie Corporation of New York has voted an appropriation of 10,000*l.*, or so much of that sum as may be necessary, to the Carnegie Institution of Washington to meet expenses incurred by the National Research Council during the war.

THE following committee to deal with problems either psychological, or having a psychological aspect, in connection with the war has been organised by the U.S. National Research Council: Messrs. J. McKeen Cattell, G. S. Hall, E. L. Thorndike, R. Dodge, S. I. Franz, G. M. Whipple, C. E. Seashore, J. B. Watson, and R. M. Yerkes.

ACCORDING to *Engineering* a Chemical Industries Bureau is in course of formation in Sweden, the object of which will be to bring together the Swedish chemical industrial interests, to keep in touch with changes and developments within its domain, and to further the special requirements of the chemical industry in its various branches.

THE fifth annual meeting of the Indian Science Congress will be held in Lahore on January 9 to 12 next, under the presidency of Dr. G. T. Walker, F.R.S., Director-General of Observatories. The sectional presidents will be:—Dr. L. Coleman (Agriculture), Dr. Wali Mahomed (Physics and Mathematics), Dr. G. J. Fowler (Chemistry), Dr. Choudhuri (Zoology and Ethnology), Mr. R. S. Hole (Botany), Mr. E. S. Pinfold (Geology). Dr J. L. Simonsen, of the Presidency College, Madras is the honorary secretary for the meeting.

SIR JOHN STIRLING-MAXWELL has undertaken the duties of Assistant Controller of Timber Supplies for Scotland.

WE regret to have to record the death, on August 18, of Prof. S. B. Kelleher, Erasmus Smith professor of mathematics in the University of Dublin.

THE death is announced, on July 27, of Dr. W. B. Clarke, professor of geology in the Johns Hopkins University, director of the Maryland State Weather Service, and State geologist for Maryland.

THE Charles P. Daly medal for geographical research has been awarded by the American Geographical Society to Mr. G. G. Chisholm, lecturer in geography in the University of Edinburgh. The inscription on the medal reads:—"To George Goudie Chisholm, scholar, teacher, author. Through sustained research and broad generalisation he has created a world-wide interest in the geographical basis of commerce."

THE David Livingstone centenary medal of the American Geographical Society has been awarded to Señor M. V. Ballivian, president of the Geographical Society of La Paz, Bolivia. The previous recipients of the medal are Sir Douglas Mawson and Col. Roosevelt.

A CATALOGUE of current journals dealing with chemistry and chemical industry, and the libraries in which they can be consulted in the United Kingdom, is being prepared by the Society of Chemical Industry. The journal list comprises about 5000 titles, and contains journals from well-nigh every country, almost all of which periodicals were, it is believed, current at the beginning of the war. Chemistry and chemical industry are treated in a very broad spirit, the list including journals dealing with all industries in which chemistry enters. Some 800 libraries will be listed, so that from the completed catalogue it is hoped that any chemist will be able to find the most convenient library in which he can consult any particular journal. The completion of the catalogue during the ensuing winter is aimed at.

THE Petroleum (Production) Bill introduced by Mr. Long in the House of Commons on August 15 may have proved a surprise to many, who probably had not realised that the discovery of petroleum in this country is possible; indeed, various favourable indications have long been evident. In no industry has there been such prodigious waste; there has been the rush of pioneers boring throughout a district where oil has been proved; there has been the frequent gush of oil which could not be dealt with, leading to losses of millions of gallons. With the possibility of the industry being established in this country we should profit by past experience gained in the rich oil-producing countries, and this Bill is to be heartily welcomed as an important step, providing as it does for investing in the Government all rights to get petroleum, and arranging for leases and defining petroliferous areas, payment of fixed royalties, and the general control through the Board of Trade. The Government thought it right, in view of possible adventurous schemes, to put the matter forward at once in order that unfortunate enterprises might be checked. Whilst private enterprise might undertake the exploratory borings, this is surely such a speculative business, and yet of such vast importance if expectations are realised, that it would appear desirable that the preliminary work at least should be liberally assisted, or entirely borne, by the National Exchequer.

DURING excavations at Horncastle a short time ago a human skeleton was discovered. The bones were in a very good state of preservation, and indicated that the body had been buried on its back, at full length. By its side were a long sword, a large spear, and a smaller one, all of iron. These have just been purchased for the Municipal Museum at Hull. The remains are of Anglo-Saxon date, and were probably brought to this country by the Angles, and as these people came largely from Angle-land, in the district now known as Sleswick, the relics may be said to relate to an early Teutonic invasion of Lincolnshire. The sword is remarkable for its length, is double-edged, and, though naturally slightly corroded, is in a very fair state of preservation. Its total length is 33 in., it is $1\frac{3}{4}$ in. in width, and it tapers at the top in order to accommodate the handle. Quite apart from the archæological value of this collection, the sword is of particular value, as these weapons are very rarely found in Anglo-Saxon burials, though spears and other weapons are not uncommon. In his work on "The Industrial Arts of the Anglo-Saxons" Baron De Baye points out that the scarcity of swords is due to the fact that only individuals belonging to the upper classes were buried with this weapon, and that no doubt the swords were preserved as family treasures and left to heirs or friends.

IN the *Museum Journal* of the University of Pennsylvania (vol. vii., No. 4, December, 1916) is a reprint of an ancient Babylonian map showing part of the agricultural area of the city of Nippur, prepared about 1500 B.C. It throws a welcome light on an obscure provision in the celebrated law code of King Hammurabi. The map describes the custom of blowing a horn at the village gates to notify to the shepherds of the plains that the grazing season was over. Thus rural villages in which the people congregated for mutual defence appear to have been so arranged that the village buglers were able to make the shepherds and farmers hear the sound of the horn throughout the whole land of Babylonia.

IN the *Scientific Monthly* for July (vol. v., No. 1) Prof. Leo Rettger discusses some of the newer conceptions of milk in its relation to health. He emphasises the nutritional value of milk as milk, irrespective of

whether it is whole, skim, sweet, or sour milk. Many persons have little or no tolerance for sweet milk, while sour milk, or buttermilk, is well borne. On account of the highly important known food substances which are present, namely, fat, sugar, casein, lactalbumin, and certain inorganic salts, and of the as yet poorly understood vitamines, or accessories, milk has a most stimulating influence on bodily growth and strength, and is therefore an important factor in regulating and preserving health.

THERE is considerable need for an "ink" for the skin for localisation marks. It should stain the skin such a colour that it will show up against iodine, be unaffected when rubbed with alcohol, ether, acetone, etc., last for some days under a dressing, and not damage or inflame the skin. Capt. Finzi gives the following formula, which fulfils all these requirements:—Acid. pyrogallic., 1 gram; acetone, 10 c.c.; liquor ferri perchlor. fort., 2 c.c.; sp. vini meth., ad 20 c.c. The mixture keeps well, and can be applied with a brush. The mark is brownish-grey at first, but after a few hours becomes a brilliant black (*Archives of Radiology and Electrotherapy*, No. 204, July, p. 38).

WE have received a copy of the report on explorations and field work of the Smithsonian Institution for 1916 (*Smithsonian Miscellaneous Collections*, vol. lxvi., No. 17). The volume contains short reports from about thirty investigators in geology, zoology, botany, archæology, ethnology, and astrophysics in various parts of the world, from the United States, Cuba, and Venezuela to South Africa and Borneo. The result of these investigations is to enrich the National Museum with material for exhibition and research. The outbreak of war practically cut off all the supply of animals for the National Zoological Park, as the trade was formerly almost wholly in German hands. The New York, Philadelphia, and National Zoological Parks sent a representative to South Africa, aided by a grant from the Smithsonian Institution, and he was successful in securing a certain number of ruminants, birds, and reptiles, chiefly from the Zoological Gardens at Pretoria. It should be noted that some of the excellent photographs in this volume are of permanent scientific value, although it claims to be only a summary of work done.

A VERY concise and admirable summary of the "Moults and Sequences of Plumages of the British Waders," by Miss Annie Jackson, appears in *British Birds* for August. This is apparently meant to serve as an introduction to a detailed description of the plumages of the several species on the British list, which will prove a very useful piece of work, since it will not only summarise what has already been written on this theme, but also include much original work by Miss Jackson. Only during recent years has this subject been seriously investigated, the earlier collectors caring for little but adult males in their nuptial dress. Hence it is that none of the great collections of skins examined in the course of the preparation of this paper contain skins of the oyster-catcher, stone-curlew, greenshank, or red-necked phalarope, showing the transition from the first winter to the first summer plumage. But these are only a few of many gaps in our knowledge of this matter which have yet to be filled.

