THURSDAY, OCTOBER 18, 1906.

FLORAL BIOLOGY.

Handbook of Flower Pollination based upon Hermann Müller's work "The Fertilisation of Flowers by Insects." By Dr. Paul Knuth. Translated by J. R. Ainsworth Davis, M.A. Vol. i. Introduction and Literature. Pp. xix+382; illustrated. (Oxford: At the Clarendon Press, 1906.) Price 18*s.* net.

THE Clarendon Press is to be congratulated on the appearance of the first volume of what is a serious undertaking—the translation of a German book in five volumes and nearly 3000 pages.

Hermann Müller's book "Die Befruchtung der Blumen" appeared thirty-three years ago, and D'Arcy Thompson's translation, published in 1883, has long been out of print. English readers will therefore welcome the present work, incorporating as it does the great mass of research on floral biology which has been carried out in recent years.

The book appears under favourable conditions, since the author—a recognised authority on the subject—has been able to come to an arrangement with H. Müller's representatives by which he is allowed to make use of all that naturalist's writings and admirable illustrations.

The chief feature in which it differs from Müller's books is the prominence given to the statistical method of studying the visits of insects. This subject has received especial attention of late from MacLeod, Verhoeff, Loew, Willis, Burkill, and others. It was a department of study to which the author devoted much time, and in consequence his book contains perhaps more on this subject than most readers require.

It is, as Prof. Balfour says in his preface, an encyclopædic work, and it has some of the defects of its qualities. It is admirable as a book of reference, and will be of great value to anyone desirous of extending his knowledge of the subject; but we confess to missing what we expect in the introductory volume of a handbook, namely, a broad treatment of the subject such as is needed to introduce a student to a detailed account of flower-pollination. There is no effective discussion of what lies at the root of the whole science of floral biology, namely, that fertilisation at any price is the primary necessity, while cross-fertilisation is a secondary need. From this standpoint the arrangements of the sexes in plants become comprehensible as compromises between the extreme cases of cleistogamy and diœciousness. In one case fertilisation is assured, while cross-fertilisation is impossible; in the other fertilisation is not a certainty, but if it occurs it implies of necessity a cross between two individuals. Nor, again, is the point of geitonogamy made clear, namely, that if pollen is brought from a separate flower there is at least a chance that it may come from another plant.

In referring to Darwin's "Cross- and Self-Fertilisation," Knuth speaks of the paucity of the experiments on crosses between flowers on the same plant, but he neglects to mention what Darwin thought the chief outcome of his work—the fact that crosses between individuals grown under identical conditions fail to give vigour to the offspring; and this is a result that includes the effect of crosses between flowers on the same plant.

The need of a more generalised introduction to floral biology was not so obvious to us in reading Knuth's book in German, but those who read it as an English text-book, presumably intended for university students, and who know the standard of knowledge which such readers bring to the study, will probably form a similar opinion.

In the pages devoted to the history of the subject a full account is given of the various ways of classifying flowers from a biological point of view. Here we find Hildebrand's and Axell's systems, of which the second is not generally accessible to English readers, being written in Swedish. Here, too, is Delpino's interesting arrangement of typical floral mechanisms into classes. Thus class iii., made up of flowers which are visited by insects crawling into the tubular corolla, contains the types named after the genera Datura, Digitalis, Campanula, &c. In class vii. we find one of the instances of the awkward translations which occur here and there in the English edition. The mechanism of Genista, Ulex, &c., is named by Delpino "Forma a scatto," and this is rendered by "tension form," which has none of the appropriateness of the original and does not direct attention to the explosion which is so characteristic of the type. In other cases the translator is a little too literal. What service is it to an English reader to find Hymenoptera described as membrane-winged insects, or Diptera as two-winged?

Under the heading "Autogamy" a list is given of all known instances of self-sterility; this, together with the corresponding lists of heterostyled and cleistogamic plants, forms a useful feature in the book. Again, in relation to cleistogamy, we are glad to see a refutation of some of the supposed instances of perpetual and unavoidable self-fertilisation, such as the case of *Juncus bufonius* and of *Salvia cleistogama*.

A good deal of space is given to the various classifications of flowers according to their mode of fertilisation and the type of insect visitors. The best-known system is that of H. Müller, who divided them into flowers visited for pollen only, flowers with exposed nectar, with concealed nectar, those adapted to the visits of bees, Lepidoptera, &c. These classes are known by the symbols Po, A, B, H, F, &c. Knuth propounded a more elaborate classification for which he had good reasons; but why the translator has altered the symbols so as to suggest the English equivalents of the class-names we cannot understand. Thus, instead of keeping Kl for "small-insect flowers," he gives Sm as the symbol. This, except on general principles, is no great matter; but when

we find the familiar F which stood for lepidopterid flowers applied to those fitted to the visits of Diptera we have ground for complaint. The same is true of the introduction of new symbols for the well-known A, AB, and B. Surely English standards are sufficiently different from those in use on the Continent without our needlessly multiplying instances.

The discussion which follows on the different classes of flowers forms one of the most interesting parts of the volume. Thus we get Knuth's curious observations on the proportion of anemophilous plants on the wind-beaten Halligen Islands in the North Sea, where they form 47 per cent. of the flora, whereas on the mainland the percentage is 21·5—a case which may remind us of the wingless insects of Madeira. Then, again, we have details of flowers fertilised by bats, birds, slugs, and snails which we think are here put together for the first time in English. There is also a discussion of some interest on flowers which to our eyes are inconspicuous, but which nevertheless attract many visitors. Further on is a good account of the well-known methods of fertilisation in the yucca and the fig.

Under pollen flowers, *i.e.* those visited for the sake of their pollen, the author makes what seems to us an unnecessary blot in his system of classification. Thus *Sarothamnus scoparius*, *Genista tinctoria*, &c., though devoid of nectar and visited solely for pollen, "are not regarded as pollen-flowers but as well marked bee-flowers." Even here he is not consistent, since *Cassia chamaecrista* and *Solanum rostratum* are described as pollen flowers, though they too are adapted for bees.

H. Müller's important work on the specialisation of insects in relation to flowers is fully given, and this is a subject often neglected for the converse instances of floral adaptations. Here too is an interesting account of differences in habits according as the visitors are of the social or solitary bees. The social class, having to work hard for a living, is forced to visit flowers which the luxurious solitary bee neglects. Near the end of the book is a good account of the statistical method of treating the visits of insects, as illustrated chiefly from MacLeod's researches. The volume concludes with a valuable bibliography comprising 3748 entries, and occupying 160 pages.

The translator has done his work well on the whole. We must, however, direct attention to a few instances of faulty rendering. Thus "Blumenblätter" is translated by "floral leaves," "Saft" (nectar) by "sap." But the few slips in translation that occur are not serious; we have no objection to H. Müller being described as a "genial" author (p. 25), or to the incorrect statement that Darwin inherited his house at Down (p. 8*n*), except that they are due to the translator, not to the author.

But these are trifles in comparison to the fact that his English is thoroughly readable, and this is a standard by no means easy of attainment in translating from German.

F. D.

SINGLE-PHASE COMMUTATOR MOTORS.

Single-phase Commutator Motors. By F. Punga. Translated from the German by R. F. Looser. Pp. xvi+187. (London: Whittaker and Co., 1906.) Price 4*s.* 6*d.* net.

RECENT advances in the application of single-phase alternating currents to electric traction have given rise to a large volume of literature dealing chiefly with the motors employed. The possibility of working direct-current motors with alternating currents is by no means new, but it is only within the last few years that the principles of good design have become sufficiently well known to enable such working to be made a commercial success.

It was perhaps inevitable that a large part of the literature devoted to this subject should be somewhat academic; in any new departure of this kind the experimental work which forms the basis of progress is in the hands of manufacturers, to whose interest it is that the information so obtained should not be made public. It is, therefore, all the more interesting to examine a book which is evidently written for the practical man. In such a book circle diagrams should occupy a subordinate position, and attention should be directed to the question of proportions that may be assumed in practice.

The course adopted in this book is to set out as clearly as possible what may be called the practical theory of the motors, and to follow this up by applications of the theory to the design of actual examples. This is no doubt the right course, for however valuable a knowledge of the fundamental theory may be, there are many points of equal importance which can only be brought out in the calculation of an actual motor.

The setting out of the theory of single-phase commutator motors has been made very clear, and although circle diagrams are referred to, the author states very truly that they are of little practical value, and that it is better to calculate the current for a few points from first principles. Particular attention has been paid to the question of sparking, and its dependence on the "transformer voltage," the "reactance voltage," and the "rotation voltage" in the coils short-circuited by the brushes. The effect the transformer voltage has on the general design is also clearly explained, but hardly sufficient reference is made to the magnetising action of the circulating current produced.

Turning now to the calculation of typical motors, a series motor of 60 h.p. is worked out, and also a repulsion motor of 48 h.p. It is unfortunate that practically no indication is given as to how these motors are rated. At present, single-phase commutator motors are inevitably associated with traction work, in which it is customary to speak of the one-hour rating. Supposing this to be the intention of the author, it must be confessed that the size of the motors is rather large for their output, chiefly on account of the low speed chosen. Another objection, which is perhaps more serious, is that the windings have been made

suitable for very low voltages in the armatures. For instance, the input of the 60 h.p. motor is about 620 amperes at 100 volts. This choice of voltage no doubt greatly facilitates the design from the point of view of a low transformer voltage, but such a choice would be almost impossible for traction work, owing to size of the controlling gear. At this voltage the current required by four 100 h.p. motors in parallel would be approximately 4000 amperes; and even, if connected two series two parallel, the control of 2000 amperes would involve very heavy cables and switches.

If, on the other hand, a higher voltage had been chosen, a higher value of the transformer voltage would have resulted; but this is precisely the difficulty which has to be met in practice. For railway work, voltages less than 220 are practically unknown.

The book concludes with two appendices, the first of which deals with the theory of the repulsion motor, taking account of magnetic saturation, and the shifting of the brushes; and the second gives some oscillograph tests dealing with the commutation of a small motor operating with alternating currents.

Mr. R. F. Looser, in translating this book from the German, has accomplished his task with excellent results.

VOLCANIC HISTORY OF AUVERGNE.

L'Age des derniers Volcans de la France. By Marcellin Boule. *La Géographie* (Mars, Mai, 1906.) Pp. 64; illustrated. (Paris: Masson et Cie.)

THE volcanic outbursts of Auvergne are to a certain extent disconnected locally and different in age. The western group is the more linear in arrangement, the eastern the more sporadic. In the one, the broad mass of the Cantal sends off a short spur—Aubrac—to the south-east, and a long one to the north, which extends through the famous Mont Dore district and terminates in the chain of Puys west of Clermont-Ferrand; in the other group we have the noted chain of the Velay and the outlier of Mezenc, Megal, and Coirons. The eruptions, apparently, were the latest to begin in the first of these districts, and the latest to cease in the region of the northern Puys. The tuffs and other sedimentary deposits, which are associated with the lava flows and masses of coarser scoria, have furnished palæontological data which fix the age of some of the volcanic outbursts, and make it possible by a comparative study of the ejecta to synchronise the discharges in different districts. The materials oscillate from basalts to andesites, with fairly abundant phonolites in two areas, and occasional rhyolites and trachytes among some of the older rocks. The earliest outbursts occurred in the Upper Miocene. Volcanic activity ceased in one of the southern extremities with the Lower Pliocene, in another with the Middle, in the Cantal itself with the Upper. It was prolonged in four districts well into the Quaternary, the date of its cessation being still far from certain.

In the neighbourhood of Le Puy, eruptions, as the discovery at Denise showed in 1844, were contemporaneous with Palæolithic man. The evidence of the Gravenoire skeleton (found in 1891) is doubtful, as it is from one or two other places, while that from Pranal, Blanzat, St. Saturnin, and Neschers is negative. There is none anywhere to show that eruptions were contemporary with Neolithic man; but an awakening, as Vesuvius once proved, is possible after a long slumber. Has this been the case in Auvergne? For that, according to some authorities, we have historical evidence. Here Prof. Boule's title and preface led us to hope for some additional information, but we have been disappointed. In fact, his discussion of the evidence is hardly so full as that which it received in the *Geological Magazine* so long ago as 1865. As was then stated, several earthquakes occurred about the year 451 A.D., and the wild deer became so terrified as to take refuge in Vienne. A third "portent" happened, but whether this was a volcanic eruption depends on the translation of certain Latin words in two letters written by bishops. If these refer to severe fires—possibly the consequences of the earthquakes—the language is extraordinarily bombastic; if to an isolated volcanic outbreak, this could not be in the "Puy" district, and there is much difficulty in locating it nearer Vienne. We do not find that the uncertainty has been diminished by Prof. Boule's researches; but, notwithstanding this disappointment, and though most of the information has been already published, we welcome as a boon to students this clearly written summary of the volcanic history of Auvergne from one who has taken such a leading part in its elucidation. T. G. BONNEY.

OUR BOOK SHELF.

The Birds of the British Islands. In twenty parts. By Charles Stonham, C.M.G. With illustrations by L. M. Medland. Part i. Pp. 40 and plates. (London: E. Grant Richards, 1906.) Price 7*s.* 6*d.* net.

To use the language of sport, Mr. Stonham may claim to have established a new record. He has aimed at a colourless book, and colourless it is, both in the plates and in the text, though whether it is "far in advance of anything of the kind which has so far been attempted" must be left to the individual judgment of the reader.

In saying this, however, we are far from implying, or wishing to imply, that the work is without merit; it gives a careful and pleasing description of the species and their habits, and shows considerable acquaintance on the author's part with most of them; but nothing strikes us as impressive, nothing as an addition to our knowledge, nothing, in short, as unlike what may be found without much trouble elsewhere.

All this may, of course, be altered when families other than the Turdidæ come under discussion, but in this part—and it is this part that we are called upon to notice—we can see no sufficient reason for the publication of the work. Nevertheless, we infinitely prefer it to many other books treating of British birds, and hope, for the author's sake, that it may meet with more success than we anticipate. We can hardly believe, however, that the considerations of fine paper, brilliant ink, and so forth, advanced in the prospectus, will outweigh those of comparative cost. 6*l.* 15*s.* is no small price for a publication of this kind with black plates, especially when it is proposed

to relegate the rare and occasional visitors—often of the utmost interest—to a future supplement, which will enhance the expense.

To the eye of an artist the plates will doubtless appeal as admirable specimens of the process employed, but to that of an ornithologist they lack the life and vigour which in many cases compensate for an absence of coloration.

Finally, we quite agree with Mr. Stonham that in many species the female and young are well worth depicting, and that it is quite useless to attempt to represent the songs of most birds by a set of syllables which each reader would in all probability mouth differently.

The Manufacture of Concrete Blocks, and their Use in Building Construction. By H. H. Rice and W. M. Torrance. Pp. 122. (London: Archibald Constable and Co., Ltd., 1906.) Price 8*s.* net.

THIS work is a reprint in full of the two prize papers on concrete block construction in connection with a competition instituted by the *Engineering News* and the *Cement Age*, and, in addition, abstracts are given of the papers of ten other competitors, which contain data not given in the prize papers.

Mr. Rice in his paper deals fully with the raw materials—cement, sand and gravel, or crushed stone; with the mixing and manufacture of the blocks; and with the important questions of curing and facing the blocks with a finer quality of the material, and he briefly discusses the principles underlying the use of this material in building construction.

Mr. Torrance deals more fully with the form of the blocks, illustrations being given of many of the moulds for which patents have been granted, and with the relative cost of buildings of concrete and other material; finally, he states that from an artistic standpoint the best success so far obtained has been where the process of casting in sand has been adopted, and several reproductions of photographs are given to illustrate this point.

The abstracts of the other ten papers give much useful information on many points of detail not dealt with by the authors of the two prize papers, with regard both to the manufacture of the blocks and also to their employment in building construction.

In an appendix are the rules and regulations governing the use of this material and the testing of the blocks in Philadelphia. There has been quite a flood of literature during the past year on reinforced concrete, but until this book appeared little had been written in reference to the use of concrete by itself for building purposes.

Elementary Electrical Calculations. By W. H. N. James and D. L. Sands. Pp. 216. (London: Longmans, Green and Co., 1905.) Price 3*s.* 6*d.* net.

THIS book is based upon a series of lectures given by the authors to first- and second-year students of electrical engineering, and can be confidently recommended to those for whom it is written. So far as it goes, it is well arranged and perfectly clear; the only criticism that can be suggested is that it does not go far enough. The range of a subject which should be studied by first- and second-year students is, however, a matter for individual teachers to settle.

It will suffice, therefore, to state that the book begins with an account of the fundamental units, proceeds to discuss Ohm's law very fully, and devotes brief chapters to power and work, conversion of energy, transmission and distribution treated quite simply, electrochemistry and photometry. Each chapter contains numerous examples fully worked out, and a large number of exercises for the student.

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.*]

Biometry and Biology: A Rejoinder.

I SHOULD like to preface my remarks on Mr. Lister's reply by relieving his mind from any anxiety about Dr. Pearl's feelings. Dr. Pearl is in America, and I cannot, of course, communicate with him, but I know him intimately, and am convinced that he is far too good a man of science to feel aggrieved by any criticism of his writings. He might well feel aggrieved that Mr. Lister supposes him desirous that his paper should remain uncriticised, because the criticism should affect his reputation. I am inclined to think that, as a fellow biometrician, he will rejoice with me that Mr. Lister's vague charge—made at a singularly unfitting moment—has been brought to a definite issue, and can be tried *coram judice*.