IN a lecture published in the May issue of the Journal of the Royal Statistical Society Lord Dunraven advocates the nationalisation of the marine and fresh-water fisheries. He suggests that the State should take over these industries in the same way as it now controls or works others of national importance. Such Government acquisition, control, and development would, he expects, result in the cheapening of fish as food, and also in a very great increase of revenue, since the State would acquire the original and intermediate profits. The lines of development are suggested. Methods of preservation of fish by cold storage, salt curing, canning, and analogous processes should be applied on a large scale, and means of distribution of fresh fish should be greatly extended. Methods of "scientific fertilisation of fish-culture" should be practised on a very much broader basis than has hitherto been attempted. In this way the author hopes to see the fresh-water fisheries developed and salmon cheapened again to its original price of 4*d.* per lb. He advocates the removal of restrictions on methods of fishing and the re-opening of many days formerly closed to trawling, and generally urges the adoption of many of the recommendations of the Inshore Fisheries Committee of 1913.

M. JOHS. SCHMIDT contributes an interesting article on the occurrence of the wild hop in Denmark to the *Comptes Rendus des travaux du Laboratoire de Carlsberg* (1917, vol. ii., part 6). By the distribution of inquiry forms throughout the country a considerable mass of information was collected, especially from forest officials. This shows that the wild hop is commonest in Funen and most rare in West Jutland, but is not found on several small islands. The wild hop propagates by seeding as well as by the vegetative process. The seedlings grow slowly, do not flower the first year, and probably but rarely in the second. The flowering time at one locality in North Zealand was found to occur (1911–15) at the end of July or the beginning of August, the male plants commencing to flower somewhat earlier than the female. The hop has not hitherto been found in prehistoric deposits in Denmark, and it is therefore uncertain whether it existed there prior to human habitation. Generally the wild hop is of small value for brewing purposes, as it contains but little bitter resins. Some plants, however, were obtained which contained as much as 14 per cent. of this constituent. The same author has found that although the quality of "aroma" is absent from the male plant, it can nevertheless be transmitted to the offspring through the male parent. When an American male plant was crossed with a European female plant the offspring plants gave hops which exhibited typical "American" aroma.

WE have just received three recent parts of *Bergens Museums Aarbok*, published in 1915 and 1916. One of the most important articles is that by Prof. Nathorst on some plant remains found in the Hornelen district, at the mouth of Nordfjord. Since these contain *Thursophyton Milleri* they appear to be contemporaneous with the Middle Old Red Sandstone. The generic name Thursophyton is new. There are also new genera: Bröggeria, of very doubtful affinity, and Hyenia, a probable precursor of Sphenophyllum. Both as an introduction to this paper and as a separate article Dr. C. F. Kolderup describes the geology of the west coast district in which the plant-bearing sandstones occur. He also reports on earthquakes in Norway in 1913 and 1914. Zoological articles comprise a preliminary note on the pelagic Nemertines of the German South Polar Expedition, 1901–3, by Mr. August Brinkmann, and a report on the Alcyonarian and Madreporarian corals collected by the *Fram* and the *Michael Sars*, and now in Bergen Museum, by the late Prof. Jungersen. Mr. N. J. Føyn contributes a second report on the climate of Bergen. Volumetric analyses made in the neighbouring seas are communi-

cated by Th. Hesselberg and H. U. Sverdrup, and T. Gaarder writes on oxygen in the fjords of Vestland.

IT is not generally recognised that the common British ragwort (*Senecio Jacobaea*, L.) is poisonous to cattle. Such would appear to be probable, however, from cases which have recently been investigated in the veterinary laboratory of the Board of Agriculture, and form the subject of a note in the *Journal* of the Board for July. Under natural conditions the poisoning is a slow process, but with continuous doses the amount of poison which becomes available is sufficient in time to cause very serious symptoms, which often end in death. In one case quoted visible symptoms of poisoning were not observed until forty-four days after feeding on ragwort commenced. No cure has yet been devised, and prevention resolves itself into removing the ragwort from the forage or eradicating it from the pastures. The winter and early spring grazing of infested land with sheep has been recommended for this purpose, and has been practised apparently without harmful results. It would be unsafe, however, to conclude from this that sheep are immune to poisoning by ragwort, since there is reason to think that the flowering season—June to August—is the time of greatest danger. This aspect of the matter is receiving further attention.

THE Journal of the Royal Agricultural Society of England for 1916 (vol. lxxvii.) presents the usual features of special articles, notes, and official reports, although for obvious reasons the number of special articles is somewhat curtailed in comparison with past volumes. Dr. Russell and Mr. E. H. Richards contribute an article on making and storing farmyard manure, which outlines various results of interest both for practice and for science obtained in recent investigations at Rothamsted. Attention is again directed to palm kernel cake and meal by Prof. C. Crowther, in a summary of existing information as to the nature, use, and merits of these materials as food for stock. An interesting article on the origin and characteristics of Welsh black cattle is contributed by Prof. C. Bryner Jones. The annual reports of the scientific advisory officers of the society contain, as usual, many matters of interest, of which we may note Sir John McFadyean's account of results obtained at the Royal Veterinary College in the investigation of Johne's disease, and Mr. Cecil Warburton's summary of the present state of knowledge concerning the ox warble-fly.

VARIOUS matters of immediate interest to agriculturists are dealt with in Occasional Notes, No. 2 (July, 1917), issued by the Royal Agricultural Society. The general scope and arrangement of the opening number of this new series are retained, the various advisory officers of the society contributing the different sections into which the notes are classified. The notes are essentially practical, dealing, amongst other matters, with the growing of wheat, the raising of farm seeds, plant pests, motor tractors, and calf-rearing.

IN the *Rendiconti del R. Istituto Lombardo*, vol. l. (2) 6, Prof. Torquato Taramelli discusses the origin of the deposits of sand found in the island of Sansego and other islands off the Istrian coast, and finds geological arguments in favour of Italy's claims to territory which is the scene of the present military operations. Among the numerous papers previously dealing with the geological features of the islands of the Quarnero basin many references occur to deposits of sand and red earth, but Prof. Taramelli occupies himself mainly with the mass of sand overlying a calcareous base, which forms the island of Sansego. This island has a surface area of about three square kilometres and a circumference of about seven kilometres, and is the outermost island of the Quarnero archipelago. In its composition this sand is largely identical with that deposited by the river Po off the Italian coast, while nothing similar is to be found in the neighbouring Austrian mainland. It is thus inferred that in the Quaternary period the northern portions of the Adriatic were occupied by a vast river basin of Italian origin, and that the natural frontier of Italy, based on geological considerations, extends up to the confines of this basin.

DR. L. F. NAVARRO contributes to the *Revue générale des Sciences*, 1917, p. 263, a most useful and interesting summary of what is known as to glacial phenomena in the Iberian peninsula. He points out that well-founded evidence of glaciation in this area, outside the Pyrenees and certain high chains, was brought forward for the first time by W. Halbfass so recently as 1912. The references to literature, including the author's own work, show how rapidly observation is progressing. No general mantle of ice has been traced, even in the Cordilleras; but a sheet of some magnitude, here called "*un grand inlandsis*," occurred in Leon. Two glacial episodes are recognised, corresponding to the Riss and Würm ages elsewhere in Europe. The author regards these as times when the present conditions in the peninsula were exaggerated in the direction of greater humidity and greater cold. Glacialists, however, are coming to the conclusion that no great demands need be made upon humidity, provided that there is a sufficiently low temperature.

THE revolution—a milder word would be inadequate—in the position of the British optical industry is one of the commonplace changes brought about by the war, and it is not surprising to find that the new conditions are reflected in the growth of the Optical Society, which is now thoroughly representative of the industry and is rapidly becoming as fully representative of those whose interest in optics has been of a more theoretical character. Advantage has very appropriately been taken of the improved outlook to issue the society's Transactions at more frequent intervals and in a new form. The first number of the new series, of the same size as the Proceedings of the Royal Society, is chiefly occupied with a paper by Mr. J. W. French dealing with the grinding and polishing of glass. It is suggested that the processes involved are essentially different from those which apply in the polishing of metals. Evidence is brought forward to show that, in the process of grinding, glass is removed in consequence of the formation of conchoidal fractures originating at the points of contact of the glass and the abrasive, rather than by a ploughing action. Incidentally, an interesting method of grading partially worked surfaces is described. The first part of the polishing process consists in ploughing up the soft surface layer of the glass, which has a thickness of about eight wave-lengths, by coagulated lumps of the wetted polishing medium until all the material above the bottom of the deepest grooves has been removed. In the second part of the process, which begins when the water is allowed to dry up, the surface layer of the glass is liquefied by the pressure of the pitch tool and caused to flow until the surface becomes uniform. The paper is illustrated by a large number of excellent photomicrographs, and followed by a discussion in which alternative theories are suggested, and the views of some experienced glass-workers are given. The number is attractively printed, and gives an excellent start to a journal which should play a large part in establishing the optical industry

of this country on a secure foundation, a task in which the Optical Society, where manufacturers and scientific workers are brought into intimate contact with one another, is eminently fitted to lead.

THE most recent contribution of the Bureau of Standards to the problem of the photometry of sources of light of different colours is Scientific Paper No. 299, by Messrs. Crittenden and Richtmyer, who have arrived at a number of general conclusions by collating the measurements made by more than a hundred observers. When two light sources of different colours, such as a carbon and a tungsten filament lamp, are compared by a photometer depending on a setting for equality of brightness, a considerable amount of practice is necessary before consistent results are obtained by any observer not specially trained. When a flicker photometer is used an observer of fair ability can readily get good results, but they differ from those given by the former method. The flicker photometer may give, *e.g.*, the candle-power of a tungsten lamp 3 per cent. less as compared with a carbon lamp than does an ordinary photometer. If the colour sensation of the observer differs from the normal, his comparison differs in consequence, but the authors find that the Ives-Kingsbury method of standardising the eye by the use of glass cells containing aqueous solutions of potassium bichromate 72 grams, and copper sulphate crystals 53 grams, to the litre respectively, interposed between the photometer and two equal sources of light, enables such an observer to get results identical with those obtained with a normal eye.

THE extent to which viscometers of various forms are now used for the classification and identification of oils and other liquids has led the Bureau of Standards to take up the question of a supply of standard liquids of known viscosities for the standardisation of viscometers. The investigation of the most suitable liquids has been carried out by Messrs. E. C. Bingham and R. F. Jackson, of the Bureau, who conclude that mixtures of 20, 40, and 60 per cent. by weight of ethyl alcohol in water, and solutions of sucrose in water containing 20, 40, or 60 per cent. by weight of sucrose, form the most suitable standard liquids. They give the viscosities and fluidities of these liquids at temperatures from 0° C. to 100° C. at intervals of 10° C. in a series of tables, and the variations of the fluidities with change of concentration and temperature are shown by a series of curves. The simple shapes of these curves suggest that it would be better to use the fluidity rather than its reciprocal the viscosity, in all calculations on the subject.

THE Tasmanian Government's Great Lake hydro-electric power undertaking, inaugurated in 1909 and opened last year, is described in the issue of the *Engineer* for July 27. It is based chiefly on a joint utilisation of two rivers—the Ouse and the Shannon—the latter having its source in the Great Lake and the former in what are known as the Ninety-nine Lagoons. The Great Lake lies at a level of 3250 ft. above the sea, and the lagoons are some 200 ft. higher. A curious feature of the two rivers is the great dissimilarity of their gradients, in spite of the fact that their sources are but a few miles apart, and their junction merely twenty miles or so downstream. At one point, about five miles south of the Great Lake, the Ouse is actually 1300 ft. below the Shannon. A dam has been built across the south end of the lake, giving an additional depth of 11 ft., and increasing the storage area from forty-two to fifty square miles. The catchment basin lies in the centre of the island, and is some 227 square miles in extent, and the annual precipitation of rain and snow is upwards of 60 in. By means of a diversion weir the water from the Shannon is turned into a canal, which serves a storage reservoir of 380 acres The power station is on the banks of the Ouse, and this river receives the exhaust water. The difference in level from reservoir to power station gives a net head of 1015 ft. of water, sufficient to develop a normal output of 4900 brake-horse-power in each of two turbines already installed. The installation has, in fact, proved so successful that an extension is now in hand. Although at present only serving the town of Hobart, the central position of the station renders it convenient for the transmission of power to any point in the island.

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, W.1, have issued a useful catalogue (No. 349) of rare and valuable books, comprising, among others, works dealing with Africa, America, Australia, entomology, ornithology, and physical and natural science. The same firm has purchased the existing stock of "Biologia Centrali-Americana," and has in preparation a detailed prospectus of the work.

OUR ASTRONOMICAL COLUMN.

THE COMMENCEMENT OF THE ASTRONOMICAL DAY.—In a letter to the *Observatory* for August the Astronomer Royal and Prof. H. H. Turner invite expressions of opinion from astronomers as to the desirability of adopting the civil day—*i.e.* the day commencing at midnight—in astronomical ephemerides; and, if thought desirable, as to the most suitable date for introducing the change. It has usually been considered convenient that observations made during the same night should all be of the same date, but this does not seem to them to balance the objection of having a time at variance with the civil reckoning. It is pointed out that the arrangement which is convenient for observations of stars is inconvenient for observations of the sun, and that the change would probably be welcomed by navigators. The only serious difficulty seems to be the discontinuity which would thus be introduced into astronomical records. A change of this kind could only come into operation after some time, as the national ephemerides are prepared several years in advance.

OBSERVATIONS OF MIRA CETI.—In *Ast. Nach.*, 4892, Prof. Nijland gives particulars of seventy-nine observations of Mira made at Utrecht between July 20, 1916, and February 15, 1917. The most probable date of minimum was July 24, when the star was of magnitude 9·4. The maximum occurred on November 8 (J. D. 2421176), the magnitude then being 3·75. The following is a summary of recent maxima observed by Prof. Nijland, together with a comparison with Guthnick's ephemeris :—

Maximum	Guthnick	Obs.-G.	Mag.	Period
J. D. 2420199	0209	−10*d*	3·35	328*d*
0527	0539	−12	3·8	
0852	0870	−18	3·5	325
1176	1201	−25	3·75	324

ECLIPSING VARIABLES.—A further important contribution to the study of eclipsing variables has been made by Prof. H. N. Russell in collaboration with Mary Fowler and Martha C. Borton (*Astrophysical Journal*, vol. xlv., p. 306). The observational data were provided by the Harvard Observatory in the form of 2101 observations of the photographic brightness of the six eclipsing variables, W Delphini, U Sagittæ, S Cancri, RW Tauri, SW Cygni, and W Ursæ Majoris. The resulting light-

curves for these stars were compared with those derived from visual observations, and it was found that identical geometrical elements gave a satisfactory representation of both the visual and photographic curves. Light-curves with the same epoch of mid-eclipse, however, do not satisfy both sets of observations, the difference amounting to as much as twelve minutes in the case of S. Cancri. The differences in velocity of the visual and photographic rays which would be required to explain the discrepancies in the case of the six stars in question range from −0·9 to +5·1 metres per sec., and are so discordant as to furnish no evidence in favour of an explanation based upon differences in velocity of light of different colours. On the contrary, the observations prove the identity of the velocity of light of the different wave-lengths within a few metres per second. The discussion strengthens the view that the typical eclipsing binary of large range consists of a small, bright, dense component of Class A, or thereabouts, and a large, faint component of much lower density, of Class G, or redder. It is considered highly probable that the component of low density represents the earlier stage of evolution. In addition to the already astonishing amount of information which has been derived from the study of eclipsing variables, it is expected that from them it will be possible to determine the relation of colour-index to surface brightness, and thence the linear diameters of all stars of known colour-index and parallax, and the angular diameters of all stars of known spectral type.

DRUM-FIRE.

THE following is an abbreviation of a letter by Mr. G. F. Sleggs which appeared in the *Times* of Tuesday last. The conclusions arrived at are the result of eighteen months' experience at the Front:—

There is a fundamental and peculiar difference between the sound emitted by a gun and that of an exploding shell. When the gun is fired the sound-wave produced is of a totally different nature from that produced by the burst of a shell. In the former case the impact of the gases leaving the muzzle, as it were, "strikes" the atmosphere in the direction in which the gun is pointed, but the burst from the shell causes a sound-wave of uniform intensity all around, as the gases emanating from the high explosive are not confined in any direction, as is the case with the cordite of the gun, the only escape being at the muzzle. Every soldier who has been to the Front knows that if you stand in front of a field gun or naval gun whilst firing even at a considerable distance (several hundred yards), the crack is painfully intense to the ears, and may even cause injury, whereas it is possible to stand close behind the gun with comparative impunity. In other words, the sound-wave from a gun is more concentrated along its line of fire than elsewhere. No such difference is observable with a shell, its concussion being equally violent to the ear whether it explodes in front of or behind one.