Had a first-year biometrical student in my laboratory sought advice from a biological freshman about the nature of *Paramaecium caudatum*, I should have anticipated that he would receive much the information with which Mr. Lister provides us. His remarks could only be made by one who (*a*) had either not studied the memoir he criticises, or had failed to perceive the significance of the constants calculated by the author, and (*b*) had never attempted accurate measurements on infusoria, or previously to such attempt been trained to that caution and accuracy in measurement which it is the function of biometry to inculcate.

I challenged Mr. Lister to substantiate the charge he made in August, when, presumably, the grounds of his insinuation at York were fresh in his mind. He then considered that Dr. Pearl's position was traversed by the objection that the conjugants individually are possibly or probably differentiated gametes.

What was the author's position? He expresses it exactly by quotations from Huxley and Romanes:—

"In my earliest criticisms of the 'Origin' I ventured to point out that its logical foundation was insecure so long as experiments in selective breeding had not produced varieties which were more or less infertile, and that insecurity remains up to the present time" (Huxley, "Life and Letters of Darwin," vol. i., p. 170).

"To state the case in the most general terms we may say that if the two basal principles are given in heredity and variability, the whole theory of organic evolution becomes neither more nor less than a theory of homogamy—that is a theory of the causes which lead to discriminate isolation, or the breeding of like with like to the exclusion of unlike" (Romanes, "Physiological Selection").

This problem of the divergence of individuals into varieties is the one selected by Dr. Pearl, and according to Mr. Lister is the best example by which he can illustrate his statement that biometricians do not select a sound biological problem "before bringing a formidable mathematical apparatus into action for its investigation." This is the "hare cooked before it was caught," to cite again Mr. Lister's phrase. Dr. Pearl shows that such homogamy exists in an extraordinarily high degree in *Paramaecium caudatum*. In other words, he has broken entirely novel ground, which, to say the least of it, renders Huxley's position no longer tenable. This is now admitted, albeit in a niggardly fashion, by Mr. Lister himself. In August he considered that Dr. Pearl's position was traversed by his omission to consider the differentiation of gametes which was possible or probable. He does not now even endeavour to show that it is traversed by this, but says that I have claimed for Dr. Pearl the *first* demonstration of the existence of this differentiation. In other words, he now admits that Dr. Pearl has fully considered the problem of differentiation. In fact, more than half Dr. Pearl's memoir is devoted to it. He further twits Dr. Pearl and myself with not distinguishing between a man and his gamete!

I turn to the last point first. I venture to think that the problem of homogamy is essentially the same in relation to both Metazoan and Protozoan, when we are considering its effect on the possible differentiation of species, and endeavouring to surmount Huxley's difficulty. Having shown myself that homogamy certainly does exist in one type of Metazoa, it was necessary that it should be shown to exist in the Protozoa, and for one type this is what Dr. Pearl has achieved.

Mr. Lister only obscures Dr. Pearl's statement as to the persistency of type in conjugant Paramæcia. Had he understood the constants dealt with by Dr. Pearl in this part of his paper he would have seen that they were what in biometry are termed *intra-racial* and not *inter-racial* values. The conclusions of Dr. Pearl have nothing to do with the inter-racial differentiation of gametes. Dr. Pearl grew Paramæcia under much variety of environment, and found that the non-conjugant type was highly correlated with the environment and the conjugant type singularly little affected by the environment. The whole inquiry was, of course, undertaken to illustrate Weismann's position, that while acquired characters are not inherited, the environment can influence inheritance where one cell is both soma and germ. In biology it has become almost axiomatic to assume that the Protozoa can inherit acquired characters on account of this identity, while in the Metazoa the acquired character of the soma is at the very least not usually inherited. Dr. Pearl brings out the all-important point that the gamete in Paramæcium is not, like the non-conjugant cell, markedly influenced by the environment. If Mr. Lister assumes that the characters *acquired* by the somatic cells are handed over to the gametic cells, this is, of course, to sweep away entirely the Weismannian hypothesis, and we may reasonably ask him for the quantitative proof of this assumption. The proof will at any rate go to the basis of the current hypothesis of "gametic purity." Mr. Lister asks for evidence of any relation between external characters in man and his gamete. The problem is not this, but the relation between the external characters in two phases of a cell which can be watched in passing from its conjugant to non-conjugant conditions, and that is an entirely different matter. Even here biometricians will shortly be prepared with an answer to the thus restated question,[1] although it has no relation whatever to Dr. Pearl's main point.

The remainder of Mr. Lister's letter would never have been written had he studied Dr. Pearl's paper or measured, as the latter has done, five or six thousand Paramæcia. The passage in Maupas was sufficiently familiar to me, and is actually referred to, together with the previous work of Hertwig, Gruber, and others on differentiation by Dr. Pearl *himself* in his paper. But the differentiation of two populations can only be *demonstrated* by an accurate quantitative investigation of the means, *variabilities, and correlations* of those populations. It may be rendered "possible or probable," as Mr. Lister held in August by a statement conveyed without detailed measurements in *seven* lines of print. In fact, Maupas says he has never found conjugants to exceed 225 μ, while Dr. Pearl, measuring immensely larger numbers, has found individuals up to 285 μ, a value considerably in excess of what was reached by the largest non-conjugant in his measurements, 275 μ. It will be clear in the face of such results that *demonstration* can only follow a study of large numbers and their proper statistical treatment.

Mr. Lister next proceeds to state that "every practical biologist knows" that specimens which have been preserved and fixed will be distorted. Will the reader credit the fact that pages of Dr. Pearl's memoir are devoted to a discussion of the methods needful to avoid distortion? Mr. Lister's statement only amounts to the confession that he himself cannot prepare undistorted specimens. The "practical biometrician" knows that the distortion can be almost entirely avoided by instantaneous killing of the Paramæcia and the avoidance of diffusion currents in changing to the higher grades of alcohol. The method of attaining these results is amply discussed by Dr. Pearl, but their application depends, as in all such matters, on long practice, on training and on technique. It is open to Mr. Lister to assert that the methods adopted by Prof. Worcester and Dr. Pearl failed in their object; it is not open to him to insinuate that they have overlooked a distortion the danger of which is obvious to the merest tyro in biology. But as he has not seen the preparations he can only defend his assertion on the ground that the measurements show marked evidences of the irregularities which would be produced by such distortion; and here we see at once the absence of thorough examination of Dr. Pearl's paper by Mr. Lister. Only *three* of the fourteen series discussed by Dr. Pearl were from *preserved* specimens. The methods employed in the other cases were *different*, but the many series were not mixed, as might be inferred from Mr. Lister's statement. Even including Dr. Simpson's measurements, made in a wholly different manner, there is striking general agreement which is absolutely inconsistent with the amount of variation which would arise in the case of largely distorted forms. As Dr. Pearl himself says, "The good agreement is something . . . which probably no biologist would have predicted before the measurements were made. One has been accustomed to think of Paramæcium as a soft-bodied creature likely to show great and altogether irregular fluctuations." He then points out that Paramæcium is less variable than Arcella, *Eupagurus prideauxi*, or *Ophiocoma nigra*, all of which organisms have a more or less firm exo-skeleton. So much for the question of the influence of distortion.

Mr. Lister next proceeds to the assertion that Paramæcium being a "slipper-shaped" (!) animal, there would be difficulty in measuring the breadth of the non-conjugant as compared with the conjugant. He would never have made this statement had he read Dr. Pearl's paper, where the relative weight of length and breadth measurements is considered at great length. The statement is further mere hypothesis, and not the experience of one who has learnt to measure Paramæcia. *The difficulty of measuring the breadth lies with the conjugating individuals and not with the non-conjugating individuals*, for reasons amply set forth by Dr. Pearl. In the next place, Dr. Pearl's main argument is drawn, not from the breadth, but from the length measurements, and, lastly, had Mr. Lister followed the significance of biometric constants he would at once have seen that his hypothesis was invalid. If the measurement of the breadth were affected by a large source of error due to diversity of aspect when the Paramæcium is measured after death, there would be little or no *organic* correlation between length and breadth. Dr. Pearl shows that the actual correlation is markedly higher for the non-conjugants than for the conjugants, and is of an intensity which we might reasonably expect from previous investigations of similar organic correlations.

Lastly, Mr. Lister proceeds gravely to inform us of another source of error which he supposes to exist. He says that Dr. Pearl's non-conjugant population consists of heterogeneous material, in which the variability would be increased by the fact that it contained all stages of individuals in process of differentiation into gametes. It seems astonishing to have to state it, but as a matter of fact no less than six control series of Paramæcia, in which no conjugation at all took place, and which each numbered 500 individuals, are dealt with by Dr. Pearl in his paper and compared with the series of conjugant Paramæcia. The comparison between conjugants in a preparation and the nearest non-conjugants was made primarily to ascertain whether the cultures were in any state of *local* heterogeneity, so that a spurious correlation between conjugants would necessarily arise from their being drawn from the same part of the culture. It was precisely of the nature of the test used by Prof. Weldon and myself to ascertain if *locality* influenced the value found for assortative mating in man.

Further, the slightest examination of Dr. Pearl's diagrams would have shown Mr. Lister that the so-called non-conjugant population is widely separated in distribution

[1] I will venture on a prophecy, rash as it may seem, but based upon a general experience of cell division where the mother and daughter cells have not been measured under like phases, that the correlation will not be found to be less than 0·5 or more than 0·7.

from the conjugant, and only in the first days of the conjugating fit is there an approach to a very slight secondary mode at the conjugating type value. This may correspond in the first days to a very small percentage of individuals in a "conjugating mood" among the non-conjugants. The skewness, however, as measured by Dr. Pearl's numbers, although slight, is the *other* way, showing that the non-conjugant population might best be conceived as a distribution *wanting* a portion about the conjugant type, and not as a population with an addition on that side, as it must be in the case of a mixture of non-conjugants and potential conjugants. Taking the variability of (*a*) all populations in which there were no conjugants, (*b*) populations of non-conjugants in which conjugants appear, and (*c*) populations entirely consisting of conjugants, we have the three numbers 8·7, 8·6, and 7·9, which suffice to show that non-conjugants in a conjugating population are practically identical in variability with non-conjugants in a non-conjugating population, *i.e.* the potential conjugate is a very small proportion of the population, conjugation taking place rapidly after the conjugating phase is reached.

I am sorry to have to reply to Mr. Lister in this fashion. I fear, to use his own phrase, he will still "go away unedified" from "the biometric side of the church." But the time has come when vague insinuations based on no complete study of biometry must be replaced by some attempt to understand before criticism is passed. Above all, in a case like the present, a total disregard of the contents of Dr. Pearl's memoir and a suggestion that he has made errors and overlooked difficulties, which he has actually dealt with at every turn, is not to the credit of the critic. A man who has spent years in studying Paramæcia, and made thousands of measurements after much consideration of the difficulties, may reasonably expect a different type of criticism from another who clearly has attempted no such series of measurements, and whose authority for *ex cathedra* utterances may therefore be well called into question. Dr. Pearl's full paper is now in type, and I do not think his reputation will suffer when the paper is tested against the *a priori* criticisms which Mr. Lister has passed upon it. KARL PEARSON.

Biometric Laboratory, University College, London, October 12.

Radium and Geology.

IN NATURE of October 11 (p. 585) two letters appear on this subject, in reply to which a few words may perhaps usefully be said. Mr. Fisher's principal point is that if the earth's internal heat is maintained by radium, there is no room left for that shrinkage of the globe by cooling which some geological theories require. I think that the difficulty is only apparent. The duration of radium, it is generally agreed, is limited to a few thousand years. The supply must be in some way maintained, or there could be no radium on the earth now. Writers on radio-activity are generally agreed that the radium supply is kept up by the spontaneous change of uranium into radium.

Since radium is found in ordinary rocks, we must, on the received theory, suppose that uranium also exists in these rocks. It may be objected that uranium is never entered as one of the constituents found by chemical analysis. But, since the quantity to be expected is only of the order of 1/1000th of 1 per cent., this is not surprising. It might be possible, by very special methods, to detect uranium in granite, but I think in any case we may feel confident that it is there.

Everything depends on this initial supply of uranium. It gradually passes into radium, and, after that, into some inert form. The supply of uranium cannot last for ever. Its gradual diminution must involve the cooling and shrinkage of the globe.

It may perhaps be thought in these circumstances illegitimate to equate the escape of heat per second from the earth to the supply generated by radium in that time. There is reason, however, to feel pretty sure that thermal equilibrium is practically established in a time small in comparison with the duration of uranium, so that the rate of change in the amount of the latter can have no appreciable influence on the distribution of temperature in the globe at any moment.

Mr. Palmer suggests that if the earth's internal heat is due to radium, the moon ought to be internally hot too, and its volcanoes should be active. I discussed the question of the moon's internal heat in my first paper (Proc. Roy. Soc., A, vol. lxxvii., p. 472). I quote from that paper:—"It has generally been supposed that the lunar volcanoes are extinct. But that view seems to rest chiefly on an *a priori* conviction that the moon has no internal heat. As Prof. W. H. Pickering has pointed out, all those observers who have made a special study of the moon have believed in the reality of changes occurring there."

Even if there were good reason to be sure that the lunar volcanoes were extinct, that would still be inconclusive. For it is believed by many geologists that volcanic action is due to the penetration of surface water to the hot interior of the globe. Thus volcanic inertness may be due, not to the absence of internal heat, but to the absence of surface water. R. J. STRUTT.

The Rusting of Iron.

IN my remarks on "The Rusting of Iron," published in NATURE of September 27, I directed attention to the fact that pure hydrogen peroxide solution was rapidly decomposed by cast-iron, the latter becoming covered with rust. This, I stated, "was, no doubt, due to catalytic action."

In his friendly criticism of my remarks, Dr. Gerald T. Moody writes, in NATURE of October 4, "that the metal becomes covered with rust in a few minutes, is not, however, to be referred to catalytic action, as Mr. Friend suggests, but is a consequence of the formation of acids by the oxidation of some of the impurities present in the iron, and of the subsequent electrolytic action."

That acids are formed in the above manner may be regarded as certain. These attack the iron, forming minute quantities of salts, which are decomposed by the oxygen of the peroxide, yielding rust, and liberating the acid, which can now attack more iron. In this way a small quantity of acid may be instrumental in oxidising a large quantity of iron. In other words, the acid is a catalyser, and the reaction is analogous to the rusting of pure iron in the presence of carbonic acid, oxygen, and water. The particular acid or acids which will cause this catalytic action must depend, of course, on the sample of iron used.

For the same reason "the intensity of action will be determined by the amount of acid formed on the surface of each particular sample of metal, when in contact with the peroxide." It is thus unnecessary to assume an electrolytic action, as Dr. Moody suggests. This is supported by the fact that the same result may be obtained by employing pure iron, and commercial hydrogen peroxide, which invariably contains hydrochloric acid and other impurities, as Dr. Moody has himself pointed out.

Würzburg, October 9. J. NEWTON FRIEND.

Optical Illusions.

IN your issue for September 27 a description of some optical illusions furnished by revolving fans recalled to my mind a very powerful illusion which I noticed some time ago, but for which I have not been able to furnish a satisfactory explanation.

A thaumatrope card (*i.e.* a card having a cage pictured on its one side and a bird on its other side) was mounted so as to turn round a vertical median axis at a speed of about two revolutions a second.

When an observer, viewing the rotating card from a distance of 5 feet or more, shuts one of his eyes, the card appears instantly to reverse its direction of rotation. (At the same time the axis of rotation appears to tilt a little away from the vertical.) On reopening the closed eye the illusion vanishes, and the card again appears to assume its true direction of rotation.

I showed the illusion to several friends, who all agreed as to its striking perfection. DOUGLAS CARNEGIE.

Newcastle-on-Tyne, October 10.

ETHNOLOGY OF SOUTHERN INDIA.[1]

THIS book is a reproduction, with some additions and quotations from published materials, of the useful bulletins which the author, as curator of the Madras Museum and director of the Provincial Ethnographical Survey, has issued during recent years. The arrangement of the book might be much improved; full references to the authorities should have been given, while a bibliography would assist the student in investigating a mass of unfamiliar literature. Even as it stands, the volume, with its useful collection of photographs, supplies much interesting material. The greater part of it is devoted to notes on marriage and death customs, and to a miscellaneous group of notes on omens, charms, magic, and the like. It is, as Mr. Thurston calls it, "a farrago," with which we can only deal by gleaning some of the interesting facts which abound in its pages.

FIG. 1.—Sorcery Figure. From "Ethnographic Notes in Southern India," by E. Thurston.

Thus in the notes on marriage we find the rite of *confarreatio* adopted by the Kammalans of Malabar in the case of polyandrous unions, a fact which we believe to be new to Indian ethnologists. The bride and her prospective bridegrooms, who are all brothers, are seated in a row, the eldest on the right, the others in order of seniority, and last of all the bride. The tribal priest solemnises the union by pouring milk into the mouths of all the parties to the contract. Much evidence on the subject of fraternal polyandry is here collected, but for a scientific treatment of the subject we must await the forthcoming book on the Todas by Dr. Rivers. Numerous cases, again, are given of actual or feigned resistance offered by the friends of the bride to the bridegroom and his party. These are accepted *en bloc* as evidence of marriage by capture, which seems unscientific in view of the evidence collected by Mr. J. G. Frazer to show that many of these mock combats are really intended to promote the fertility of the soil, and are thus by analogy appropriated in the marriage rites. The hill people of Vizagapatam practise a curious method of selecting the bride. Near their houses is a pit in which the children are placed at night to keep them warm in the cold season. In spring all the marriageable girls are shut up in one of these pits, and a young man who has already selected his bride with the consent of his parents comes to the brink and sings out her name. If she likes him she comes out, a fire is lighted, and a dance solemnises the union. If she sings back that she will not have him he immediately tries the name of another girl, and goes on doing so until he is successful.