The laws of sound say that the intensity of the sound emitted from a body grows less in proportion to the square of the distance of the ear from the source of the sound; in other words, at double the distance the sound is a quarter as great. This, of course, is identical with the laws of light, and applies perfectly to the shell, but not to the gun, in the same way as the ordinary law of the intensity of light will apply to a candle, but not to a searchlight, which concentrates its light along one path instead of distributing it equally all around. Hence we are driven to the conclusion that the wave of sound emitted by a gun is closely analogous to the wave of light emitted by a searchlight. The intensity of the ray from a searchlight only diminishes gradually, and this analogy is borne out by the peculiar fact, familiar to those who have been in the trenches, that the German machine-guns, or rifle shots, always seem as loud whether the width of "No Man's Land" is seventy yards or 500 yards. One of the most wonderful and, indeed, majestic of all sound phenomena in connection with artillery is the great "roll" that follows the discharge of a high-velocity gun. To hear this at its best one must visit a part of the front where the contour is rugged, or where the landscape is well wooded, and where houses and other excrescences are abundant, as at Arras. The report of the cannon is followed at once and continuously by a majestic echoing roll that may be compared to a mixture of thunder and the music of a mighty bass orchestra. This rolling sound seems to travel forward as though it were following the flight of the shell, and is, indeed, mistaken by some for the actual sound of the shell.

The real explanation, however, is that it is a series of echoes from the thousands of heterogeneous excrescences in the surface of the landscape, each of which sends back its echo to the ear, the whole combining to form a continuous trail of sound. Now the fact that this continuous sound travels in the direction of the shell, and hence in the line of fire of the gun, also fits in with the searchlight analogy; as otherwise if the sound of the firing gun were not concentrated along its line of fire this chain of echoes would not appear to flow in any definite direction, and thus one of the most grandiose aural phenomena that the ear can receive would not exist.

The above considerations give rise to a remarkable and surprising fact, which, indeed, arises in theory and is borne out in practice. This is, that at a certain distance and upwards from the firing-line the sound of the German guns will be greater than the sound of our own, because we are in front of the German guns but behind the British, and although the latter are nearer to us, yet the sound of the former will appear louder and sharper because of the peculiar nature of the sound-wave emitted from the muzzle of a gun, the noise being nearly all concentrated in the direction of fire. Thus, when approaching the firing-line before a big attack, the sound of the German guns often appears to preponderate over our own, giving one the apprehensive impression that the enemy's artillery is in superior strength to our own, and it is only in coming into the artillery zone that the British superiority is perceived. Another point illustrating this is the origin of the word "drum-fire." This term (*trommel-feuer*) was first used by the Germans to describe the effect of our massed artillery on an unprecedented scale on the Somme. Now to the British, who were, of course, behind the direction in which their artillery was firing, this term would never have occurred, for to be behind a British bombardment there is but little resemblance to a drummer's tattoo, the whole sound being merged into a dull and heavy roar of guns; but to the German generals behind their lines every shot from the British guns would stand out as a sharp staccato note, the whole combining to give the impression of the rat-a-tattat of a mighty drum tattoo.

From these conclusions it will appear that the further one is behind the firing-line the greater is the tendency for the sound of the German guns to preponderate over our own, although the latter may be in much greater strength, and the probability is that the greater part of the noise of firing audible on our coasts comes from the German artillery and not the British, although the sound of shell bursts may tend to modify matters.

THE TREATMENT OF WAR WOUNDS.[1]

WE are wont to classify the patients in our military hospitals into sick and wounded. In reality all, or nearly all, are suffering from bacterial infections. And the essential difference between the sick and the wounded lies in this, that the sick are suffering from infections spontaneously contracted, the wounded from infections induced by mechanical injuries. My theme is the treatment of this latter class of infections. They are distinguished by certain quite special features.

In spontaneous infection we have to deal with microbes which have fought their way into the body, and generally only a single species of microbe will have done this. In wounds we have microbes mechanically driven in, and every sort of microbe which exists in external Nature may thus be introduced.

But let me, before embarking upon the question of their treatment, first tell you something about the

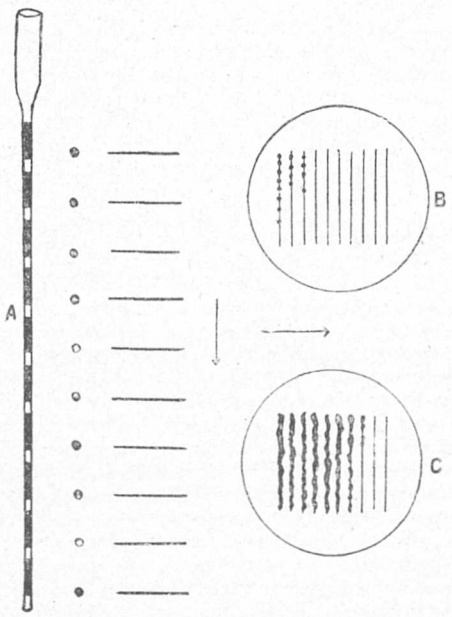

FIG. 1.—Method of pyo-sero-culture. A, Pipette which has been implanted by the wet-wall method, and has then been filled in by the wash and after-wash procedure with unit-volumes of serum. By the side of the pipette to the right is ranged a series of drops representing the series of unit-volumes of serum blown out in order from the pipette, and, finally, to the right of the drops is a series of lines representing linear implantations made upon agar. B, Results of the series of linear implantations made with the unit-volumes of the patient's serum. C, Results of the series of linear implantations made with the unit volumes of the normal serum which was used as a control.

natural agencies by which the inroads of microbes are combated. You are, of course, aware that we are guarded against microbic infection by our blood fluids and our white blood corpuscles.

THE BODY FLUIDS.

Let me begin with the blood fluids, and let me take you directly to the following experiment. I call it the experiment of *pyo-sero-culture—i.e.* the experiment in which we implant pus into serum to see which of the microbes of the wound can grow in the blood fluids.

We procure for our experiment a suppurating wound. We take from it a specimen of pus containing a large variety of different organisms. At the same time we take from the patient's finger a sample of blood; and we take a specimen also of our own. When the serum has issued from the clot we take a capillary pipette, fit a rubber teat to the barrel, and inscribe a mark upon the stem at about, say, one-third of an inch from the tip. We now aspirate a little pus into the stem, drawing it up only so far as our fiducial mark, and, blowing it out again, leave a wash of pus upon the walls. This done, we sterilise the tip of the pipette, and then aspirate into the stem a series of unit-volumes of serum, dividing each volume off from the next by a bubble of air. The pipette when filled in this manner presents the appearance shown in Fig. 1, and we have in the proximal end our first and heaviest implantation of pus, and in the distal end our last and lightest implantation. The pipette is now placed in the incubator to allow every microbe which is capable of growing in serum to do so. After an interval of six or more hours we proceed to our examination. What we do is to blow out our series of unit-volumes of serum in separate drops and examine under the microscope; or, better, we plant out a sample of each drop upon a separate seed-bed. Here in B and C you have the results of such culture represented diagrammatically—the meagre crop in B being that obtained with the patient's serum, and the more copious crop in C being that obtained with normal serum.

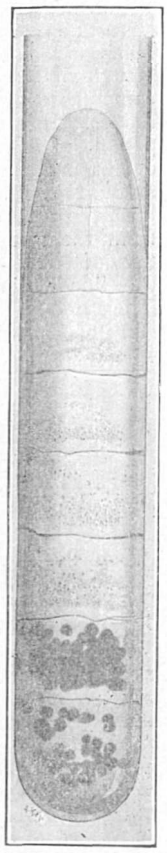

FIG. 2.—A portion of a pyo-sero-culture planted out upon an agar slant divided up by furrows into a series of seed-beds.

And you have in the next figure (Fig. 2) a drawing of an agar tube implanted from a pyo-sero-culture made with the serum of a wounded man. In the upper part of the agar tube you see two seed-plots implanted from the distal portion of the capillary stem. These have remained sterile. In the middle of the tube you see four plots implanted from the unit-volumes of serum which occupied the middle region of the capillary stem. These have grown colonies of only one species of microbe—the streptococcus. At the bottom of the tube you see seed-plots implanted from the proximal end of the capillary stem. These are overgrown with colonies of staphylococcus. But no doubt interspersed with, and overgrown by, these are also colonies of streptococci. If, instead of cultures from the patient's serum, I had been showing you here cultures from normal serum, what you would have seen would have been a much larger number of fertile seed-plots, and the seed-plots implanted from the proximal end of the pipette would have shown a large assortment of different colonies.

We learn from such experiments three lessons: *first*, that in the uncorrupted serum in the distal region of the pipette only two species of microbes from the wound can grow and multiply; *secondly*, that in the corrupted serum in the proximal end of the pipette all the microbes of the wound can grow; and, *thirdly*, we learn from a comparison of the wounded man's serum with the normal serum that the former offers more resistance to microbic growth, and is less easily corrupted by the addition of pus.

Cause of the Corruption of the Serum.

Experiments of this kind clearly do not tell us the cause of the corruption of the serum. That corruption

[1] By Sir Almroth E. Wright, C.B., F.R.S. In its original form this lecture was delivered at the Royal Institution on March 9. It was supplemented by additional matter relating to antiseptics and the method of Carrel, and was printed in full in the *Lancet* of June 23. Parts of the lecture of purely technical interest have been omitted.

may be due to some chemical substance contributed by the pus to the serum or to something special in the character of the bacteria implanted. This point we can clear up as follows. We go back to our very septic wound. We clean it out carefully by syringing. That leaves us with a wound cavity clean but still abundantly infected. We then take the little cupping apparatus which is shown in Fig. 3. We apply it to the walls of the wound, using light pressure. Then, puncturing the attached rubber tube with the needle of a hypodermic syringe, we withdraw the contained air, and leave our lymph leech *in situ* adhering by negative pressure until the time for redressing the wound comes round. When we now go back to our wound we find there two quite different discharges. We have in the general cavity of the wound a thick pus containing many broken-down leucocytes and pullulating with all sorts of microbes. In the body of the lymph leech we have a nearly clear lymph containing well-preserved leucocytes and only a very few staphylococci and streptococci. Since we had on every part of the walls precisely the same amount and kind of bacterial infection, and since we are in each case dealing with the self-same lymph and leucocytes, this difference of results is imputable, not to our having in the lymph leech a different bacterial implantation, but to the negative pressure having furnished a larger proportion of blood fluids.

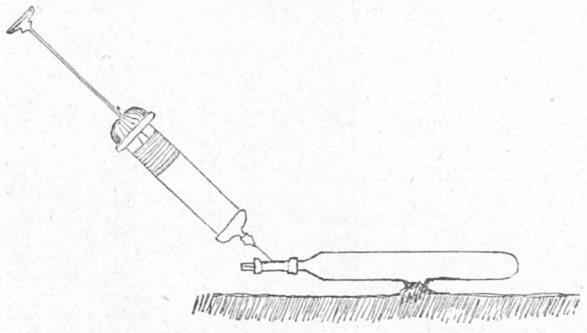

FIG. 3.—Lymph leech in position, showing technique for exhausting the air.

But with this the problem is, as you see, only incompletely resolved. We have learned that the corruption of the lymph is not determined by the nature of the bacterial implantation; we have reason to think it is hindered by a larger afflux of lymph; and it looks as if it might have something to do with the breaking down of the leucocytes. But we have not yet put our finger upon the particular element that takes away from the serum its power of inhibiting microbic growth, and converts it into a congenial pabulum for all manner of micro-organisms.

Let me in this connection invite you to consider—for that may perhaps put us on the path for the solution of our problem—a scheme of classification of the albuminous substances. I would propose to classify them from the point of view of their capacity to furnish pabulum for microbes, and to distinguish three classes of albuminous substances. First would come *digested albumens*. It is familiar matter that these furnish very congenial pabulum for microbes. In the form of peptone we use them for all our artificial cultures. A second category of albumens would be *native albumens*. Muscle, milk, and eggs furnish such albumens. These are not like digested albumens, directly assimilable. Before they can be assimilated, whether by ourselves or by microbes, they must be broken down into simpler elements by digestion. To that end we, and a certain number of microbes also, are furnished with digestive ferments. There is yet a third class of albumens. I would venture to call these *defended* or *protected albumens*. These cannot, like the digested albumens, be directly assimilated. Nor can they, like the native albumens, be directly digested. They are specially defended against the attack of digestive ferments. The albumens of the serum fall into this class of "defended albumens." It is well known with respect to serum that it has an antizymotic, and in particular an antitryptic, power—a power of neutralising digestive ferments, and in particular trypsin. You will, perhaps, not immediately perceive that the fact that the serum is antitryptic in any way elucidates our problem. But let us take that fact and put it in another way and then consider. Let us, instead of saying that the serum has an antitryptic property, say that it has a power of preventing its constituent albumens being converted into pabulum for microbes, and immediately, as I think, light is projected upon our problem. For once we envisage the facts in that way we are immediately impelled to inquire whether the serum's power of inhibiting bacterial growth may not be due to its power of neutralising digestive ferments, and whether the corruption of the lymph in the cavity of the wound may not be due to a collapse of its defence against proteolytic attack.

That is a point which is very easily settled by direct experiment. And let me now show you what happens when we add trypsin to a serum which has been implanted with microbes. I have here two tubes of a serum implanted two days ago with a minute quantity of pus containing a variety of different microbes. To the one I added trypsin, the quantity added being less than that required to neutralise its antitryptic power. The other tube of the implanted serum served as a control. Both tubes were then placed in the incubator. And you see the difference. The trypsinised serum is turbid with microbic growth. That is, we have here exactly the same result as that obtained in our pyo-sero-culture in those volumes of serum which were corrupted by a heavy implantation of pus; and the same result also as was in the lymph leech experiment obtained in the discharges in the wound cavity. Our control serum has, as you see, remained almost perfectly clear. That is exactly the same result as was obtained in our pyo-sero-culture in the distal end of our tube, and again in our lymph leech experiment in the cavity of the lymph leech.

And the doctrine that the antitryptic power is the protector, and trypsin the corrupter, of the blood fluids wins further support from the following facts:—(1) In every suppurating wound there is, as we shall presently see, a source from which trypsin can be derived. (2) Blood fluids which inhibit microbic growth are strongly antitryptic; and blood fluids which we find teeming with microbes are tryptic. (3) Examination of the blood shows that all wounded men have a markedly increased antitryptic power, and heavily wounded men (you saw in our pyo-sero-culture what results from this) on an average a three- or four-fold increased antitryptic power. That clearly teaches that the body when endangered takes steps to protect itself non-specifically against all microbic infections of the blood fluids.

THE LEUCOCYTES.

I now pass on to consider the leucocytes and the part they play in the destruction of microbes. You already know with respect to leucocytes that they can emerge from the blood-vessels, burrowing their way out through small pores in the capillary walls; that they make their way to every focus of infection; that they ingest microbes when these have first been prepared by the action of the blood fluids; and, finally, that they can, if things go favourably, digest and dissolve the ingested microbes. There would by consequence in connection with the leucocyte be

three functions to study. First would come emigration, then phagocytosis, and lastly intracellular digestion. Emigration has up to the present been studied only in the interior of the organism. You will realise that means that it has been studied only in a difficult setting and in the presence of all manner of disturbing factors, and you will appreciate that we want now a new and better technique. For we require for the treatment of the infected wound to find out how best to call out the leucocytes; and how, when occasion requires, to restrain their emigration.

I have in connection with this a technique to describe to you; but first I want you to appreciate what we can and what we cannot expect from leucocytes in the matter of locomotion. Leucocytes can, we know, make their way out through small openings. They can also travel over any ordinary surface. They can edge their way along faster when lightly compressed between two surfaces. They can crawl along strands, creep through a meshwork, and climb a scaffolding. But they are unable to climb a vertical glass wall. And again, they are unable to swim, and so once they get into open fluid they simply go to the bottom. We may liken them to very minute slugs crawling along surfaces and climbing trellises, but brought up short by any considerable barrier of fluid.

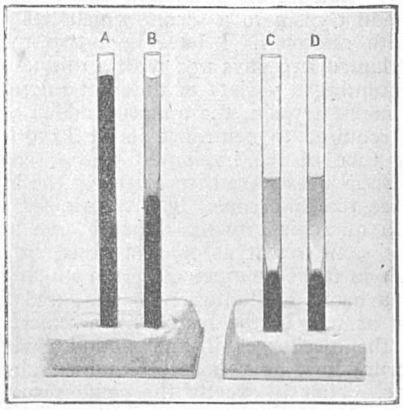

FIG. 4.—Drawing of four flattened capillary tubes. A, filled in with blood; B, a similar tube after centrifugalisation showing above the "white" and below the "red clot"; C and D, similar tubes after incubation. Leucocytic emigration is in each case visible to the naked eye as an opaque white band occupying the lower portion of the white clot. In D, where physiological salt solution had been imposed upon the white clot, the band of emigration is much broader than in C.

All these points must be considered when seeking for a technique for the experimental study of emigration, using for that study specimens of blood withdrawn from the body. The containing blood-vessel can up to a point be imitated by a glass tube, and we can, to facilitate observation, use tubes drawn out flat, such as shown in Fig. 4. But the artificial differs from our natural capillary in having impermeable instead of permeable walls. This, of course, makes emigration through the walls impossible. None the less, these tubes supply what we want for the study of the movements of leucocytes. We can institute races along the length.