The chapter on death rites, though badly arranged, abounds in useful information. Madras supplies an admirable field for such investigations, because prehistoric interments are numerous, and it would be interesting to compare the usages of the earlier people with those of the present forest tribes. This Mr. Thurston has not attempted to do, but his collection of facts will help European students to undertake the inquiry.

A good illustration of the theory propounded by Mr. E. S. Hartland at the York meeting of the British Association—that both magic and religion, in their earliest forms, are based on the conception of a transmissible personality, the Mana of the Melanesian races—is found in the belief that from the eye of a man of low caste a subtle matter proceeds which contaminates food and other things upon which it falls. The most remarkable example of black magic

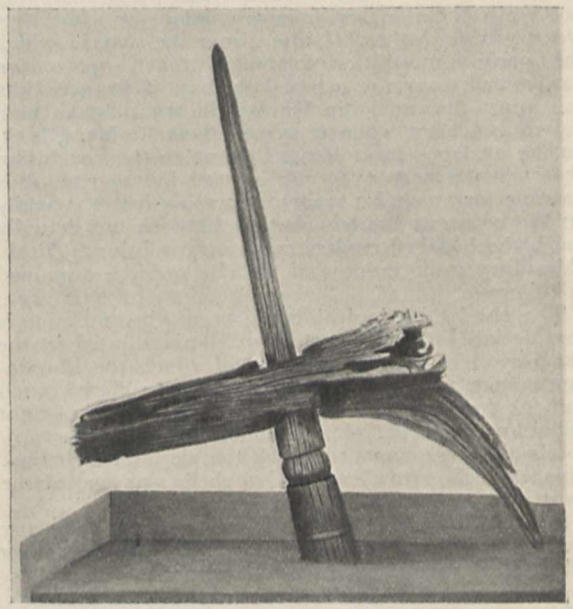

FIG. 2.—Meriah Sacrifice Post. From "Ethnographic Notes in Southern India," by E. Thurston.

is found in the nude figure of a woman, with her feet turned backwards, a large square hole cut above the navel, and the whole body covered with long iron nails and Arabic inscriptions, which was washed ashore at Calicut in 1903. This figure, of which the illustration is here reproduced (Fig. 1), Mr. Thurston supposes to be that of a woman of the Laccadive Islands who was possessed by an evil spirit, "which was nailed to it before it was cast into the sea." The fact that the feet are turned backwards certainly indicates its demoniacal character, and it seems more probable that it represents some notorious witch; that the nails were driven into it and the mutilation made in order to injure her, and the spells added to destroy her magical power; finally, that the image was cast into the sea as a means of getting rid of the sorceress.

The chapter on fire walking supplies many facts, but does not help us much to understand the methods and significance of the rite. The question has been discussed by Mr. J. G. Frazer in his recent book on "Adonis, Attis, and Osiris," with the result that it

[1] "Ethnographic Notes in Southern India." By E. Thurston. Pp. viii+580; 40 plates. (Madras: Government Press, 1906.)

seems to be a survival of a rite of actual fire sacrifice. In some cases the juice of the *Aloe indica* is said to be used as a protective, but Mr. Thurston seems to believe that the indurated skin on the soles of men who habitually walk barefoot over the roughest ground accounts for many cases of immunity. A recent description by Mr. D'Penha of the rite as it is performed at Travancore indicates that the length of time which is allowed to expire between the lighting of the fire and the actual walking makes it an operation of little danger. Mr. Partridge, who witnessed the ceremony at Ganjam, describes the priest as going to the fire-pits, "which were a mass of red-hot ashes; he sprinkled not more than a handful of incense on to them; dipped his feet in a mixture of rice-water and milk; and walked across one pit, leading another man. He then dipped his feet again in the fluid mixture, and returned by the other pit. The time he took in walking across one pit was not more than four seconds, and he took about four steps on the ashes. At least fifty persons in the crowd walked over the pits afterwards, but they went a little faster than the priest, and some of them only took two steps on the ashes. Their feet were not hurt, and they did not wash them in any mixture before or after they went over the ashes. I infer from the way in which the performance was conducted that anyone can easily walk over the ashes, but that, if he goes like the priest, he must dip his feet in the mixture both before and after walking across them." Mr. Risley, on the evidence from Bengal, came to the conclusion that when a narrow trench is used in the rite, it is possible for an active man to place his feet so rapidly on the edges of the trench that he does not actually touch the burning cinders, and escapes injury. Probably many performances of the rite may be explained in this way.

The chief ethnological curiosity of the museum is the Meriah sacrificial post from Ganjam, used in the blood sacrifices of the Khonds, of which the illustration is here reproduced (Fig. 2). It has suffered much damage from white ants, and its original form is not easily recognisable. It seems to represent the proboscis of an elephant to which the victim was bound. This, according to General Campbell, was one of the most common forms.

Mr. Thurston's book is arranged without any method, but it contains a mass of curious information which will make it welcome to European ethnologists.

MEDICAL SCIENCE AND ARMY EFFICIENCY.

IN spite of the natural interest which the nation takes in the Army, few people realise completely what is the work that the Royal Army Medical Corps has to do, how vast are the responsibilities committed to it, and how dependent army efficiency is upon medical science. It is difficult to explain this want of interest and knowledge, but it arises probably from the fact that much of the work which the medical service does in the Army, both in peace and war, is of an unostentatious nature, and lacks the pomp and glamour which appeal so strongly to a public when associating itself with the military organisation of the country. Apart from this, the medical service suffered for many years under grave official disabilities, being systematically snubbed, and its professional and military pride injured. Such an attitude on the part of highly-placed persons in the military bureaucracy could not fail to dishearten its *personnel* and lessen any general enthusiasm or interest in its work by the general public. To a large extent these mistakes of the past have been rectified, and the army medical service desires now, as it ever has done, to do its duty and to deserve well of the country; but it recognises that to do this it must advance and utilise fully the progress of science and the increasing knowledge of the profession of medicine which it represents in the military machine. Before attempting to explain these aspirations, it may not be uninteresting to readers of NATURE to sketch briefly the evolution of the army medical service from less enlightened times to the present day.

The need of medical attendance with an army in the field seems to have been always more or less recognised. In the days of the early Edwards, physicians and surgeons are recorded as having formed part of the levies which were taken into the field; but until the sixteenth century the proportion of such men to the whole force was very small, and even in the time of James I. we find no allowance or provision in the estimates for medicines or hospital appliances; these details were supposed to be found by the surgeons themselves, for the cost of which a weekly stoppage of 2*d.* was made from the pay of the private soldier. It is not until the time of Marlborough that we find any sign of prominence being given to the medical service of the Army, but it was nearly fifty years later that the first reforms in military medicine and sanitation were introduced by Sir John Pringle, when physician-general to the forces in Flanders. The long series of wars in which England was engaged at the end of the eighteenth and the beginning of the nineteenth centuries produced many able men who left their mark on the organisation of the Army; not the least remarkable among them was Sir James M'Grigor, who, beginning his career as a military surgeon in 1793, became principal medical officer in Portugal and the Peninsula under Wellington, and finished his official career as medical director-general after the time of the great war. To him it was due that, in the service of which he was head, order was evolved out of chaos, and that the army medical service became an organised body, uniting in itself the best traditions of two professions.

In the long peace that followed Waterloo, our military machinery rusted from disuse or decay, notably the supplementary services which are necessary to form an army. The arrangements which had been made and the materials which had been collected in the old war-time for the care of the sick and wounded disappeared with nothing to replace them, and, when the Crimean War came, the best endeavours of the best men were powerless to grapple with the problems which were to be faced. The lessons of old experience had been forgotten, and the army medical service found itself helpless, without means to carry out even an antiquated system of professional duty. At that time the army medical service consisted only of officers, divided into two classes, staff surgeons and regimental surgeons, though the whole were borne on one list, and, up to a certain rank, were interchangeable. After a regimental surgeon had attained a certain seniority he was promoted to be a staff surgeon of the first class, and was employed thenceforth in superintendence and administration rather than in regimental or personal professional practice. Practically all the officers of the medical staff had at one time or another been regimental surgeons, and presented in varying degree the merits or demerits of that training. The system of gazetting medical officers to individual corps had many advantages, both socially and professionally, but it had undoubted drawbacks. The first and most important of these was that there was a constant difficulty in utilising them elsewhere than with their own corps, hence, if the public service

was to be carried out, the total number of surgeons to be maintained was excessive. Putting aside this question of economy and distribution of *personnel*, the system was extravagant owing to the hospitals being regimental also; this involved an unnecessary duplication of equipment, while, too, in many instances the regimental surgeons, by this limitation of their sphere of duty, had a tendency to drift into a quasi-routine method of professional practice.

In 1858, following the close of the Crimean War, came the Royal Commission under the presidency of Sidney Herbert. The immediate result of its report was the formation of the Army Medical School at Netley for the training of medical officers in military technical duties, also the re-modelling of the service and the initiation of practical reforms in the administration of military medical affairs, as well as the creation for hospital duties of the Army Hospital Corps, a body of men possessing a complete military organisation. In 1873 the system of regimental surgeons, except in the Guards, was abolished finally, and all medical officers were consolidated into one staff; at the same time disappeared also the regimental hospitals, their places being taken by general hospitals and station or field hospitals. From this date all regimental organisation ceased to exist, the arrangements for medical affairs passing into the hands of the medical officers alone. In 1877 authority was given to medical officers to command the whole of the Army Hospital Corps, and also all patients in military hospitals, as well as other soldiers attached to them for hospital duty. From this date the medical officers became invested with the responsibilities as to discipline, training, supply, payment, and movement of their own subordinates, similar to the responsibilities resting upon a commissioned officer in any other branch of the service. In 1885 the appellation of the Army Hospital Corps was changed to Medical Staff Corps, and in 1898 the Medical Staff and the Medical Staff Corps were further consolidated into an autonomous whole as the Royal Army Medical Corps of the present time. As a necessary sequel to the functions and responsibilities of the Corps in its new organisation, its officers were given full army rank and title, thus completing the evolution of the medical service from the chaotic state when its *personnel* were mere camp followers endowed with neither official status nor responsibility to the completely autonomous and purely military organisation of to-day. These recent reforms have embraced the granting of good pay, liberal terms of service and study, with the abolition of the archaic school of instruction at Netley and the substitution of a Royal Army Medical College in London, where the officers of the Corps are brought into intimate touch with the newest theories and practice of medicine. In a word, the liberal and far-seeing policy of those responsible for the reforms of 1899 to 1902 has revolutionised the position and *moral* of the Corps, with the result that its 1002 officers and 4189 non-commissioned officers and men constitute a contented and thoroughly efficient body of technically trained men, equipped and able to meet the needs of the sick and the wounded.

Is the task ended? it may be asked, and have we reached finality in our efforts to build up a medical corps at once worthy of the country and the Army of which it is an integral unit? Unfortunately no; there is much yet to be done. Military history has, up to to-day, been a history of the battle only, of brave deeds done and suffering bravely borne; but what of the history of the means by which armies were rendered numerically efficient and placed in a condition to fight? We have faced the problem of how to treat and provide for the sick and wounded, and unhesitatingly compel our commanders to encumber their fighting force with *impedimenta* and medical provision for 10 per cent. of sick; but need this be? The two great scourges of armies in the field are enteric and dysentery. During the late war in South Africa, these two diseases alone caused 74,000 admissions to hospital and 9200 deaths. Yet both diseases are largely preventable. It is no exaggeration to say that for every man wounded in war twenty sick men are brought to hospital, largely from preventable causes. The unopposed crossing of the Modder River lost us more men from enteric than the battle of Colenso lost us from wounds. Surely if this enormous waste of fighting strength is avoidable, the prevention of sickness and disease in a field force is of more importance than the mere treatment of its victims. Thanks to the evolution in its organisation and perfection of equipment which the Royal Army Medical Corps now presents, the soldier of to-day has a better chance of recovery than the sick or wounded man of the Peninsular or Crimean Wars; but the same cannot be said of the soldier's chances of contracting preventable disease, for the organisation and equipment of the British Army as to disease prevention remain little better than they were a hundred years ago. The reason of this is, that army administration (medical) has not kept pace with the advance of science, and has neglected to note early the influence of Pasteur's work upon the problem of war. This, then, is the task still before the army medical service—how to translate scientific knowledge into an administrative system for the efficient prevention of disease among troops in the field. This would be easy enough if no regard were paid to the necessities of mobility and supplies, but those are points which we cannot ignore; in fact, the whole object and aim of sanitary effort is to increase fighting efficiency and lessen transport; therefore, in our campaign to reduce the incidence of preventable disease, we need to be careful not to add *impedimenta* to the Army with one hand even though we take some away with the other.

It is to the solution of this problem that the medical corps of the Army is now devoting itself, and the principles on which it is working are briefly these:—(1) the Army at large, from highest to lowest, must be educated to appreciate the need of radical reforms in the direction of preventing disease, and to understand that these cannot be secured "by order" only, but require personal effort on the part of each individual and the recognition by officers of their own direct responsibility for the health of their men; (2) the elaboration of an organised system for providing safe and potable water for all troops when in camp or on field service. The practical application of the first principle has taken the form of systematic instruction in the various garrisons of all ranks in elementary sanitation. These classes are conducted by officers of the Royal Army Medical Corps, whereby the importance of personal effort on the part of both officers and men is enforced and the special training of a certain number of men in practical sanitation secured, so that each unit may have its own sanitary squad for these special duties. Having these trained men at their disposal, it is hoped that commanding officers will find no future difficulty in the maintenance of their own lines and camps in conditions of sanitary efficiency. For the provision of safe and approved water to each unit in the field the Royal Army Medical Corps proposes to take full responsibility, and to this end every water-cart, every filter, every heat steriliser, and all chemical reagents for the routine purification of water will be in the charge of, and worked by, trained men of the Medical Corps.

Experience has shown that to hand this kind of equipment over to other than specially trained men is certain to end in failure. For the training of these men in methods of water purification the new School of Army Sanitation has been established at Aldershot, where special provision is provided for practical instruction in every method and the working or trial of any new apparatus or chemical technique adapted for army needs. The success of this effort has been already remarkable, demonstrating not only the feasibility of purifying water for soldiers under field conditions, either by means of special filters, by heat exchange sterilisers or by chemical reagents, but also showing the fitness of the men of the Royal Army Medical Corps for this special work. The school is utilised also for instruction of men from every branch of the service in general sanitary duties, and in this two-fold way constitutes a centre for the dissemination of practical sanitary knowledge and work to the whole Army.

It is early yet to say what will be the final result of this attempt, but everything points to the conclusion that the incidence of preventable disease in time of war must and will be reduced thereby. It is gratifying, further, to record the sympathetic support which the movement is receiving from a large number of general officers, commanding officers, and others outside the medical corps; but there is much leeway to be made up and much apathy and inertia to be overcome. This will be done only by the support of public opinion and interest, particularly of the scientific public. Possibly this outline of the present position may appeal to them to see that the scheme of work here sketched out has free scope and opportunity to evolve itself; in other words, that medical science is applied logically to the attainment of army efficiency, and that disease prevention is regarded as much a function of the medical corps as disease or wound treatment.

R. H. FIRTH.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES IN THE COLONIES.[1]

THE question of the introduction of the metric system of weights and measures into the United Kingdom has been before the public for more than forty years. An important step in this direction was taken in 1897, when the Weights and Measures (Metric System) Act was passed which rendered it lawful to use metric weights and measures in this country for the general purposes of trade. The trading community as a whole has not, however, manifested any eagerness to take advantage of this permissive legislation, and, so far as retail trade is concerned, the use of the metric system appears to be restricted to dispensing chemists and a few vendors of lager beer. It is true that for some years past the system has been allowed to appear in the official syllabus of our public elementary schools, but no stress is laid upon it there, and its chief recommendation is represented as being "the advantage to be gained from uniformity in the method of forming multiples and sub-multiples of the unit."

But although the metric system has made little progress in this country, and has met with scant official encouragement, the importance of its universal adoption is becoming every year more fully recognised in our colonies. The report which forms the subject of this article is a very clear indication of the strong current of public opinion in the Transvaal in favour of the general adoption of the system. The commissioners, of whom Mr. R. T. A. Innes, the well-known Government meteorologist, was chairman, recommend that the kilogram, the metre, and the litre be adopted as the basis of the standards of weight and measure in the colony. An important resolution, which will go far towards making the public familiar with metric weights and measures, is that it shall be compulsory to use the system in land surveying and in the retail sale of drugs. The opinion is expressed that it will not be practicable to insist upon the exclusive use of the metric system in general trade in the colony until the system is made compulsory in the United Kingdom, unless the other South African colonies consider it feasible to combine for the purpose.