But first certain preparations must be made. The course must be cleared of all obstructions—*i.e.* the red corpuscles must be got out of the way. Next the leucocytes must all be brought back behind the scratch line. Further, we must provide a scaffolding for the leucocytes to climb. All this can be arranged. We fill in our flat emigration tubes with blood and seal them at one end. Then, by centrifuging, we bring the blood fluids to the top and the corpuscles to the bottom. The lighter leucocytes will now have arranged themselves in a layer immediately above the red; and presently the supernatant fluid will clot and the meshwork of fibrin will then provide the scaffolding we require. We can now impose upon the clot—let me for convenience call it the white clot—any chemical agent we please and let it slowly diffuse down to the leucocytes. For the study of the effect of bacterial infection, we can introduce microbes into the blood before this is filled into the tube. Or, as an alternative, blood can be filled into tubes the walls of which have been wetted with a microbic culture. Finally, we set our experiment going by placing our emigration tubes in the incubator—that is, we supply to our leucocytes the necessary warmth. And we can at any moment take stock of what is occurring in our tubes by examining through the walls with the naked eye or with the low power of the microscope. Also, by a very simple technique we can extract the clot from the tube and mount and colour it, so as to bring everything clearly into view under the high powers of the microscope.

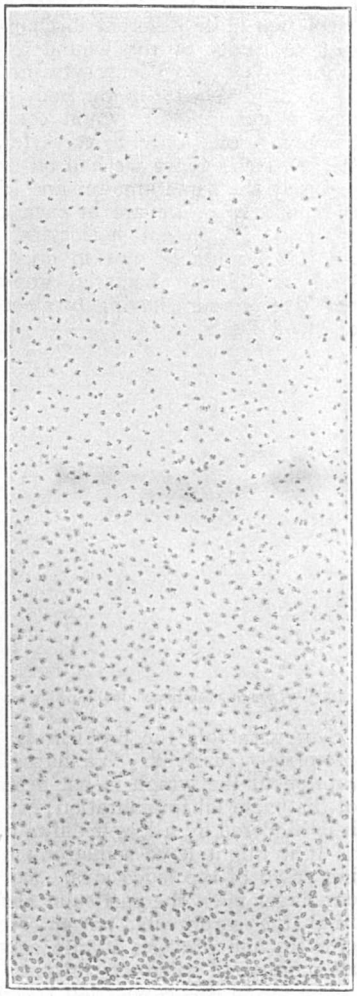

FIG. 5.—Magnified view of the band of leucocytic emigration seen in Fig. 4, D.

Emigration of Leucocytes: Facts with Practical Application.

I must limit myself to showing you in connection with emigration a few outstanding facts which have a practical application to the treatment of wounds. Let me begin with the naked-eye appearances. We have in Fig. 4, C and D, emigration tubes containing centrifuged blood which has been in the incubator for about eight hours. In C—the control tube—we have centrifuged blood to which no addition has been made. In D some weak salt solution has been imposed upon the white clot. The emigrating leucocytes are visible to the eye in the form of a slightly opaque white band extending upwards from the red into the white clot. You see that in D the corpuscles have climbed higher than in C.

Fig. 5 shows what such a band of emigrating leucocytes looks like under the microscope. Instead of the leucocytes being all, as you will see in the next figure, congregated together behind the starting line, they here are actively emigrating—the more active outdistancing the others in the race.

Fig. 6 shows what happens when 5 per cent. salt solution is imposed upon the blood. That salt passes

down by diffusion and arrests emigration, and I want you to notice on the right of the figure (and more clearly in the inset) that the few white corpuscles which were beginning to emigrate when the salt solution overtook them are broken up and destroyed. By that trypsin will be set free.

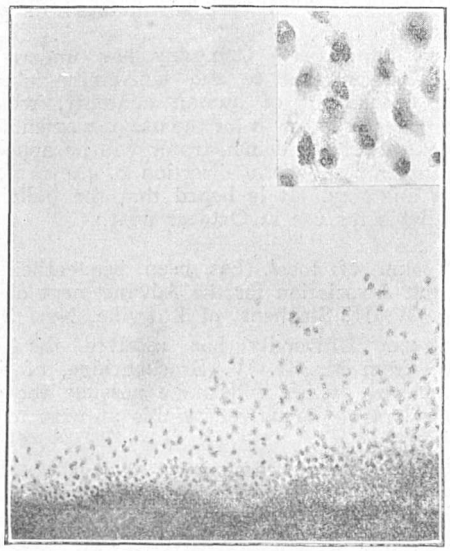

FIG. 6.—Magnified view of the leucocytic layer in the case where strong salt solution was superposed upon the white clot.

I next show you what happens when microbes have been implanted into the blood. Those microbes—supposing always that they are the sort that can proliferate in blood—grow out into colonies. In Fig. 7 is shown what happens when an excessive implantation has been made, and the bacterial colonies come up very

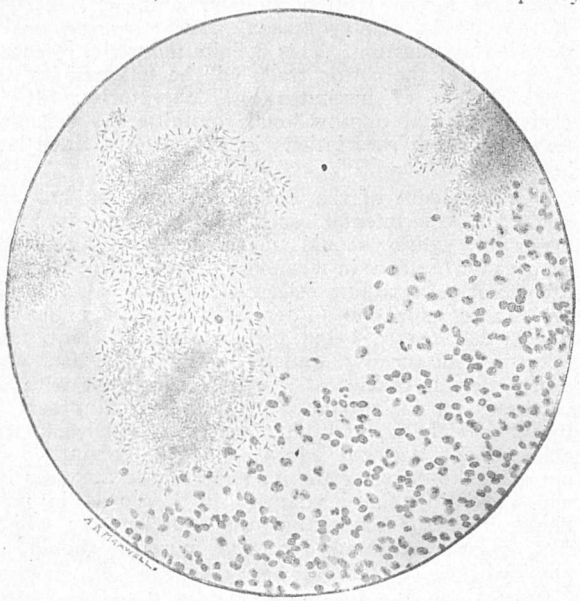

FIG. 7.—Leucocytic emigration restrained by excess of streptococcic infection.

thickly in the blood. You see here that emigration is entirely arrested. If that were to happen in infected tissues it would mean that the organism was there giving up the combat against the microbes.

In Fig. 8 we have again streptococcus implanted into the blood, but this time it is a much more sparing implantation. And here, as you see, the leucocytes are carrying out a raid against the microbes, each leucocyte ingesting and filling itself full with microbes.

In Fig. 9 I show you what happens when we make into the blood a very heavy implantation of the gangrene bacillus. Here in the neighbourhood of the leucocytic

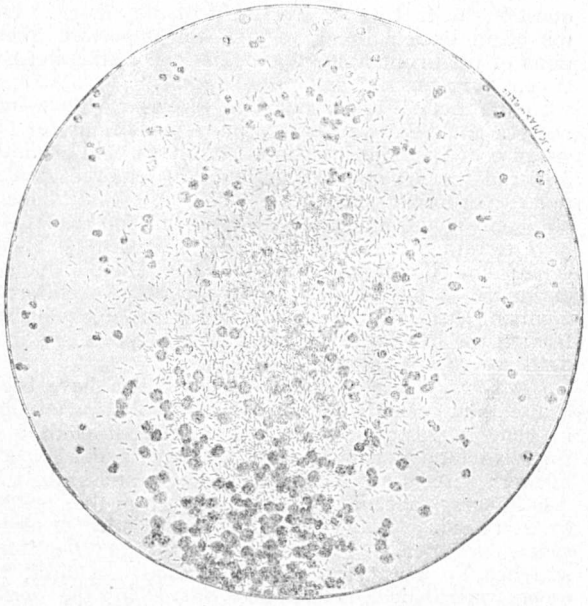

FIG. 8.—Leucocytes emigrating and attacking a colony of streptococci.

layer things are for the moment going well with the leucocytes, for they are actively phagocyting. But farther away from that layer there are very numerous colonies of the gangrene bacillus, which are growing unimpeded. The omens are consequently unfavourable. You can see in your mind's eye what is going to

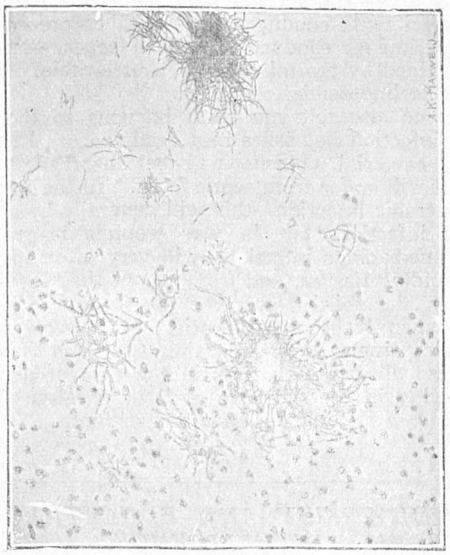

FIG. 9.—Leucocytes emigrating and attacking colonies of the gas gangrene bacillus.

happen. In the first place, all further emigration of leucocytes is going to be arrested; and, in the second, the leucocytes which have already emigrated and ingested microbes will, instead of successfully digesting them, be gradually poisoned by bacterial toxins. And when the leucocytes are killed, their

digestive ferment—trypsin—passes out into the serum. By that, the serum will, as we have seen, be converted into a medium in which microbes can grow and pullulate.

DISTINCTION BETWEEN "LIVE" AND "DEAD" SPACES.

But we must now come back from these general questions to that of the treatment of the wound. Let me begin by explaining to you—for important questions of treatment hinge upon this—the distinction between "*live spaces*" and "*dead spaces*."

In the lacunæ of vascularised tissues we have *live spaces*. In these we have optimum conditions for resistance to bacterial infection. We have here an antibacterial lymph; and by continuously renewed exudation corruptive changes will be continuously antagonised and made good. Again, in live spaces we have terrain that can be effectively searched by leucocytes; and if the bacterial infection should not be extinguished by the first leucocytic attack reinforcements of leucocytes can be supplied from the capillaries feeding the live spaces. In all these respects live and dead spaces are sharply contrasted.

Dead spaces are found in tissues which have been bruised and cut off from their blood-supply, in sloughs, in bone sequestra, and in the texture of cloth and intrusive foreign bodies. And we have a dead space in every abscess sac under every slough and scab, and also in every collection of pus lying open in the pockets of a wound. The essential characteristics of dead spaces are two. First, they cannot be effectively searched by leucocytes. In some cases chemical, in others mechanical, conditions stand in the way. Secondly, the leucocytes which are engaged cannot be reinforced, nor can the fluid be renewed. Isolation from the circulation makes this impossible.

Let me try to tell you in the fewest possible words what this imports in infection. If in an infected live space the scale turns in favour of the microbes, there is still a chance of the balance being redressed. At any rate, reinforcements can be brought up. In infected dead spaces—and let me here point out to you that all experiments conducted in test-tubes are equivalent to experiments conducted in dead spaces—an advantage gained by the microbes is irretrievable. Counter-attack is impossible.

Let me also tell you what happens to the patient when infection flourishes in a dead space. In the first place, bacterial poisons will be absorbed, and the patient will suffer from septic fever. In the next place, the microbic infection—this will generally be a streptococcic infection, but in war wounds it may be a gangrene-bacillus infection—will very often invade the surrounding tissues, and from thence the blood-stream. And in the third place, the pus in the dead space will, when it becomes tryptic, eat its way into the enclosing tissues. The containing sac will then extend in every direction, the pus in the case of an abscess burrowing in the direction of least resistance until it opens upon an inner or an outer surface.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—By the death of Arthur Cornwallis Madan, senior student of Christ Church, the University loses one who was not only an accomplished scholar in the usual sense, but also perhaps the chief living authority on the native languages of Central Africa. His work in connection with the Universities' Mission was carried on for many years both at Zanzibar and in the tropical interior, and resulted in the accumulation and arrangement of a large mass of valuable material, both philological and grammatical. Mr. Madan was the son of a Canon of Gloucester; one of his brothers is the learned and energetic Librarian of the Bodleian, and another (the late H. G. Madan), a fellow of Queen's, was for many years science master at Eton, and was well known as joint author with Mr. A. G. Vernon Harcourt, F.R.S., of an excellent manual of practical chemistry.

The Clothworkers' Company has undertaken to provide an addition to the University laboratories in the department of human anatomy, which will supply a dissecting-room for the use of women students. A woman assistant demonstrator will be appointed to teach under the general direction of the professor of human anatomy. It is hoped that the building will be available for use in October next.

THE sum of 1000*l.* has been bequeathed to the American Association for the Advancement of Science by Mr. W. H. Stephens, of Lowville, New York.

COLUMBIA University has received the sum of 10,000*l.* from Mr. G. W. Brackenridge, of San Antonio, Texas, which will make possible the opening of the doors of the university this autumn to women students.

AN educational campaign against tuberculosis throughout the Army at home and abroad has been undertaken by the National Council of the Y.M.C.A. The campaign will be conducted by means of information imparted in the huts of the association. Dr. H. Sutherland will inaugurate the work by giving an address on "Consumption: Its Causes and Cure," at the Central Institute of the Y.M.C.A., Tottenham Court Road, on Tuesday, September 4, at 7.30 p.m.

THE Tootal Broadhurst Lee Company has decided to set aside 10,000*l.* a year for five years for the promotion of research and education. According to the *Times* the provisional committee on research and education for the cotton industry will, at the close of the current holiday season, issue a prospectus of the new organisation. This definite industrial research federation of the cotton trade will be followed by the establishment of institutes and laboratories. It is also stated that a provisional committee to organise textile research associations in the woollen trade has been formed.

THE President of the Board of Education has appointed a departmental committee to inquire into the principles which should determine the fixing of salaries for teachers in secondary and technical schools, schools of art, training colleges, and other institutions for higher education (other than university institutions), due regard being had to such differentiation in respect of locality, duties, qualifications, sex, and other relevant considerations as is consistent with or necessary for the organisation of the teaching service throughout the country on a system conducive to the efficiency of national education. The committee is not asked to consider the question of the amounts by which existing salaries should be improved in particular areas or schools, or the sources from which the amounts required for that purpose should be provided.

WE have received from the British Esperanto Association, 17 Hart Street, W.C.1, an interesting pamphlet by Mr. Bernard Long, entitled "Esperanto and Why We Need It." Mr. Long considers that whatever relations may become necessary or desirable with our present enemies after the war, it would be better to use a neutral language, whenever possible, than to accentuate existing differences by employing any of the national tongues, with their attendant "atmosphere"

and associations. He strongly recommends Esperanto as a neutral language for this purpose, remarking that it is already well known both in Germany and in Austria-Hungary. Moreover, classes for Esperanto have been formed in many internment camps among both civilian and military prisoners. The knowledge of this auxiliary language has enabled prisoners of different nationalities to converse together. It is, indeed, to be expected that prisoners in a foreign country should keenly realise the advantages of a language common to themselves and their gaolers.

THE fourth annual meeting of the conference on New Ideals in Education was held, August 14 to 21, at Bedford College, London, under the presidency of the Earl of Lytton, and was, like its predecessors, largely attended by persons representative of a wide range of educational interests, lay and professional. The main subject of debate was the problems presented by the system of universal continuation schools now under the consideration of Parliament. The discussion was opened by the President of the Board of Education himself, who spoke of the continuation schools as a potential great "University of England," the best and most durable national memorial of the war, and invited missionary effort to commend the principles of his present Bill to popular opinion, and to secure its smooth working if it should be passed. In the subsequent sessions the conference considered the special problems that confront the urban and rural continuation schools respectively. With regard to the former, it was agreed that the main difficulty lies in the treatment of boys and girls condemned to monotonous unskilled labour, and that, in dealing with this great section of our juvenile population, educational cannot be separated from social and industrial reform.