The commissioners have made a careful survey of the question of weights and measures legislation, and their recommendations are embodied in a final draft ordinance the provisions of which are in many respects a distinct advance on the enactments in force in this country. Thus the definition of "trade" explicitly includes contracts for land, and so renders surveyors' measures liable to official verification. In the United Kingdom, surveyors generally test their own measures as best they can. The definition of "measuring instrument" includes instruments for the measurement of area. A similar provision in this country would be most beneficial to the leather trade in preventing disputes, now of frequent occurrence, especially in the sale of hides. Short weight and measure, and the practice of weighing the wrappers with goods sold, are made distinctly penal. People defrauded by these practices in the United Kingdom have to seek their remedy in the county court, or in a prosecution for false pretences.

It appears from the minutes of evidence appended to the report that much difficulty is experienced in the Transvaal in getting assay weights standardised with accuracy, especially weights from 10 mg. downwards. Certificates obtained some years ago from official institutions in Austria, England, Germany, and the United States were found to give very different values for the same set of proportional assay weights. So far at least as England and the United States are concerned, it is probable that at the period in question the standardising institutions had had but little experience in the verification of metric assay weights. Within the last few years, however, both these departments have been materially strengthened. The recent report of the newly-constituted Bureau of Standards at Washington sufficiently attests the high calibre of the scientific members of the present staff, whilst a corresponding improvement has been effected in this country by the appointment of Major P. A. MacMahon, F.R.S., to take charge of the Standards Department of the Board of Trade.

At the forthcoming colonial conference the importance to our colonies of the adoption of the metric system of weights and measures throughout the Empire will be urgently impressed upon the Secretary of State, and it is hoped that the Home authorities will be induced to take a greater interest in this question than they have hitherto evinced. The introduction of the metric system into the United Kingdom is not indeed a task to be lightly undertaken. It would involve much hardship to small traders, and would derange the habits of the whole trading community. Centuries of instruction in the "advantages of uniform multiples of the unit" would not prepare the nation for so great a sacrifice. When so little has been done by the authorities to familiarise the public with the real significance of the question, it is not surprising that public opinion is on the whole unripe for

[1] "Report of the Commission appointed to consider and report upon a Draft Ordinance to consolidate and amend the Law relating to Weights and Measures." (Pretoria: Government Printing Office, 1906.)

a change of such magnitude. These considerations are well understood in the colonies. Thus on p. 64 of the report now under consideration we find the statement:—"The United Kingdom is conservative and unless this is forced upon them it will never be adopted."

The question of the adoption of the metric system has not been brought forward in our colonies merely from considerations of relative practical utility or of relative scientific perfection, but owing to difficulties experienced in commerce with foreign countries, and to the prospect of continual loss of trade. Until the United Kingdom, their very good customer, takes the lead, they cannot afford to make the change. If their loyalty in respect of weights and measures is thus in great measure enforced upon them, it is none the less pathetic. Every day it is more effectually shutting them out from the new markets which are of vital importance to their commercial prosperity. So long as the public at home are taught that the claims of the metric system are based chiefly on its decimal notation, so long will they remain unconvinced of the necessity for adopting it. On the other hand, if the true issues are placed before them, they are not likely to be inconsiderate in a matter which involves the interests of their most important colonies.

NOTES.

THE following is the text of the address presented by Sir Arch. Geikie for the Royal Society at the recent celebration of the quatercentenary of the University of Aberdeen:—The Royal Society of London for Promoting Natural Knowledge sends cordial greetings to the University of Aberdeen on the auspicious occasion of the celebration of the four hundredth anniversary of its foundation. The Royal Society would more specially desire to record its sense of the importance of the services which the University has rendered to the progress of science. From its infancy the society has been privileged to count among its fellows distinguished professors and graduates of Aberdeen, and this close and valuable association still continues. It is a gratification to recall that the illustrious family of the Gregorys, which for some two centuries shed so much fame upon the University and upon Scotland, were from the beginning intimately linked with the Royal Society. James Gregory early reached such eminence in mathematical and astronomical research that in 1668, when he was only thirty years of age, he was elected a fellow, six years after the incorporation of the society. His invention of a reflecting telescope, of which he had first conceived the idea, prompted Newton to proceed in a similar direction in order to evade the difficulties of chromatic dispersion, and led to mutual regard and friendly cooperation. To his brother David Gregory, who had the distinction of being one of the earliest effective promoters of the Newtonian philosophy, the society is also indebted for important communications published in early volumes of the Philosophical Transactions. The obligations of physical science to Aberdeen did not end with the lives of the masters of the seventeenth century, for within living memory the University has numbered among its professors the world-renowned pathfinder James Clerk Maxwell. To the progress of the study of medicine the same remarkable family of Gregory continued during successive generations to make important contributions, while the fame of the medical school was in more recent years extended by Allen Thomson. In natural science the well-remembered names of John Fleming, William MacGillivray, and James Nicol appear among those who have sustained the scientific reputation of Aberdeen. But it is not only with the scientific side of culture in the University that the Royal Society has had interesting links. It is a pleasure to remember that Thomas Reid, the father of Scottish philosophy, whose fame is one of the fairest pearls in the chaplet of the northern University, contributed to the Royal Society in 1748 an essay upon quantity. In remembrance of these varied associations of the past, and with sincere wishes for their continuance in the future, the Royal Society gladly adds its felicitations to those which will this year come from all civilised countries to the University of Aberdeen.

WE regret to learn of the death on Wednesday, October 10, at the age of fifty-five, of Mr. Herbert Rix, assistant secretary of the Royal Society from 1885 to 1896. Mr. Rix resigned his post ten years ago, finding that his strength would no longer sustain the greatly increased anxiety and burden of his office. He was already suffering from a weakness of the heart, which gradually developed during the following years. A year ago he was obliged to relinquish nearly all active work, and the shock of his wife's death last August, as the result of an accident, had a disastrous effect upon him. Mr. Rix entered the service of the Royal Society in 1879, as clerk under the late Mr. Walter White, then assistant secretary, whom he succeeded six years later, his service to the society thus extending over seventeen years. During this period a great extension of the activity of the society occurred, entailing a large increase in the responsibilities of the executive and in the amount of work thrown upon the office. Mr. Rix's bent was in the direction of the moral rather than of the exact sciences, but he gave the best energies of a well-trained mind to the arduous duties of his position, and the simple directness of his character, his high principles, and his kindly nature made him popular with all who came in contact with him. After retiring from the assistant secretaryship he retained for some years the position of clerk to the Government Grant Committee, and continued up to the time of his death to act as secretary to the Lawes Trust Committee. He devoted much of his latter years to the study of comparative religion, and was a frequent lecturer on ethical subjects. He was a graduate of London University.

THE board of directors of the great manufacturing firm of Kynoch (Ltd.) has decided to introduce the metric system of weights and measures into all their works. A small committee has been appointed to consider the details of the change and to provide the necessary instruments, and as soon as the committee reports the change will be made. All the weights and measures used by the firm, whether lineal, square, or cubic, will be metric. For money calculations the pound sterling will be adopted as the unit, and this will be subdivided decimally.

A REUTER telegram of October 11 from Basse-Terre, Guadeloupe, reports that a violent eruption of Mont Pelée has caused a shower of ashes to fall over the south-east of Guadeloupe.

A NEW ZEALAND international exhibition is to be held, under the auspices of the New Zealand Government, at Christchurch, Canterbury. The exhibition will be opened on November 1, and will be terminated in April, 1907. A special feature is to be made of the representation of Maori life, and Poi dances and hakas will be arranged from time to time.

THE annual meeting of the Yorkshire Naturalists' Union will be held at York on Saturday, December 15. Mr. W. Eagle Clarke, of the Royal Scottish Museum, will deliver his presidential address, entitled "Antarctic Bird-life," which will be illustrated by a series of lantern-slides from photographs taken during the National and Scottish expeditions. Further details can be obtained from Mr. T. Sheppard, the honorary secretary of the society, at the Museum, Hull.

A FRUIT growers' conference will be held at the South-Eastern Agricultural College, Wye, on Wednesday, November 7. The chair will be taken by Mr. Laurence Hardy, M.P., and an introductory address will be given by the principal of the college. The subjects to be considered at the conference will be:—Methods of planting, S. U. Pickering, F.R.S.; strawberry culture, W. P. Wright; treatment of American blight, F. V. Theobald; and some fungus diseases of orchards and plantations, E. S. Salmon.

WE learn from the *Times* that unavoidable delay in the completion of the latest addition to the Carnegie Institute building at Pittsburg, Pa., has made it necessary to change the date for opening the annual international exhibition from November 1 of this year to April 11, 1907. This change has been made because the trustees desire the exhibition to be held in conjunction with the opening and dedication of the building, which has been enlarged during the past two years to about six times its original size. A number of eminent men, representing the scientific, artistic, and literary organisations and institutions of the world, will be present at the dedication.

THE new session of the Royal Geographical Society will be opened on November 12, when a paper will be read on North-Eastern Rhodesia by Mr. L. A. Wallace. On November 19 Mr. J. Stanley Gardiner will deal with the subject of the Seychelle Islands, and on December 10 an account of irrigation in the United States will be given by Major John H. Beacom. Other provisional arrangements are as follows:—Polar problems, Dr. Fridtjof Nansen; through Central Africa from the west coast to the Nile, Lieut. Boyd Alexander; nine years' survey work in northern China and Mongolia, Colonel A. W. S. Wingate; a journey through Central Asia to northern China, Major C. D. Bruce; the north magnetic pole and the north-west passage, Captain Amundsen; aboriginal India, Colonel Sir T. H. Holdich, K.C.M.G.; a journey from Yunnan to Assam, E. C. Young; the story of London maps, Laurence Gomme; the evolution of the map of Africa, Edward Heawood; inland waterways, G. G. Chisholm; the Taupo volcanic region, New Zealand, J. Mackintosh Bell. At one of the meetings in the early part of next year an authoritative account will be given of H.R.H. the Duke of the Abruzzi's expedition to Mount Ruwenzori.

IN 1904 an advisory committee was appointed by the Secretary of State for India to inquire into some of the problems concerning plague, and the first function of the advisory committee was to appoint a working commission which has been investigating the disease in India ever since. A series of reports on the work already accomplished has just been published in a special number of the *Journal of Hygiene* (vi., No. 4). The first half of this contains the results of experiments on the transmission of plague by fleas. Guinea-pigs allowed to run free in plague houses in 29 per cent. of cases contracted plague, but if the animals were kept screened by fine gauze, so that fleas had no access, they remained healthy. Fleas caught on rats dying of plague and transferred to healthy animals transmitted the disease. The Hon. N. C. Rothschild contributes a paper on the species of flea found on rats. Experiments on the infectivity of native floors grossly contaminated with *B. pestis* seem to show that they do not remain infective for more than twenty-four hours. In plague-infected rats as many as 100,000,000 bacilli may be present in 1 c.c. of blood, and a few in the urine and fæces. Chronic plague in rats was noted in six instances at a season of the year when neither human nor rat plague existed, suggesting that this possibly is the means by which the infection is propagated from season to season.

THE contents of the first part of the nineteenth volume of the Proceedings of the Royal Society of Victoria comprise descriptions of new and little-known marine molluscs from the adjacent sea, by Mr. J. H. Gatliff, and of decapod crustaceans from the same, by Messrs. S. W. Fulton and F. E. Grant, together with the first instalment of a census of the Victorian representatives of the last-named group by the same writers.

THE papers in the September issue of the *American Naturalist* are chiefly interesting to histologists and specialists. In the first Prof. A. W. Weysse and Mr. W. S. Burgess contribute an elaborate account of the histogenesis of the retina, summarising their conclusions at considerable length in tabular form. The marine copepod crustaceans of Rhode Island receive attention at the hands of Mr. L. W. Williams, while Mr. R. H. Howe discusses the lichens of Mount Monadnock, New Hampshire.

ANOTHER of those emendations in nomenclature which are rapidly tending to make zoology an impossible science to all save the specialists in particular branches appears in a paper on the "digger-wasps" of North America and the West Indies, forming No. 1487 of the Proceedings of the U.S. National Museum. According to the author, Mr. H. T. Fernald, none of the insects which have been included in the genus Sphex during the past century properly belongs to it. Consequently the species and subgenera so long included under that generic designation now appear under the title Chlorion, while Sphex is made to include those hitherto known as Ammophila, a further change being the substitution of the subfamily Chlorioninæ for the original Spheginæ, and the transference of the latter, under the altered form of Sphecinæ, to the old Ammophilinæ. Fortunately (under its amended form of Sphecidæ) the family name of Sphegidæ is retained for the whole group. The author appears to have made an exhaustive study of that section of the group he classifies as Chlorioninæ, having examined, and when necessary re-described, all the type-specimens in American collections.

To the June issue of the Proceedings of the Philadelphia Academy Mr. H. W. Fowler contributes the first part of a paper on American fresh-water "heterognathous" fishes, or those usually classified under the family name Characinidæ. In the author's opinion they should form two families, for which the titles Erythrinidæ and Characidæ are adopted. Apparently, however, there is no justification for the use of the name Characinidæ (or Characidæ), since there is no such genus as Characinus or Characus. If but one family is recognised the name Erythrinidæ may be employed, but if two groups are recognised a new title (such as Citharinidæ) is required. It may also be noticed that the author does not recognise the preoccupation of Chirodon (or Cheirodon) by Chirodus. The author has had access to all Cope's type-specimens,

and proposes a number of new names, and he is of opinion that the information he conveys with regard to rare or nominal species will be appreciated by naturalists.

MUSEUM technique is the leading feature of the five articles (four of which were read at the recent Bristol conference) in the September issue of the *Museums Journal*. In the first, and perhaps most generally interesting, Dr. Sorby discusses the mode of forming a collection to illustrate the origin and structure of rocks. The material of rocks, such as sands and clays, should form the starting point. This should be followed by illustrations of different modes of deposition and sorting, while the consolidation of deposits by infiltration, or by removal and replacement of material, claims the next place. The formation of concretions, and various mechanical changes, culminating in slaty-cleavage, complete the illustration of the genesis of aqueous rocks, after which come illustrations of the formation of the igneous series. The next three articles deal respectively with the exhibition of coins, models of Protozoa, and the hanging and care of pictures. In the fifth Dr. J. E. Duerden describes a new method of preserving entire tortoises which deserves the best attention of museum curators, the specimens treated by this method having, it is stated, a remarkably life-like appearance.

THE report of the working of the Government Museum at Madras for the past year is a record of steady progress. The great collection of prehistoric antiquities recovered from interments in the Nilgiri Hills by Mr. J. W. Breeks and others has now been increased by a splendid series of bronzes, iron weapons and implements, pottery, and human bones from the excavations at Aditanallur, in the Tinnevelly district, conducted by Mr. A. Rea, and these have been arranged in a new gallery built for their reception. Mr. Thurston, who usefully combines the duties of curator with those of director of the Ethnographical Survey, has made his usual tours among the jungle tribes, and has collected many curious implements, skulls, and other specimens. He has made a special anthropometric survey of that little-known tribe, the Chenchus of the Nallamalai Hills. His materials now enable him to establish the correlation, so far as the type of head is concerned, between the people of the Canarese, Maratha, and Telugu area, that is to say, the north-west and north-east of the province, as compared with the Malayalim and Tamil dwellers in the south. This is interesting in connection with Mr. Risley's speculations on the brachycephalic Marathas. During these expeditions he used for the first time an Edison's phonograph, by which he was able to secure records of tribal songs and music. Duplicates of these are to be sent to Mr. C. S. Myers for the Museum of Comparative Music at Cambridge. Mr. Thurston finds the phonograph an admirable means of conciliating timid and suspicious jungle folk, who fear the ordinary anthropometric methods. No travelling anthropologist, he says, should be without it.

A COLLECTION of diagnoses of new Philippine ferns, prepared by Mr. E. B. Copeland, forms the second supplement to vol. i. of the *Philippine Journal of Science*. The most striking novelty is an epiphytic plant of the nature of a Drynaria, receiving the name of *Thayeria cornucopia*, that is said to have a unique humus-collecting structure; each leaf forms a complete receptacle, enclosing the humus on all sides. New species are described for a number of genera, including Alsophila, Cyathea, Trichomanes, Nephrolepis, Plagiogyria, &c. The writer revives the genus Schizostege, assigned to Cheilanthes by Baker and to Pteris by Christ and Diels, for two new species.

OWING to the want of knowledge of the complete life-histories of many of the Uredinales, the classification of the group is a matter of some difficulty. Prof. J. C. Arthur presented an outline of a system of classification to the International Scientific Congress of Botanists at Vienna in 1905, that is published in their "Resultats Scientifiques." Three orders, Coleosporiaceæ, Uredinaceæ, and Ægidiaceæ, are defined according to the nature of the teleutospores and their germination. Suborders are determined by the position which the spores occupy in the tissues of the host plant. Finally, the genera in each suborder are grouped according to the development of one or more of the æcidio-, uredo-, and teleuto-spore stages.

IN the annual report for 1905–6 of the botanic station, agricultural school and experiment plots in St. Lucia, the superintendent, Mr. J. C. Moore, refers to tapping trials made on trees of *Castilloa elastica* that point to a yield of 2 lb. of cured rubber for mature trees. The agricultural instructor, Mr. G. S. Hudson, devotes a considerable portion of his report to the subject of cacao, detailing the results obtained on experiment plots. A new hybrid plant has been produced by crossing *Theobroma pentagona* with *Theobroma cacao*. On the debated question of shade or no shade for cacao, Mr. Hudson says that shade and shelter are obviated partly in Grenada by close planting, but he recommends for St. Lucia a light shade of Para rubber trees or *Erythrina indica*, and wind belts of *Inga vera*.