THE report of the committee appointed by the North-East Coast Institution of Engineers and Shipbuilders upon the education of apprentices has now been issued, and has been accepted generally by the other engineering and shipbuilding associations in the north-east district. The scheme in brief provides for elementary education up to twelve and a half years of age approximately, followed by three years' full time at a junior technical school. The bulk of the boys (*a*) then proceed to ordinary apprenticeship with two or three half-days per week at continuation classes up to eighteen years of age; the best (*b*) are to spend half-time per week in the works and the other half in the technical college up to the same age. Group (*a*) then proceeds to ordinary apprenticeship with optional evening classes. Group (*b*) is divided again at eighteen years of age, the majority proceeding to ordinary apprenticeship with optional evening classes, while those of special quality proceed to the full applied science degree course leading to the B.Sc. in engineering or naval architecture. The details of the scheme comprise many interesting features. Junior day technical schools should be regarded as a distinct type of higher school, in no sense inferior to a secondary school; this point is to be urged upon the Board of Education by a deputation representing the Institution. An advisory committee is to be appointed to be associated with the management of the schools in a consultative capacity. Youths passing out of these schools are to have preferential treatment in the matter of appointment to apprenticeship. The latter point is of great importance, and if adopted throughout the country will be instrumental in the suppression of the premium system, and also of the method which some firms adopt of taking as apprentices without premium those lads only who are sons of employees, irrespective of their previous training. The scheme is excellent on the whole, and will provide facilities for any intelligent lad possessing grit to rise to the top of the educational ladder and to qualify for the highest posts no matter how lowly he may start. There is just one point open to criticism. The best lads who are selected for university courses will be handicapped at matriculation if no foreign language is taught prior to the age of sixteen. It would be well to include, say, two hours per week in the junior technical school curriculum; this would have the effect of bringing the products of these schools into line with secondary-school boys starting apprenticeship at sixteen. The report is well worth studying by all interested in education.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 30.—M. Paul Appell in the chair.—The president announced the death of M. F. C. Grand'Eury, correspondant of the section of botany.—G. **Bigourdan**: The propagation of the sound-wave produced by gun-fire to great distances. Direct determinations of the velocity of sound in the air could be made to-day over distances nearly ten times those utilised in the earlier experiments made between 1736 and 1822.—H. **Le Chatelier**: The tempering of steel. Summarising recent researches by Portevin, Chevenard, and Dejean, the author concludes that, starting with the eutectoid with 0·8 per cent. carbon, initial state austenite, the final state may be perlite with slow cooling, troostite, martensite, or austenite being the final products as the rate of cooling is increased. The last case can only be practically realised in the presence of 2 per cent. of manganese or a slightly higher proportion of nickel.—M. **Balland**: The alterations of biscuit bread. The flour used is the same as that of which ordinary bread is made, but it is baked in a cooler oven for a longer time. It has a thicker crust, highly resistant to the action of external influences, and keeps good for from fifteen to twenty days.—A. **Nodon**: Observations on the eclipse of the moon of July 4, 1917. The observations were made at Bordeaux under good atmospheric conditions, and the results appear to indicate a luminosity due to the surface of the moon.—E. **Belot**: The physical and ballistic history of the lunar volcanoes.—M. **Portevin**: The carburation of iron by alkaline cyanides and cyanates. At temperatures of 750° C. and 900° C. the addition of a proportion of cyanate to potassium cyanide results in a considerable increase in the amount of carbon taken up by the iron.—P. **Dejean**: The formation of troostite and martensite.—A. **Colani**: The action of metaphosphoric acid upon the oxides of molybdenum. At a red heat metaphosphoric acid acts upon MoO_3, giving a slight reduction and evolution of oxygen.—H. **Travers**: The rapid estimation of manganese and chromium in metallurgical products. The method is based on oxidation with ammonium persulphate and subsequent titration with sodium arsenite and is applicable to certain chrome steels.—L. **Vialleton**: Ontogenic relations of the pelvic and thoracic bands in the tetrapod vertebrates.—A. **Lécaillon**: The signification of the colour-changes normally produced in certain non-impregnated eggs of *Bombyx mori* and the formation, in this species, of true caterpillars of parthenogenetic origin.—H. **Colin**: The antiseptic properties of nitrous fumes. In the absence of oxygen, nitric oxide is devoid of antiseptic properties. The contrary results obtained by Priestley were due to nitric acid produced by the simultaneous presence of air and water.—P. **Portier**: Researches on symbiotic micro-organisms in the animal series.—MM. **Weinburg** and P. **Séquin**: Serotherapy of gas gangrene in man. An account of the favourable results obtained by a mixed serum.—P. **Armand-Delille**: Remarks on the parasitological aspects of malaria contracted in Macedonia.

August 6.—M. Paul Appell in the chair.—A. **Lacroix**: The granulated rocks of a leucitic magma studied with the aid of the holocrystalline blocks of the Somma.—G. **Humbert**: The continued fraction of Stephen Smith.—H. **Le Chatelier** and B. **Bogitch**: The refractory properties of silica. Work supplementary to results published in an earlier paper (*C.R.*, 1917, p. 64). A brick made from refractory clay, crushed at a temperature of 1500° C., flattened and showed rounded edges, whilst, with silica, the first action of the pressure produced no appreciable effect. On breaking the test piece by increasing the pressure, the pieces corresponded in shape with those normally observed with hard materials. Good silica bricks contain between 3 per cent. and 5 per cent. of basic oxides, and the weight of sulphates obtained after attack by hydrofluoric and sulphuric acids is between 8 per cent. and 14 per cent. Results are given of the resistance to crushing after one hour at 1600° C. of a number of good commercial silica bricks.—P. **Sabatier** and G. **Gaudion**: A new case of reversible catalysis: direct formation of nitriles starting from amines of the same carbon chain. Benzylamine passed in the state of vapour over reduced nickel at 300° C. to 350° C. is converted into benzonitrile, toluene, and ammonia, one-third of the amine being converted into the nitrile. *iso*Amylamine behaves similarly.—H. **Hildebrandson**: Some remarks on the possible influence of violent cannonades on rainfall.—J. **Guillaume**: Observations of the sun, made at the Observatory of Lyons, during the first quarter of 1917. Observations were made on sixty-four days, and are grouped in tables giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A. **Colani**: Study of the system: water, uranyl oxalate, ammonium oxalate.—E. **Rengade**: The purification of salts by *clairçage* or by fractional crystallisation. The word *clairçage* is applied to the displacement, by means of water or an appropriate solvent, of the impure mother liquor impregnating the crystals. The case of ammonium nitrate mixed with a small proportion of sodium chloride is discussed in detail, the reactions being followed microscopically.—A. **Cochain**: The existence of an approximate centre of symmetry in the figure formed by the directing lines of the Alpine system. The tectonic interpretation of this quasi-symmetry.—J. **Deprat**: The frontal zone of the preyunnanaise sheets in the regions of Bao-lac and Cao-bang.—J. **Amar**: The physiopathology of *effort*. *Effort* is defined as a maximum muscular action generally sustained, sometimes instantaneous. The present paper deals with the relations between respiration and effort both in the normal and pathological states.—O. **Bailly**: Does the law of mass-action govern diastatic reactions? Earlier work has been in the direction of measuring the reaction-velocities of diastatic reactions: the author gives reasons for preferring to study the final equilibrium state, and for this it is necessary to choose reversible diastatic reactions carried out in homogeneous media. The case chosen is the synthesis and hydrolysis of β-methylglucoside, making use of the experimental data of Em. Bourquelot and Em. Verdon, and here the experimental values and those calculated from the law of mass-action are in good agreement.

CAPE TOWN.

Royal Society of South Africa, June 20.—Dr. L. Péringuey, president, in the chair.—H. V. **Exner**: A case of hermaphroditism. A description of the body of a person of unsound mind who had the outward appearance of a Kaffir girl.—I. B. Pole **Evans**: The genus Terfezia. A truffle from the Kalahari. Chœromyces, a truffle hitherto unknown to Africa, has recently been reported from South Africa. It was pointed out that the best known South African truffles belong to the genus Terfezia. The distinction between Chœromyces and Terfezia was indicated, and a description given of a truffle (*T. Claveryi*, Chat.) recently sent from the Griqualand West district in the Kalahari.

BOOKS RECEIVED.

The Theory and Use of Indicators: An Account of the Chemical Equilibria of Acids, Alkalies, and Indicators in Aqueous Solution, with Applications. By Dr. E. B. R. Prideaux. Pp. vii+375. (London: Constable and Co, Ltd.) 12*s.* 6*d.* net.

Bureau International des Poids et Mesures. La Mesure Rapide des Bases Géodésiques. By J. R. Benoît and C. E. Guillaume. Cinquième édition. Pp. 283. (Paris: Gauthier-Villars et Cie.)

The Thyroid Gland in Health and Disease. By Dr. McCarrison. Pp. xvii+286. (London: Baillière, Tindall, and Cox.) 12*s.* 6*d.* net.

Stanford's Half-inch Map of the Battle Front: Ostend, Zeebrugge, Bruges. (London: E. Stanford, Ltd.) 2*s.* 6*d.*

Laws of Physical Science. By Dr. E. F. Northrup. Pp. vii+210. (Philadelphia and London: J. B. Lippincott, Ltd.) 8*s.* 6*d.* net.

Standard Method of Testing Juvenile Mentality by the Binet-Simon Scale. By N. J. Melville. Pp. xi+142. (Philadelphia and London: J. B. Lippincott, Ltd.) 8*s.* 6*d.* net.

Standard Methods of Chemical Analysis. By W. W. Scott and others. Pp. xxxi+864+plates iii. (New York: D. Van Nostrand Co.; London: Crosby Lockwood and Son.) 30*s.* net.

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