WE have received several of the recent issues of the *Boletin del Ministerio de Fomento* of Peru, a well-edited journal issued by the Department of Public Works. It contains much valuable information regarding the railways of the Republic.

AN admirable coloured geological map of Queensland (Publication No. 206), on a scale of forty miles to the inch, has been received from the Geological Survey of Queensland. It has been compiled under the supervision of Mr. B. Dunstan, acting Government geologist, by Mr. H. W. Fox, and shows the mineral localities clearly marked in red.

THE Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part vii.) contains a valuable paper on equimomental systems and their use in applied mechanics, by Mr. R. F. Muirhead. The value of this principle has hitherto been regarded by engineers as of academic interest, and in developing the principle and in reducing the results to a form suitable for practical application the author has done much to reduce the time and labour of engineering calculators.

THE annual memorandum issued by the chief engineer of the Manchester Steam Users' Association deals with several subjects of importance to engineers, such as steam-pipe explosions, the brittleness of steel plates, and boiler tests. Many steam pipes are badly designed, and may explode at any time. They could, however, be made safe without much expense; and in order to encourage those dealing with these matters to study the subject, a sketch is given of a glass model which clearly shows the hammering action of water when confined in steam pipes. In the section dealing with boiler tests, particular stress is laid on the carrying out of gas analysis with the greatest possible care. If this is done, it will be possible to utilise the gas analysis for determining the chemical composition of the fuel, and for ascertaining at any instant what is the efficiency of the heating surface.

IN *Engineering* (vol. lxxxii., No. 2126) an abstract is given of a paper by Mr. A. R. Ledoux, presented to the American Institute of Mining Engineers, describing a new method of mining kaolin. Deposits in the Housatonic River district in Connecticut were being worked at a loss, owing to transport difficulties and to increase in expenses caused by the dip of the vein, which ran at an angle of about 50 degrees from the vertical, between gneiss and hornblende schist, and a footwall of rock. The material is therefore now mined by well, by which method the crude material is obtained with but little of the overburden, &c. The wells are from 50 feet to 198 feet deep, and contain a 4-inch, and, inside this, a 2-inch pipe. These go down gradually into the clay. Water at a pressure of about 40 lb. per square inch is forced through the smaller pipe, and on its passage upward carries with it about 5 per cent. of solid matter, of which 75 per cent. is pure kaolin.

MUCH valuable information regarding the mineral resources of Peru continues to be got together in the admirable series of monographs issued by the Government Corps of Mining Engineers. In *Boletin* No. 29 Mr. Federico G. Fuchs describes the copper-bearing region in the vicinity of Ica and Nazca. His detailed description, covering 100 pages, and his geological map show the importance of a mining centre that has long been neglected. In *Boletin* No. 35 Mr. Enrique I. Dueñas reviews the mineral resources of Jauja and Huancayo. At the present time no mines are being worked in these provinces, but the author shows that they are rich in coal, asphalt, copper, silver, gold, molybdenum, and iron. In *Boletin* No. 36 Mr. Luis Pflücker describes the iron-ore deposits of Aija and Calleycancha. The ore, which occurs in veins, is of great purity and richness, but the absence of fuel is, in the case of the Aija deposits, unfavourable to their development. The Calleycancha veins are more promising owing to their proximity to the Mancos coalfield.

THE address delivered by Mr. James Adamson, hon. secretary to the Institute of Marine Engineers, on October 1, dealt in a scholarly manner with the advantages of a technical society. To the individual member, the advantages are in the direction of mental exercise, and consequent strengthening of the faculties of the mind; in the direction of finding out, in the course of discussions with fellow-craftsmen, how troubles in connection with details have been met and difficulties overcome; in the direction of social intercourse, and in exchanging experiences for mutual benefit. The advantages to the community of which the members of the society are units are in tending to improve the conditions of life and work all round; in tending to bring to the front, for the benefit of all, the latest improvements and developments; in tending to educate the general public in respect to the various aspects of the world of science, and to give the people a better understanding of things within the domain of science. The advantages to the nation are in tending to improve the trade of the country by improving methods of manufacture; in tending to improve material and minimise risk of failure; in tending to lessen insurance premiums by lessening risk of breakages, stoppages, and disablements; in tending to the adoption of improved methods, material and appliances, with better conditions of upkeep and improved views in respect to upkeep and expenditure, to get the best results in immediate running and prospective life average, thus minimising costs and economising capital outlay, with consequent advantages in competing for the traffic of the world; and in tending to reduce the cost of material and running expenses and repairs, enabling employers to lessen the cost of output, and make improvements in their plant to enable them to keep up to date in their works and factories with all competitors.

DURING the past few years several theories have been advanced connecting the fluorescence of organic substances with their chemical constitution. A new hypothesis is now suggested by Profs. Luigi Francesconi and G. Bargellini, based on the examination of a very large number of substances by a very sensitive method which they have devised for detecting fluorescence (*Atti dei Lincei*, series 5, vol. xv., No. 3). When a beam of sunlight is concentrated by a lens on a solution of the substance contained in a test-tube in a darkened box, and the liquid is examined from above, the cone of light appears, in the case of fluorescent substances, of a different colour from that of the solution. The striking fact has been elicited that aliphatic substances do not show fluorescence, and the same holds true of alicyclic compounds in which fatty groups predominate. It is contended that all aromatic substances are potentially fluorescent, and that a greater or less degree of fluorescence is to be attributed to the presence of certain groups or radicals which enhance or diminish the effect, each group possessing a specific influence.

THE chemical and electrical effects induced by ultraviolet light in the case of certain elements have recently attracted attention, and explanations have been advanced based on the electronic theory of matter. In this connection an investigation of the photoelectric properties of anthracene, by A. Pochettino (*Atti dei Lincei*, series 5, vol. xv., ii., p. 171), has a special significance. It has long been recognised that anthracene is highly fluorescent, and the author has recently proved that this fluorescence is accompanied by "ionisation" of the air in the neighbourhood of the anthracene. In the paper cited it is shown that the photoelectric effect of anthracene is very nearly the same as that of zinc, and that, as with zinc, the activity decays with time. This decay is, however, observed only when the layer of anthracene exceeds a certain thickness (0·02 mm.), and is attributed to the high dielectric properties of the material, which, by allowing the accumulation of a positive charge on the anthracene, arrests the ionisation effect. The original activity of anthracene which has completely lost its photoelectric properties can be restored, not only by leaving the material in darkness, but by exposing it during a few minutes to the radiation of radium, which serves to neutralise the positive charge. The decay of the activity with time is capable of being expressed by an exponential curve. Similar results are noticed in the case of phenanthrene. The resemblance of the phenomena described to those characteristic of radio-activity again raises the question, suggested by Armstrong and Lowry in 1903, of the relationship of radio-activity and fluorescence. In the case of anthracene, atomic degradation is hardly probable; the fluorescence of anthracene is, indeed, generally attributed to molecular transformation involving the change of one structure into another under the influence of light. Whether radio-activity is not also a molecular, as distinguished from an atomic, change, caused by an external stimulus, similar to, if not identical with, light, is a question which naturally arises from the analogy presented by the two cases.

AN elaborate work on salt and salt mines is in course of publication by Mr. W. Engelmann, Leipzig, for the Vienna Academy of Sciences, under the title "Das Salz: dessen Vorkommen und Verwertung in sämtlichen Staaten

der Erde." The second volume, dealing with salt in Asia, Africa, America, and Oceania, appeared recently, and the first volume, which will be concerned with Europe, is in the press.

THE prominence now given to geometrical and machine drawing in the curricula of schools and colleges has led to an increased demand for trustworthy mathematical drawing instruments. The recent catalogue, with its numerous illustrations, published by Mr. W. H. Harling, of Finsbury Pavement, London, showing the instruments he is prepared to supply, may be commended to the attention of teachers and students. In it they will find particulars concerning a great variety of instruments designed to meet every want.

OUR ASTRONOMICAL COLUMN.

COMET 1906*e* (KOPFF).—In addition to those published by Herr M. Ebell, elliptic elements have been calculated for the orbit of Kopff's comet by Messrs. Crawford and Champreux, and are published in No. 100 of the Lick Observatory Bulletins. They are as follows:—

Elements.

T = 1906 May 2·0877 G.M.T.
Epoch = 1906 Sept. 5·67091 ,,

M = 18° 41′ 54″·6
ω = 19 28 44·9
Ω = 263 45 23·6 } 1906·0
i = 8 44 09·8

log *q* = 0·230114
log *e* = 9·716356
log *a* = 0·549258
μ = 532″·255
Period = 6·66633 years

The first decimal place of the period is determinate, and as this agrees with Herr Ebell's, who gave 6·617 years, it may be taken as fairly established. An ephemeris which accompanies the elements gives the following positions for the remainder of this month:—

Ephemeris (12*h*. *G.M.T.*).

1906	α (true) h. m	δ (true) ° ′	1906	α (true) h. m.	δ (true) ° ′
Oct. 17·5 ...	22 28 ..	5 3	Oct. 25·5 ..	22 30 ...	4 30
21·5 ...	22 29 ...	4 45	29·5 ...	22 32 ...	4 17

JUPITER'S SEVENTH SATELLITE.—From a telegram from Prof. Pickering to the Kiel Centralstelle, published in No. 4123 of the *Astronomische Nachrichten*, we learn that Jupiter's seventh satellite was re-observed by Prof. Perrine at the Lick Observatory on September 25. The position-angle and distance at 1906 September 25·9962 were 119°·1 and 2578″ respectively.

OBSERVATIONS OF VARIABLE STARS.—Bulletin No. 8 of the Laws Observatory, University of Missouri, contains the results of some variable-star observations made at the observatory during 1905–6. A grant of five hundred dollars from the Gould fund of the National Academy of Sciences has enabled the director, Prof. F. H. Seares, to engage an assistant observer, Mr. E. S. Haynes, for this work with gratifying results.

The star B.D. + 55°·2817 has been shown to be a variable of the continuous variation type, with a range of 0·4 magnitude and a period of 5·4 days. Observations of V Lacertæ, V Vulpeculæ, and 108.1905 Capricorni are also recorded. In the case of the last-named, the rise to maximum is very rapid, an increase of 1·5 magnitudes taking place in 1¾ hours, and the observations show that this star is probably not of the Algol type.

SUN-SPOT SPECTRA OBSERVATIONS.—In No. 2, vol. xxiv., of the *Astrophysical Journal*, Mr. W. M. Mitchell, of Princeton Observatory, records the results of his sun-spot spectra observations made during the period October, 1905, to May, 1906. Mr. Mitchell found that during the more recent observations the number of "weakened" lines in the spot spectra has increased considerably; many lines previously recorded as "reversed" are now "weakened," and new lines of the latter type are recorded. A suggestion that this change may be a result of the passing of the sun-spot maximum awaits the confirmation of further observations. Numerous cases of abnormal "reversals" are referred to in the paper. From the observations of reversed lines Mr. Mitchell deduces a temperature for the gases producing these lines of 4700°, and a further deduction gives 0·38 as the ratio of the sun-spot radiation to the radiation from the unaffected photosphere. The spectrum and construction of the chromosphere are also discussed at some length.

CONDENSATION NUCLEI.[1]

PROF. Barus has written more upon the subject of condensation nuclei than any other physicist. In the present memoir, as in those which have preceded it, he arrives at conclusions which are not in agreement with the work of others who have investigated the properties of ions and nuclei. If his investigations are to be trusted, the determinations which have hitherto been made of the charge carried by the ions by means of the condensation method must be regarded as quite untrustworthy. The matter is of sufficient importance, therefore, to justify an examination of Prof. Barus's methods.

The first three chapters, and the greater part of the sixth and concluding chapter, are concerned with experiments upon the production of clouds by the sudden expansion of dust-free air initially saturated with water vapour, the air in most cases being exposed to the action of X-rays or radium. As described by Prof. Barus, the phenomena are exceedingly complicated and irregular. This is not surprising, however, being largely a result of complication in the experimental conditions.

The expansion was brought about by suddenly opening communication between the "fog chamber" and another much larger, partially exhausted vessel, a measured fall of pressure being thus produced. By means of the coronas formed, an estimate was obtained of the size, and hence indirectly of the number of the drops; filtered air was then re-admitted to bring the pressure back to that of the atmosphere. This method of effecting the expansion is not a suitable one for investigations of the kind attempted. For the rate of fall of pressure must diminish as the expansion approaches completion; it is probable that with a suitable width of connecting tube no great error will be introduced into the measurement of the least expansion required to produce a cloud (*i.e.* that the expansion may be made practically adiabatic), but it is unlikely that the maximum degree of supersaturation resulting from expansions greater than this approaches at all closely to that calculated from the pressure fall. For the condensation on the nuclei which first come into action will, by reducing the amount of vapour remaining uncondensed and by the heat set free, prevent the full supersaturation corresponding to the pressure fall from being attained. The larger the number of easily caught nuclei, the more will the maximum supersaturation attained fall short of the theoretical. The method is thus not a suitable one for obtaining information about the number of nuclei corresponding to various degrees of efficiency.

If we produce a cloud in dust-free air upon nuclei which require a high degree of supersaturation to make water condense upon them, the drops which are formed, if caused to evaporate by compression of the air, appear to leave behind nuclei requiring only a slight supersaturation to make water condense upon them. Unless these are removed before expansions large enough to catch the original nuclei are again attempted confusion is sure to follow. The result of neglecting this precaution is not merely that these residual nuclei give rise to drops as well as those under investigation, but unless the apparatus is such as gives exceedingly efficient expansion the supersaturation necessary for the capture of the nuclei under investigation may not be attained, the number of drops produced being thus too small in contrast to what might at first sight be expected. The experiments of Prof. Barus's investigation were performed under conditions which made this effect

1 "The Nucleation of the Uncontaminated Atmosphere." By Prof. Carl Barus. Pp. 152. (Published by the Carnegie Institution of Washington January, 1906.)

conspicuous, the result in many cases being a remarkable alternation of larger and smaller coronas, corresponding to variations in the number of the drops, for successive expansions of equal amount. It is easily seen how, under the appropriate conditions, such an alternation may arise, for the second expansion may remove the greater number of the residual nuclei due to the first, so that the third takes place under conditions similar to those of the first expansion. A large amount of space is given to the study of these alternations, and they are finally traced to their true source after many hypotheses have been suggested for their explanation, "the solutional enlargement" of the nucleus, as the author calls it, being then apparently regarded as a new discovery. Besides incidental references to these residual nuclei in earlier papers, he would have found them described in Thomson's "Conduction of Electricity through Gases," p. 139, or in a review of the subject of condensation nuclei presented to the International Electrical Congress of St. Louis in 1904, and a great deal of labour might have been saved. That small drops of pure water might be expected to cease to evaporate, even in an unsaturated atmosphere, beyond a certain minimum size (related to the thickness of minimum surface tension of thin films) is pointed out by Thomson in the same chapter, p. 153; and a theory (having a similar basis), which explains the permanence of certain slow-moving ions requiring a negligible degree of supersaturation to make water condense upon them, has been given by Langevin and Bloch.

By exposing to intense X-rays the moist air in a "rectangular condensation chamber of wood impregnated with resinous cement," the front and rear faces being of plate glass, persistent nuclei requiring only a very slight expansion to cause water to condense upon them were obtained. The only nuclei hitherto observed in dust-free air exposed to X-rays require large expansions to capture them. That such nuclei should, under the appropriate conditions (the occurrence of chemical action giving rise to soluble products), grow into larger bodies is what might be expected; such a growth has, for example, been observed in the case of the ions arising from a point discharge. It is quite likely that sufficiently intense X-rays or radium rays might bring about in moist air the chemical action necessary for such a growth of the nuclei, as intense ultraviolet light certainly does; but results, obtained with a chamber of wood impregnated with resinous cement and not rigorously shielded from all possible direct electrical effects from an X-ray bulb placed a few cm. from it, are not free from ambiguity.

Apart from this effect of very intense radiation, the conclusions arrived at by the study of the effect of X-rays and radium rays appear to differ from those of other observers. Prof. Barus holds original views, not only upon the relation of "nucleation" to ionisation, but as to the nature of the radiation from an X-ray tube. These are best given in his own words:—

Chapter vi., p. 133: "Let the X-radiation to which the dust-free air is exposed be relatively weak, so that the density of ionisation may remain below a certain critical value. The nuclei observed on condensation are then very small, and they require a high order of exhaustion, approaching but always below the fog limit of non-energised air. They are usually instantaneously generated (within a second) by the radiation, so that their number is definite independent of the time of exposure. They decay in a few seconds after the radiation ceases, *i.e.*, roughly, to one-half their number in 2 seconds to one-fifth in 20 seconds, in the usual way. I fancy that these nuclei are what most physicists would call ions; but nevertheless the particles are not of a size, the dimensions depending on the intensity of the penetrating radiation to which they are usually due, and they pass continuously into the persistent nuclei, as shown in the next paragraph, where decay of ionisation and of nucleation are very different things. They are abundantly produced by the γ rays, which though weak ionisers, become from this point of view strong nucleators."

Chapter vi., p. 142: "While the phosphorescent, photographic, and electric effects of X-radiation decrease rapidly with the distance, D, from the tube, the nucleating effect (N, nuclei generated per cubic centimetre, instantly) is nearly constant over relatively enormous distances. Thus to give two examples among many ($\partial p = 25$ cm.):—

D=	... 6	... 200	... 600	... 6	... 200	... 600 cm.
$N \times 10^{-3}$	88	... 83	... 83	... 79	... 79	... 79 ,,

The law of inverse squares would predicate a reduction of 10,000 to 1 between these limits; and in fact, at 6 cm. the phosphorescent screen is intensely luminous, at 200 cm. very dim, at 600 cm. quite dark as in the case of any ordinary illumination. The leaves of an electroscope within a glass bell jar collapse in a time which is directly as the square of the distance from the energised X-ray bulb. The result obtained with nuclei is astonishing; the nuclei-producing radiation would, at first sight, seem to be of an extremely penetrating kind, akin to the gamma rays of radium, and distinct from the ordinary phosphorescence-producing X-rays."

Chapter vi., p. 144: "To the eye of the fog chamber therefore the walls of the room are aglow with radiation, and no matter in what position the bulb may be placed (observationally from 6 cm. to 6 m. between bulb and chamber) the X-illumination as derived from primary and secondary sources is constant everywhere. It is to be understood that the X-illumination here referred to may be corpuscular. In fact, so far as I see, the primary and secondary radiation here in question may be identical; for the corpuscles may come from the circumambient air molecules shattered by the shock of gamma rays."

Chapter vi., p. 145: "It has been shown that for very short exposures (sections 101 and 102) the nucleation is the same, whether the bulb is placed at 6 cm. or 6 m. from the fog chamber. But only in the former case (D=6 cm.) is the effect cumulative; only for very short distances will persistent or very large nuclei appear if the exposure is prolonged several minutes. I have therefore suspected that the radiation from the X-ray bulb is twofold in character; that the instantaneous effect (fleeting nuclei) is due to a gamma-like ray, quick moving enough to penetrate several millimetres of iron plate appreciably even for D=6 metres; furthermore that the cumulative effect (persistent nuclei) is due to X light, properly so called, which produces the usual effects subject to the laws of inverse squares; but it is noteworthy that while the penetration of X-rays is relatively small, and the distance effect negligible (section 101), they are both large for the radiation from radium (section 104)."

The conclusion that the nucleus-producing radiation from an X-ray bulb is constant over distances varying from 6 cm. to 6 m. (or as elsewhere expressed that "the whole medium within the room is almost equally energised throughout") is somewhat startling. One would not expect the number of nuclei present at a given moment in any case to fall off inversely as the square of the distance; the number of ions might under suitable conditions be expected to vary inversely as the distance; but the fact that there is no falling off at once suggests that there is something wrong with the experiments or the interpretation put upon them. Possibly the observed constancy is partly due to the failure of the method to deal with more than a limited number of nuclei. Some of the results, however, suggest that it may have been partly due to the failure to shield off the rapidly changing electric field produced by the working of the coil.

There is more danger of the statements of the first paragraph quoted above leading to confusion. The expression "fog-limit" apparently indicates the smallest pressure fall which produces a sufficiently large number of drops to admit of a corona being observed. Previous expansion experiments, in which a sudden definite volume change was produced, have shown three critical or limiting values of the expansion (measured by the ratio of the final to the initial volume). These are 1·38, beyond which dense fogs begin to be produced in dust-free air under normal conditions; 1·25, the least expansion required for the capture of negative ions; and an intermediate one in the neighbourhood of 1·31, the least expansion required for the capture of positive ions. Certain apparently uncharged nuclei require an expansion of about the same amount as do the positive ions. Ions of both kinds are always present in small numbers in the air of a closed

vessel unless an electric field is present to remove them as they are set free; an expansion exceeding 1·25 gives, in the absence of such a field, fog or rain, according as the air is exposed to external ionising agents or not. The above three limits would correspond to adiabatic pressure falls of 27·7, 20·5, and 24·1 cm. of mercury respectively, if the initial pressure was 76 cm., and would vary with the initial pressure. The fog limit obtained by Prof. Barus for air exposed to X-rays or radium rays, except under conditions such that persistent nuclei resulted, generally lay between 19 and 21 cm., except when the radiation was exceedingly weak, when the limit approached that which he obtained for "non-energised" air, about 24 cm., which may be compared with the intermediate critical expansion mentioned above. The results of Prof. Barus are accounted for if we suppose that his method failed to detect the comparatively small number of drops formed on the spontaneously produced negative ions; such variation of the limit as was observed in air exposed to external radiation, as the intensity was varied within moderate limits, being what might be expected with a method in which the "fog limit" is only reached when a certain minimum number of drops is exceeded. It is true that the ions are not at any one moment all in an equally favourable condition for helping condensation, a certain range of expansions (not very wide, however) being required, for example, to catch all the negative ions; but there is no evidence that the efficiency of the ions as nuclei increases with the intensity of the ionising rays, if we leave out of consideration the possible effect of exceedingly intense rays; for the weakest radiation (that responsible for the "spontaneous" ionisation), as well as for radiation of very considerable intensity, the efficiency of the most favourably situated ions remains the same. Prof. Barus has apparently failed to notice that the limits found by him are, if properly interpreted, in fairly good agreement with those of previous observers—quite as good agreement as could be expected from the comparative roughness of his methods. Possibly some explanation of this omission is afforded by a passage on p. 50, where the volume change corresponding to a given pressure fall has been wrongly calculated, as if the expansion were isothermal instead of being nearly adiabatic.

It is a matter of some difficulty to know what views Prof. Barus really holds upon the relation of the ionisation as determined by electrometer measurements and the "fleeting nuclei" which "most physicists would call ions." That he does not regard such nuclei as identical with the ions is plain from the statement that the gamma rays, though weak ionisers, are strong nucleators, as well as from the suggestion that the fleeting nuclei produced by an X-ray bulb may be due to "a gamma-like ray," and only the persistent nuclei to the "X-light properly so called, which produces the well-known effects subject to the law of inverse squares" (the ionisation as determined by electrometer measurements being one of these, as another of the passages quoted seems to indicate). Prof. Barus seems to have entirely failed to realise how complete is the evidence of the identity of the nuclei produced, in the investigations of previous observers, by X-rays or any of the various types of Becquerel rays with the ions the existence of which has to be postulated to explain the phenomena of the conduction of electricity through the air exposed to such rays. Not only has it been shown by direct experiments that the nuclei are positively and negatively charged bodies having properties such as have to be assigned to the ions to explain the phenomena of conduction through gases, but a still more direct proof of the identity is furnished by the agreement of the two methods by which the charge on the ions was determined, that of J. J. Thomson and that of H. A. Wilson. For the former gives the ratio of the ionisation (the product of the number of the ions per c.c. and the charge carried by each), as determined by electrical methods, to the number of the nuclei, while the latter gives directly the actual charge of a single nucleus. Thus the number of nuclei, multiplied by the charge on each nucleus, is equal to the product of ionic charge and number of ions deduced from electrical measurements. The ionisation accounted for by the nuclei in question is thus equal to the ionisation determined by the electrical method.

Chapters iv. and v. contain an account of observations made at Providence and in the comparatively uncontaminated atmosphere of Block Island upon the variations in the number of nuclei in unfiltered atmospheric air. The nuclei are here such as may be caught with smaller expansions than are required by the ions; they are Aitken's "dust" particles. Their number was estimated, not by Aitken's method, but by observing the coronas seen through the fogs produced on expansion of the air in an apparatus of the same type as that used in the investigations already discussed. In the present case, where only easily caught nuclei are involved, the objections brought above against the method do not apply, and there can be no doubt about the importance of such investigations.

C. T. R. WILSON.

BOTANICAL CONGRESS AT HAMBURG.

THE Society of Applied Botanists held its annual conference at Hamburg in September, and the Society of Systematic Botanists held its meeting there at the same time. Some 150 botanists in all, mostly interested in applied botany, attended. The choice of place of meeting was a happy one, as in Hamburg, the chief Continental port, the closest connection can be seen between commercial and scientific activities.

All the botanical institutions are under the direction of Prof. Zacharias, and while the educational requirements are well cared for, everything that the botanical scientific staff can do to foster the trade of the city is done. The seed-testing station is under the direct charge of Prof. Voigt, who, with six assistants, tests some 1500 samples of seed, oil-cake, &c., each year. An important export seed trade with the Argentine Republic is carried on, the certificates required by the Republic being supplied from the station. Another important institution is the Station for Plant Protection, founded some seven years ago as a means of protection for the vineyards and orchards of Germany against the San José scale insect and other pests liable to be imported into Germany on American apples, fruit-trees, &c. This station is in charge of Dr. Brick, who, armed with the necessary staff, library, and apparatus, must report on every barrel of apples coming into port. The rejected apples, dangerous to Germany, find a ready market in England and elsewhere.

In the Botanical Museum the collections are arranged in two sections. One part follows the usual lines—the specimens are arranged in systematic order, according to their natural affinities, and serve more especially for educational purposes. The other part of the collection appeals to commercial interests. The fibres of commerce, the chief rubbers, gums, resins, cereals, &c., are in each class grouped together, regardless of natural affinities, and solely for trade purposes. A new and more commodious museum in the Botanic Gardens is just reaching completion. The museum is regularly visited by schools and their teachers, and a large piece of ground is set apart in the suburbs to supply the specimens required in the schools for teaching purposes.

Everything that could be was done by the local botanical staff and others to make the meetings of the societies a success. The Hamburg Government granted a sum of 4000 marks toward expenses, and in other different ways showed a practical interest in the proceedings. One important feature was the first International Conference on Seed Testing. Most of the seed stations in the world were represented, and attempts to establish a uniform system of testing, applicable in different countries, were discussed. It was generally felt that it would be premature to seek to go further at present than simple discussion. Many valuable papers were contributed. Dr. Stebler gave the results of twenty years' investigation in the station at Zürich as to the country of origin of the seeds of commerce, judged sometimes from the particles of soil found in the impurities (!), but more usually from the weed-seeds present. This paper was fully illustrated by dried plants and seeds. Dr. von Weinzierl, of Vienna, dealt with sugar-beet and mangel seeds; Dr. Degen, of Budapest, with dodder in clover; Prof. Rodewald, of Kiel, with the sources of error in seed-testing; while Prof. Voigt, of Hamburg had pre-

pared a comparative report embodying the rules governing seed-testing in Germany, Russia, Scandinavia, and the United States of America. Surprise was expressed that there was only one Government seed station in the United Kingdom—that in the present writer's charge in Dublin, where during the past year 1476 samples were examined.

A paper which aroused considerable interest was that by Prof. Warburg urging the claims of tropical agriculture on behalf of the German colonies, and the conference adopted resolutions urging the necessity of:—(1) The erection of a central imperial institute in connection with the Biological Institute at Dahlem, for the study of tropical agriculture and forestry. (2) Conversion of the botanical garden in Victoria, in the Cameroons, into an agricultural institute of the first order. (3) Foundation of similar institutes in Togo and the South Sea Islands. Prof. Warburg thought that a banana trade in German West Africa could be developed, that rubber could be made available in increasing quantities by cultivation of rubber trees, and that mistakes had been made by attempts to apply to tropical countries the crops and methods of cultivation found to succeed in Germany.

Many important papers on other subjects by Profs. Drude, Zacharias, Aderhold, Appel, Vañha, &c., were read, but limitations of space prevent further mention here. A detailed official report is in course of preparation. The systematists, with Dr. Engler as president, devoted one day to the Heide near Wintermoor, where, under Dr. Graebner's guidance, fine specimens of native Juniperus, and many other features, wild and cultivated, of the moor, which is of enormous extent, were seen. While attempts are being made to restore to profitable cultivation land which is now in possession of heather, and was formerly covered with oak and beech, one portion, some fifty acres in extent, near Totengrund, has been bought by Prof. Thomsen, of Münster, and presented by him to the nation as a permanent "nature memorial."

T. J.

METEOROLOGICAL OBSERVATIONS.

TERRESTRIAL Physics in Messina.—The *Annuario* of the Messina Observatory for the year 1905 shows that Prof. G. B. Rizzo has made a good beginning in the important task recently imposed upon him by the faculty of the university. The climate of Sicily is fairly well known so far as the principal towns are concerned, thanks to the efforts of the directors of the large observatories of Palermo and Catania and others, but, as Prof. Rizzo points out, little or nothing is known about the conditions of the other parts of the island. To remedy this want a number of rainfall and temperature stations have been established during the last year in the province of Messina, and have recorded observations from the beginning of 1906. On the initiative of the International Meteorological Committee, the Solar Committee of which Sir Norman Lockyer is president is carrying out an important study of the connection of solar and terrestrial phenomena; for Italy, Prof. Riccò at Catania and Prof. Rizzo at Messina are actively engaged in the investigation on the general plan laid down by the committee. For the study of earthquake phenomena one of Vicentini's microseismographs has been erected; in connection with this subject Prof. Rizzo is investigating the facts relating to the terrible Italian earthquake of September, 1905, with the cooperation of more than eighty observatories in various parts of the world. The seismograms show that the disturbance was felt from Norway to the Cape of Good Hope, and from California to New Zealand. The complete results will shortly be published.

Meteorology in the United States.—The report of the U.S. Weather Bureau for the fiscal year 1904–5 (pp. xxiv+384) gives a brief survey of the development of the weather service during ten years' administration of the present chief (Prof. W. L. Moore). The magnitude of the work now performed by it is almost astounding; indeed, Prof. Moore claims that in the results accomplished for the benefit of the farmer, the sailor, the seeker after health or pleasure, and others, there is no weather service in the world comparable with it. The estimated amount of the expenditure for the year exceeded 278,000*l.*, and the appropriation for the following year, including the support of Mount Weather Observatory (Virginia), an institution devoted purely to meteorological research, exceeded 290,000*l.* The supervising director of that observatory is Dr. W. J. Humphreys, late professor of physics in the University of Virginia, and Prof. Moore states that Mount Weather may be expected to do as much for the science of meteorology as the service has already done for the material interests of the United States. It is stated that the daily distribution of weather forecasts and charts has increased to nearly 623,000, of which 158,000 represent printed reports. Weather maps are printed at nearly 100 local stations, and daily telegraphic reports are received from the Azores and west coasts of Europe, and the Bureau has developed one of the best wireless systems now in use. The Navy Department has instructed its wireless stations to receive and promptly transmit to the ocean or other places where the information can be made useful the storm warnings of the Weather Bureau, and has requested vessels having the use of its wireless stations to take observations and to transmit them to the Bureau, *without charge against the Department of Agriculture.* With a further extension of wireless telegraphy, it is thought that the reports will render possible a storm-warning service for the western coasts of Europe and for vessels in mid-ocean. Arrangements have been made for aërial research by liberating unmanned balloons from many stations, in cooperation with those at Mount Weather.

The last semi-annual Bulletin of the Colorado College Observatory contains the annual meteorological summary for 1905. The present observatory, erected in 1894, is about 6040 feet above sea-level, and was the gift of Mr. H. R. Wolcott, of Denver; the director is Dr. F. H. Loud. It is well equipped with astronomical and self-recording meteorological instruments; the college became a voluntary station of the U.S. Signal Service in 1878. The mean temperature of the year 1905 was 46°·1, mean maximum 58°·8, minimum 33·5, absolute maximum 91°, in June and August, minimum −22°, in February. The yearly rainfall was 15·9 inches, number of rain-days 70. The Bulletin also contains monthly summaries of weather records at Colorado Springs between 1872 and 1903, which have been collected from various sources with considerable labour by Mr. C. M. Angeli, and prepared for press by Mr. C. D. Child; their present publication is merely preliminary, in view of numerous demands for historical information, and is subject to later revision.

Observations in Mauritius.—The annual report of the director of the Royal Alfred Observatory, Mauritius, for 1905, shows that the rainfall there was much above the average of the last thirty years, viz. 67·90 inches as compared with 48·27 inches; in January the fall was 21·16 inches, or 12·77 inches above the normal, and is the greatest on record. The maximum shade temperature was 89°·0, in November, and the minimum 52°·3, in August; the highest temperature in the sun's rays was 156°·4, in January, the highest on record being 165°·5, in February, 1898. From observations obtained from ships' logs, the tracks of seven cyclones in the Indian Ocean were laid down; 474 photographs of the sun were sent during the year to the Solar Physics Committee. Fifty-three earthquakes were recorded. The registered velocity of the wind was below the average in every month except April; Mr. Claxton remarks that a comparison of the records of the Robinson and Dines anemometers in use at the observatory in the years 1904–5 indicates that one or both are untrustworthy as standard instruments.

Rainfall in German South-West Africa in 1904–5.—Notwithstanding the considerable damage and loss of records due to the rebellion of several tribes, complete results from twenty-eight stations are published in *Wissenschaftliche Beihefte zum deutschen Kolonialblatte*, Band xix., 2 Heft. The total number of stations which have suffered during the last two years amounts to forty, but steps are being taken to replace the instruments as soon as practicable. The rainfall of the year in question was, on the average, only about three-fourths of that in the previous year—in the central and southern parts only about one-half. The principal rains fall between January and March; the greater

part of the annual amount is sometimes made up in the course of a few days. At Okombahe, for instance, two-thirds of the annual amount of 11¼ inches fell in the course of four days (January 27–30), and of this amount 5 inches fell on January 28. Generally speaking, little or no rain falls between May and September, inclusive.

Report of the Liverpool Observatory, 1905.—This observatory, maintained at Bidston by the Mersey Docks and Harbour Board, is one of the oldest and best equipped in the United Kingdom, and it transmits daily telegraphic reports to the Meteorological Office. Under the head of automatic instruments are included anemometers of the forms designed by Dines, Osler, and Robinson. We give the comparative maximum records of these during two of the heaviest gales of the year :—

	Dines. miles	Osler. lb. on sq. ft.	Robinson. miles per hour	Direction
1905, Jan. 8 ...	73·3 ...	32 ...	55 ...	S.W.
,, Nov. 26 ...	70·1 ...	40·5 ...	68 ...	W.
,, ,, 27 ...	77·0 ...	33·2 ...	61 ...	W.

The gusts recorded by the Dines and Osler anemometers were not exactly at the same time; the figures seem to show that the force of the gusts differs considerably at different points of the same locality. With respect to observations with Milne's seismograph, Mr. Plummer makes the interesting remark that during the time of the recent Antarctic expedition many earthquakes recorded by the exploring party were registered on the instrument at Bidston, although intermediate stations did not in all instances record the tremor. The average number of astronomical observations made with the transit instrument has been practically maintained during the year.

South African Meteorology.—Under the title "South Africa as seen by a Meteorologist," Dr. H. R. Mill gave a lecture before the Royal Meteorological Society on March 21, and an abstract has now been published. The address contains much instructive matter, but Dr. Mill's meteorological notes naturally refer chiefly to rainfall. Table Bay was reached on August 15, 1905, the minimum temperature at Cape Town being only 38°. The most unusual part of the meteorological equipment at the Royal Observatory was the size of the standard rain-gauge, having a diameter of about 11¼ inches; at other stations in the colony the size is 8 inches. The usual exposure of the gauges in South Africa is 4 feet high, a fact, as Dr. Mill observes, that must be borne in mind when comparing readings with gauges in this country, where they are usually placed at a height of 1 foot. Meteorology in Cape Colony suffers, the author states, by the excessively small annual grant available, and the opinion is expressed that the good work done at Kenilworth (Kimberley) makes it desirable that the institution should be placed on a permanent footing. The Transvaal Government spends a comparatively large sum on meteorological observations; at Johannesburg the observatory is admirably fitted up, and the site offers peculiar advantages for anemometer work. The rain gauges here and in the Orange River Colony are 5 inches in diameter. The site of the observatory at Grey Town is not a very good one, and is shortly to be changed. Meteorology at Bulawayo is under the charge of Father Goetz, to whose work we recently referred; he has constructed an ingenious electrical recording rain gauge which is apparently very efficient. On the homeward journey a visit was made to the Portuguese station at Beira; with regard to this observatory, Dr. Mill remarks that it is "an imposing structure and the rain gauge is of heroic dimensions." This interesting paper is embellished by many photographic illustrations.

Report of the Observatory Department of the National Physical Laboratory for the Year 1905.—As this branch is in many respects complete in itself, and its work appeals to a different class from that interested in the other departments, the director thinks it desirable to issue the report separately. The magnetographs have been in constant operation throughout the year, and the curves have again been free from any very large disturbances; the most interesting movements were those of November 12 and 15. On the latter date an auroral display was generally observed (NATURE, November 30, 1905, p. 101). The mean declination during the year was 16° 32′·9 W., mean inclination 67° 3′·8 N. Owing to the disturbance of the vertical force produced by electric trams, it was found impossible to tabulate the curves for this element satisfactorily. The meteorological traces and tabulations have been, as usual, sent to the Meteorological Office for publication, therefore only the results are given as an appendix to the report in question. The maximum shade temperature was 81°·5, on July 8, and the minimum 22°·4, on November 22 (23°·4 on January 19). The rainfall was 22·61 inches, and the number of rain days 154, including five days on which snow was recorded. The number of instruments verified (exclusive of watches and chronometers) amounted to 26,658, being a considerable increase as compared with the previous year; about 60 per cent. of these instruments were clinical thermometers.

The Warm Air Current at the Height of 10–12 *Kilometres.*—In the *Meteorologische Zeitschrift* for June, Dr. R. Nimführ discusses the question of one of the most interesting results of the international balloon ascents, viz. the "inversion of temperature" at an altitude of 8–13 km. pointed out by M. L. Teisserenc de Bort (*Comptes rendus*, April 28, 1902), and by Dr. Assmann at an altitude of 10–15 km. (*Sitzb. Akad.*, Berlin, May 1, 1902). Dr. Nimführ states that the French experiments were made with paper balloons, that in about half the ascents the maximum height of the balloon was at the critical altitude of 11–12 km., and that consequently the instruments were affected by solar radiation owing to decrease of ventilation; also that Dr. Assmann's experiments were probably similarly affected, although to a less extent, as he used closed rubber balloons. Dr. Nimführ thinks that the lifting power of the balloons was decreased in the higher regions owing to the rubber becoming porous by expansion; further, that the bimetallic thermometer used in some ascents is subject to a fundamental error, now under further investigation, which possibly affects some of the results obtained. We offer no comments on the questions raised; they will no doubt receive full consideration by those engaged in this important branch of meteorological inquiry.

Rainfall in the Philippines.—The Bulletin for December last, issued by the Weather Bureau of Manila, under the direction of the Rev. Father Algué, contains a table of the monthly and annual distribution of rainfall in 1905 at fifty-three stations scattered over the different islands of the archipelago. It is shown that the stations may be arranged in three groups :—(1) where the fall is uniform in the various months; (2) where the rainfall is scarce from December to March inclusive; (3) stations with abundant rains from June to October, and little in the rest of the year. At some stations the amounts are large, *e.g.* Baguio, an elevated plateau, more than 165 inches, while eighteen of the other stations have falls varying from 79 inches to 115 inches. From the results of the last five years' observations at Baguio we note that the mean annual temperature there is 65°·3; the lowest monthly mean is 61°·3, in February, and the highest 67°·1, in April and May. The absolute maximum was 84°·7, in April, and the minimum 42°·8, in February. Rain falls on an average on 171 days, mostly between May and October.

DISEASES OF SHEEP.

PROBABLY few persons, unless they have had reason to study the matter, have any idea of the immense economic importance of the diseases of animals. As a matter of fact, our flocks and herds are every year stricken down to an extent representing a value of hundreds of thousands of pounds!

In 1901 a committee, consisting of Prof. Hamilton, Mr. J. McCall, and Mr. E. G. Wheeler, with Mr. R. B. Greig as secretary, was appointed by the Board of Agriculture to investigate and report on the diseases of sheep known as louping-ill and braxy, and the findings of this committee have lately been published in a voluminous and interesting report.

Louping-ill is a disease which shows itself in the form of nervous spasms of the limbs and neck, or rigidity, followed by more or less complete paralysis; sometimes, however, there is a general dazed condition with speedy

collapse. It does not seem to be known in foreign countries, but in the British Isles is met with particularly on the west coasts of Ireland and Scotland, in Cumberland and Westmorland, and in small, scattered areas throughout the country. Sheep of all ages may be attacked, and the mortality may amount to 20 per cent. or even more.

Braxy is often a rapidly fatal disease. The animal goes off its feed, is restless, the belly swells, it falls on its side, becomes semi-comatose, and death soon ensues, the carcase having a characteristic odour. The disease prevails in several countries of northern Europe, and in the British Isles on the west coasts of Ireland and Scotland, central Wales, Westmorland and Northumberland, Cornwall, Wilts, and Gloucester. Sheep under one year are the chief sufferers.

A remarkable feature of both these (and certain other) diseases of the sheep is their seasonal prevalence; thus louping-ill and braxy are not met with during July and August, and the former is most prevalent from April to June, the latter from November to February.

In the case of louping-ill, for a long time the specific cause remained a mystery, carcase after carcase examined showing no lesions, and inoculations of the blood, &c., failed to convey the disease from one sheep to another. At last, examination of the fluid in the peritoneal cavity revealed the presence of a large sporing anærobic bacillus (Fig. 1), which, on inoculation into healthy sheep, conveyed the disease again and again. It was for a long time an enigma how this bacillus reached the peritoneal cavity, the blood and tissues being free from it. Eventually, however, in a diseased lamb the intestine was found to be swarming with the bacillus, and a long series of experiments proved that the organisms or their spores are taken in with the food, and if at the susceptible period of the year induce the disease in a large proportion of cases. The organism, being passed with the dejecta, fouls the pasture, and so the disease is propagated. Precisely the same holds good for braxy, which, however, is caused by an organism different from the louping-ill bacillus, the braxy organism being also an anærobic sporing bacillus, but being much smaller and more delicate than the louping-ill bacillus (Fig. 2).

Attempts to immunise by means of injections of attenuated organisms or by chemical products of the organisms proved not only failures, but dangerous on account of the mortality. Taking into account the fact that the organisms are intestinal, the happy idea of drenching the animals with cultures during the insusceptible period was adopted, and proved a decided success on the large scale. Thus, with louping-ill, 1340 sheep were treated in this manner, and a single doubtful death from the disease occurred; with braxy, 1545 sheep were treated, and there were nine possible (three being doubtful) deaths from braxy among them.

A remarkable discovery was made with regard to the seasonal susceptibility and immunity. It was found that during the period of immunity the blood of the sheep proved highly bactericidal towards the louping-ill and braxy bacilli, while during the susceptible period the bacilli were not only not destroyed by, but grew well in, the sheep's blood.

As already indicated, the diseases are mostly communicated by the fouling of the pastures by the dejecta. It has been held by some that the sheep-tick plays a part in their transmission, but experiments showed that this could only be to a very insignificant extent.

The report, which is illustrated with a number of figures and maps, is highly suggestive in many directions; the researches made promise to throw new light on the pathology of many of the contagious and infectious maladies of man and the lower animals, and we congratulate Prof. Hamilton and his collaborators on the valuable work they have done.

R. T. HEWLETT.

FIG. 1.—Bacillus of Louping-ill in peritoneal liquid of sheep, showing the rods, some without spores, others with spores in their interior. ×1000 diameters.

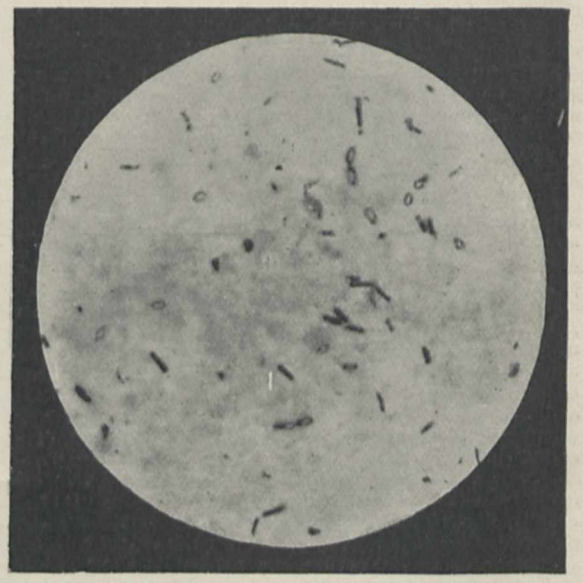

FIG. 2.—Bacillus of Braxy, peritoneal liquid of sheep, showing the comparatively delicate rods, some sporing, others not; those sporing have an oval or lanceolate form. ×1000 diameters.

THE NEW MUSPRATT LABORATORY OF PHYSICAL AND ELECTROCHEMISTRY AT THE UNIVERSITY OF LIVERPOOL.

THE laboratory of physical and electrochemistry, which the University of Liverpool owes to the munificent generosity of Mr. E. K. Muspratt, president of the council of the University, was formally opened by Sir William Ramsay, K.C.B., F.R.S., on Saturday, October 13. The distinguished company which assembled in Liverpool for the occasion included, amongst others, the following well-known men of science from abroad:—Prof. Ostwald (Leipzig), Prof. R. Abegg (Breslau), Prof. Ernst Cohen (Utrecht), Prof. H. Goldschmidt (Christiania), Prof. Lash Miller (Toronto), and Prof. Macallum (Toronto).

On Saturday forenoon the guests inspected the new laboratory privately, and were afterwards entertained to lunch by Sir John Brunner, Bart., M.P., at the University Club, many other prominent men of science and letters in

Liverpool being also present. At 3 o'clock the opening ceremony took place in the arts theatre of the University, a large and distinguished company being present. Mr. E. K. Muspratt formally presented the new laboratory to the University, and in a very interesting speech expressed his conviction that physical chemistry was that branch of chemistry which was most likely to advance knowledge at the present time. Sir John Brunner had founded the chair of physical chemistry at Liverpool. In order to complete this valuable gift a laboratory was necessary, and so he (Mr. Muspratt) had resolved to build and equip a laboratory of physical and electrochemistry. He was glad to see that a considerable number of rooms had been reserved for research work in the new building. He wished to emphasise in the strongest manner the necessity of research being most actively carried out in the University. He was convinced of the importance of electrochemistry, and so he had taken care that the new laboratory should have an adequate electrical equipment.

Vice-Chancellor A. W. W. Dale formally received Mr. Muspratt's gift on behalf of the University, the Earl of Derby, Chancellor of the University, not being able to be present. The Vice-Chancellor referred in glowing terms to the liberality and generosity of Mr. E. K. Muspratt, who had already increased his original gift of 10,000*l.* to something like 14,000*l.* Sir W. Ramsay, in an interesting address, dealt with the paramount necessity of cultivating the "troublesome habit of thinking," as against the subconscious or semi-unconscious processes of brain action. It was the duty of the University to strive with all its power to induce young men to cultivate independent thought. A man might be a walking dictionary, but, if he was, he had all the defects of a dictionary—the words were there, but they formed disconnected and desultory reading. The power to be desired was not specially to remember the words, but to build them up into living sentences. The chief duty of a chair of physical chemistry was to teach men to think for themselves. He would advise that as soon as might be the student of that fascinating subject should be induced by example, precept, sympathy, exhortation, and by all means whereby young human minds could be influenced, to extend the bounds of their subject.

After Sir John Brunner had moved a vote of thanks to Sir W. Ramsay for his very interesting address, which was seconded by Prof. Donnan, the company adjourned to inspect the new laboratory. At five o'clock Prof. Ostwald delivered a highly original and interesting address on the fundamental principles of chemistry, in which he showed that the phases occurring in nature are all solutions, and that the concepts of pure substances are only ideal limiting cases. In fact, a "pure" substance was simply a phase which, within certain limits, boiled or froze at a constant temperature. It was an artificial product. In the evening the guests of the University were entertained to dinner at the University Club by the Liverpool section of the Society of Chemical Industry.

The following brief description of the new laboratory may be of interest to the readers of NATURE. The building, which is connected with the main chemical institute, contains a basement, ground, first, and second floors. The basement includes a dynamo room, battery room, furnace room, store, and a research room for six students. The generating plant consists of motor-generators driven off the city mains at 460 volts, and comprises a 30-kilowatt direct-current generator supplying current at 80–100 volts, a 10-kilowatt charging set consisting of two machines on the same axis each giving 250 amperes at 20 volts, and an 80-kilowatt alternator with two windings to give 1000 amperes at 80 volts or 500 amperes at 150 volts. The charging set is employed to charge in sections a battery of thirty-six Tudor cells, divided up into six sets of six cells, so that different floors or rooms may have the use of separate sets. Vertical cables carry the current from the machines and accumulators to four distributing exchange-boards (one on each floor), whence run circuits (to carry 50 amperes) to the working benches. It is possible by means of flexible connections to connect up on the exchange-board the terminals at each working bench with the required voltage. From the battery switch-board three wires run to each of three exchange-boards, the arrangement being such that each of the latter is supplied with current at 4, 8 and 12 volts from a different set of cells. Specially heavy cables and terminals are arranged to permit of employing 1000 amperes (direct or alternating) in the basement furnace room. The ground floor contains a lecture room with accommodation for about ninety students, a preparation room, library, workshop, and photographic room. The second floor contains a junior laboratory to hold twenty-one students, a balance and switch room, an optical room, a room for three advanced students, research room for a member of the staff, and an instrument store room. The second floor comprises a senior laboratory for eight students, a balance and switch room, and four research rooms. On the roof there is a lavatory, a distillation room, and arrangements for carrying out work in the open air.

All working benches are supplied with gas, water, and electricity. The current is carried by uninsulated wire run on the walls and ceilings by means of wooden battens and porcelain insulators, and terminating in slate panels fixed on wooden battens above the working benches. Close to each bench is a fire-proof slab constructed of compressed red Ruabon tiles set in cement. Each centre bench carries a sink at one end and a thermostat at the other.

The architects of the building are Messrs. Willink and Thicknesse, Castle Street, Liverpool.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. Somerville, Sibthorpian professor of rural economy, has been elected to a fellowship at St. John's College.

Mr. J. E. Marsh, F.R.S., Balliol College, has been elected to a fellowship at Merton College.

Scholarship examinations in natural science have been announced for the following dates:—December 4, Balliol, Christ Church, and Trinity Colleges; December 11, University, Magdalen, and Lincoln Colleges; January 15, 1907, Jesus College.

CAMBRIDGE.—Dr. G. H. F. Nuttall, F.R.S., fellow of Christ's College, and university lecturer in hygiene, has been appointed the first Quick professor of biology; until the Senate shall otherwise determine, "to devote himself to the study of the Protozoa, especially such as cause disease, and generally to promote that branch of study." Owing to the terms of the will of the late Frederick James Quick, the professorship is not tenable for more than three years without re-election.

The voting on the proposed changes in the mathematical tripos will take place at 2 p.m. on Thursday, October 25.

The Government of India has awarded Mr. A. R. Brown, "Anthony Wilkin" student in ethnology and archæology, the sum of 300*l.* to assist him in carrying on his researches amongst the natives of Andaman and Nicobar Islands.

Mr. H. Yule Oldham, the reader in geography, will give a course of public lectures this term on the history of geographical discovery, on Thursdays at 5 p.m., beginning to-day, in the Sedgwick Museum.

The Clerk Maxwell scholarship is vacant by the resignation of Mr. O. W. Richardson, who has accepted a professorship at Princeton, New Jersey. Candidates for the scholarship should send their applications to Prof. J. J. Thomson.

MR. J. W. MCBAIN has been appointed lecturer in chemistry at University College, Bristol. Mr. McBain is a graduate of the University of Toronto, and has also studied for several years in Germany.

NEW physical and engineering laboratories were opened at Edinburgh University on Tuesday. Mr. Balfour presided over the ceremony, and an address on the progress of scientific research was given by Mr. Andrew Carnegie.

THE *British Medical Journal* states that the authorities of the Victoria University, Manchester, have received a sum of 5000*l.* from the trustees appointed under the will of the late Miss Middleton, and have allocated this amount towards the endowment of the chair of anatomy.

THE year-book of the Michigan College of Mines, a pamphlet of 132 pages, accompanied by an atlas of views showing the methods pursued and the facilities for practical instruction afforded by the immediate surroundings, has been received. Established in 1885, and situated in the centre of the Lake Superior mining district, the college furnishes an excellent practical and theoretical training in mining and kindred subjects.

A COURSE of eight lectures on "The Carbohydrates and their Relations to Living Organisms" will be given in the physiology department of University College, University of London, by Dr. S. B. Schryver, on Wednesdays at 5 p.m., beginning on Wednesday, October 24. These lectures are open to all students of the University of London, also to qualified medical men on presentation of their cards, and to such other persons as are specially admitted.

A COURSE of four lectures on the "Phylogeny of the Higher Crustacea" will be given in the zoological lecture room of University College, London, by Dr. W. T. Calman, at 5 p.m., on Wednesdays during October and November, beginning on October 24. The lectures are for advanced students of the University and others interested in zoology. There is no fee for the course; cards of admission may be obtained on application to Mr. P. J. Hartog, academic registrar of the University.

AT the opening of the winter session at St. Andrews University on October 12, Principal Donaldson announced that the Lord Rector, Mr. Carnegie, has offered 10,000*l.* to build such an addition to the University library as will provide ample space for all the books of the University, and a room where students can read with perfect quiet and with easy access to whatever they may require. Mr. Carnegie has also promised a donation of 11,500*l.* for a physical laboratory at University College, Dundee.

ACCORDING to *Science*, improvements have been made during the summer at Cornell University which will greatly strengthen the scientific work. New and enlarged quarters have been provided for the engineering department and the departments of geology, physics, and biology. Quantitative and organic laboratories have been provided for the chemical department. A large amount of apparatus has been secured for the different subjects. By the death of the sister of the late Mr. W. W. Guiteau, the University will receive the legacy left by him, said to amount to between 20,000*l.* and 40,000*l.*

THE Board of Education, South Kensington, has issued the following list of candidates successful in the competition for the Whitworth scholarships and exhibitions, 1906:—(1) *Scholarships (tenable for three years), 125l. a year each*:—Frederick G. Turner, London; William E. Hogg, London; Sidney G. Winn, London; Samuel Lees, Manchester.—(2) *Exhibitions (tenable for one year), value 50l.*:—William F. Cobbett, Gosport; William H. Mead, Southsea; Arthur Williams, Brymbo, Wrexham; James Bradley, Hollinwood, Lancs; George E. Morgan, Portsmouth; Albert C. H. Connor, Gillingham, Kent; Edgar J. Mitchell, Devonport; George O. Dawe, Devonport; Ernest Bate, London; Henry W. Turner, Portsmouth; William H. C. Coombe, Devonport; Edwin M. Vigers, London; Ronald E. Widdecombe, Saltash; Frederick R. Rogers, Devonport; Frank H. Cothay, Sunderland; Sidney Vernon, Abbey Wood, Kent; Frank R. Bloor, Gillingham, Kent; George W. Burley, Meersbrook, Sheffield; Robert James, Pembroke Dock; Sidney C. Gladwyn, London; Frederick C. Worton, London; John Airey, Bradford, Yorks; Charles A. Wright, Preston; William G. Weaver, Brighton; William E. Stokes, London; Thomas B. Bardo, Sheerness; Alfred Bailey, Oldham; John S. Buchanan, Cambuslang, Glasgow; Albert E. Palmer, Sunderland; Henry W. Maskell, London.

THE following list of successful candidates for Royal exhibitions, national scholarships, and free studentships (science) has just been issued by the Board of Education, South Kensington:—*Royal Exhibitions*: Walter H. Stock, Swindon; John M. Robertson, Pembroke Dock; John C. Nixon, Southsea; Thomas W. Page, Ipplepen, Newton Abbot; Charles A. Brearley, Halifax; William F. Cobbett, Gosport; Herbert Schofield, Halifax. *National Scholarships for Mechanics*:—Henry S. Rowell, West Benwell, Newcastle-on-Tyne; Joseph J. Brooks, Devonport; Albert C. H. Connor, Gillingham, Kent; Frederick Hickey, Southsea; William H. Mead, Southsea. *Free Studentships for Mechanics*:—Arthur C. Lowe, Harrogate; Frank R. Bloor, Gillingham, Kent; John Airey, Bradford, Yorks. *National Scholarships for Physics*:—Douglas V. Plumbridge, Isleworth; Andrew McCance, Glasgow; Thomas Royds, Oldham; Henry J. Lomax, Darwen; John N. Brown, London. *Free Studentship for Physics*:—Edward F. Pattenden, Whitstable. *National Scholarships for Chemistry*:—Arthur Bramley, Elland, Yorks; Harold W. Atkinson, New Mills, Stockport; Fred Bridge, Burnley; William A. Naish, Handsworth, Birmingham; Norman M. Comber, Brighton; Percy G. Ward, Brighton. *Free Studentship for Chemistry*:—Henry V. A. Briscoe, London. *National Scholarships for Biology*:—Rowland M. Richards, Manningham, Bradford; James H. Orton, Bradford, Yorks; Katie Barratt, Swanley, Kent. *Free Studentship for Biology*:—James L. Thompson, London. *National Scholarships for Geology*:—Abraham Haworth, Burnley; Arthur T. Cundy, Redruth; Ernest Lee, Burnley.

AT the distribution of prizes at the Royal Technical Institute, Salford, on October 11, Mr. H. B. Knowles, the principal, read an encouraging report. Speaking of the value of the training given in day technical schools, he said:—"It may be that a youth who has left school at the earliest moment allowed by the law will at the age of seventeen or eighteen have secured a position better paid than the one a student obtains immediately on leaving technical day classes, although in many cases the training received has given immediate access to a career which would otherwise have been inaccessible. The proper time for such a comparison would, however, be some half-dozen years after; and I have weighty reasons for my confidence that then it would be found that the two or three years spent in technical departments had been in every respect a most profitable investment." The principal also directed attention to two important developments in connection with the Salford arrangements for the current session. First, the correlation between the work at the institute and the work in evening schools has been made more real by the stipulation that all applicants for admission to the institute under sixteen years of age shall, before admission, pass an examination in English and mathematics. Secondly, courses of instruction suitable for students occupied in the various trades, and extending over four or five years, have been arranged on the basis of attendance at classes on three evenings per week. An added inducement to take these courses has been offered by making the fee for a course small as compared with the fees for the individual classes constituting the course. A great improvement in the quality of much of the work is expected as a result of this arrangement.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society. February 15.—"Observations on the Labyrinth of Certain Animals." By Dr. Albert A. **Gray.**

The labyrinths of six animals were examined, and the conditions found may be summarised as follows:—The labyrinth of the lion presents the usual features of the Carnivora. The cochlea is of the sharp-pointed type, and there is hardly any evidence of a perilymph space in the semicircular canals. The Indian gazelle has a cochlea of a flat type, and there is a trace of a perilymph space in the canals. In the three-toed sloth the cochlea is of a flat type. The canals are almost square, and the perilymph space is well marked. The labyrinth of the wallaby is like that of the ungulates, but two large otoliths are present in the vestibule.

Among the birds the ostrich is peculiar, owing to the fact that there is no communication between the posterior and superior canals at the point at which they cross. The cochlea is also very short. The crested screamer has a relatively long cochlea, and the superior canal droops somewhat backwards.

May 10.—"The Mechanism of Carbon Assimilation in Green Plants: the Photolytic Decomposition of Carbon Dioxide *in vitro*. By F. L. **Usher** and J. H. **Priestley.**

For summary of this paper see NATURE of October 11 (p. 604).

June 14.—"Studies on Enzyme Action. Lipase, II." By Prof. Henry E. **Armstrong,** F.R.S., and Dr. Ernest **Ormerod.**

Inasmuch as the ethereal salts which are hydrolysed under the influence of lipase are all compounds of the type R′.CO.OX′, it cannot well be supposed, as R′ and X′ may be varied within wide limits, that the selective action of the enzyme is exercised with reference either to R′ or to X′: consequently the controlling influence must be attributed to the carboxyl radicle (CO.O); the enzyme must be so constituted that it can "fit itself to this group." The problem to be solved is—why should ethereal salts derived from the lower terms of the acetic series be so much less readily hydrolysed than the higher? The differences in stability do not account for the differences in behaviour of homologous salts; in fact, ordinary hydrolytic agents appear to act more readily on the lower terms. Nor can the difference be attributed to the destruction of the enzyme by the acid which is liberated from the salt, as this destructive effect can be avoided by diluting the solutions to the necessary extent. Their experiments have led the authors to form the provisional hypothesis that the hydrolysis of the ethereal salt by lipase involves the direct association of the enzyme with the carboxyl centre and that such association may be prevented by the "hydration" of this centre: consequently, that those salts which are the more attractive of water will be the less readily hydrolysed. The facts generally seem to be in accordance with this view, inasmuch as the solubility in water of ethereal salts diminishes as the series is ascended; salts such as ethylic formate and acetate undoubtedly tend to form hydrates (hydrols) in solution, such as

$$CH_3.CO.OEt + OH_2 = CH_3.C(OEt)\begin{matrix}OH\\OH\end{matrix}$$

A noteworthy result in harmony with the view is the fact that ethylic malate is but slowly acted upon by lipase in comparison with ethylic succinate and that ethylic tartrate is practically unaffected. The explanation of the differences to be observed between animal and vegetable lipase is probably to be sought for rather in differences in their emulsifying power than in peculiarities inherent in the lipoclast. The main difficulty the investigation presents lies in securing uniform conditions; if an effective comparison is to be made between ethereal salts, it is an essential condition of success that the substances compared be in solution. Peculiar difficulties are encountered on this account in studying the action of lipase from various sources on fatty substances.

June 21.—"Ionic Velocities in Air at different Temperatures." By P. **Phillips.** Communicated by Prof. J. J. Thomson, F.R.S.

The object of this paper is to find at different temperatures the velocity in an electric field of the ions produced by Röntgen rays in air at atmospheric pressure. The method used for determining the velocities is that devised by Langevin in 1902, and published in his "Recherches sur les Gaz ionisées," Paris, 1902.

The general arrangement of the apparatus is very little different from that used by Langevin, the only serious difference being that the vessel containing the electrodes is made so that it may be immersed in baths at different temperatures.

The velocities have been found at temperatures ranging from −179° C. to +138° C., and the following are the values of k_1 and k_2, the velocities of the +*ve* and −*ve* ions under a field of one volt per centimetre:—

k_1	k_2	Temp., abs.
2·00	2·495	411
1·95	2·40	399
1·85	2·30	383
1·81	2·21	373
1·67	2·125	348
1·60	2·00	333
1·39	1·785	285
0·945	1·23	209
0·235	0·235	94

When k_1 and k_2 are plotted against the temperature we see that between the temperatures 209° and 411° k_1 and k_2 seem to be proportional to the absolute temperature, but at 94° k_1 and k_2 seem to be equal, and much smaller than would be given by this linear law.

Making use of the kinetic theory of gases, we can arrive at the following expression for k_1 and k_2:—

$$k = \tfrac{1}{2} X \frac{e\lambda}{mv}\left[\frac{4\sqrt{2}}{n\left(1+n^{\frac{1}{3}}\right)^2\left(1+\frac{1}{n}\right)^{\frac{1}{2}}}\right],$$

where X is the field in absolute units, e the charge on the ion, λ the mean free path of a molecule, m the mass of a molecule, v the mean molecular velocity of the molecule, and n the number of molecules in an ion. Making use of the values of k_1 and k_2 given above, we obtain the following values of n_1 and n_2:—

Temp., abs	n_1	n
94	4·63	4·63
209	2·12	1·82
285	1·76	1·43
348	1·64	1·34
411	1·52	1·25

When n_1 and n_2 are plotted against the temperature they show a very rapid increase as the temperature of liquefaction of air is approached. This is what might be expected, as the ions in a vapour near its liquefaction temperature are usually large. At the upper temperature the curve shows no very marked tendency, so that it is difficult to predict what might happen at a higher temperature.

The fact that n varies continuously, and not in jumps, would seem to show that there is a continual exchange going on between ions and uncharged molecules; at some collisions several molecules remain attached to the ion, while at others one or more of them is knocked off, and so a dynamical equilibrium is set up. As the temperature of the gas rises, the collisions are more violent, and, statistically, fewer molecules are attached to an ion; this gradual change would go on until the collisions became so violent that at times corpuscles would be shot off without even a single molecule attached to them. When this happened the velocity of the ion would very rapidly increase with the temperature, and so we might expect in flames those very rapidly moving ions which consist of single unloaded corpuscles for an appreciable fraction of their existence.

"Note on Opalescence in Fluids near the Critical Temperature." By Prof. Sydney **Young,** F.R.S.

The experiments described by Travers and Usher were mostly carried out at constant volume, the temperature being raised very slowly. In the author's experiments the substance was kept at its critical temperature, and the volume altered by equal stages. The tubes employed were much narrower. Where comparison is possible the observations confirm those of Travers and Usher, and the following generalisations may be deduced from them:—(1) When observations were made during compression no opalescence was visible until a definite volume was reached: opalescence then appeared at the bottom of the tube, that is to say, just over the mercury; on further compression the opalescence or mist became denser, and extended further

up the tube; near the critical volume the mist was very dense, especially near the middle; continuing to compress, the mist disappeared below, but became dense above; the clear part extended upwards, and the mist finally disappeared at the top of the tube. When observations were made during expansion the phenomena were very similar, except that the mist was usually lower down in the tube. (2) The limits of volume between which mist was visible were much the same for the four paraffins examined, about 1·17 or 1·18 to 0·87 or 0·88 (critical volume = 1·00). (3) At slightly higher temperatures the mist was much less dense and the range of volume more restricted. It seems probable that the position of maximum opalescence depends on the volume, but further investigation is desirable.

June 28.—"The Alcoholic Ferment of Yeast-juice. Part ii.—The Coferment of Yeast-juice." By Dr. Arthur **Harden** and W. J. **Young**. Communicated by Dr. C. J. Martin, F.R.S.

Experiments have been made on the nature of the dialysable, thermostable substance contained in yeast-juice, upon the presence of which the fermentation of glucose by yeast-juice depends, and to which the name coferment is provisionally applied. The inactive residue, obtained by filtration of yeast-juice through a Martin gelatin filter, has been prepared in a solid form, which is quite inactive when dissolved in glucose solution, but is rendered active by the addition of filtrate or of boiled yeast-juice. This solid retains its potential activity for a considerable time. When a *small* quantity of boiled yeast-juice is added to a solution of this inactive residue in 10 per cent. glucose, fermentation commences, and continues for a period varying with the amount of boiled juice added. The cessation of fermentation appears to be due to a change in the coferment, since the addition of a further quantity causes a repetition of the phenomenon.

PARIS.

Academy of Sciences, October 1.—M. H. Poincaré in the chair.—Remarks by M. **Berthelot** on his work entitled "Traité pratique de l'Analyse des Gaz."—Some new examples of Rosaceæ containing hydrocyanic acid: L. **Guignard**. In addition to the plants mentioned by the author in earlier papers on this subject, the names of twenty additional genera are given from which hydrocyanic acid has been obtained. The earlier experiments have also been made quantitative, and it has been found that the amounts of the acid obtainable depend on the age of the organs of the plant. The leaves nearly always furnish the highest proportion of prussic acid, and in certain cases the proportion is nearly as high as that given by the leaves of the cherry laurel.—The ravages of *Loxostega* (*Eurycreon*) *sticticalis* in the cultivation of beet-root of the Central Plateau: Alfred **Giard**. For some years this parasite has been well known in North America as a dangerous enemy of the beet. More recently it has caused great damage to beet culture in Russia, but France has hitherto escaped this pest. This year, possibly owing to the unusual dryness, it has taken firm hold of some regions of the Midi, in some districts more than 90 per cent. of the roots being affected. The author describes in detail the measures necessary to eradicate the parasite.—The periodic trajectories of electric corpuscles in space under the influence of terrestrial magnetism, with application to the magnetic perturbations: Carl **Störmer**.—The constituents of the alloys of manganèse and molybdenum: G. **Arrivaut**. The preparation of alloys rich in molybdenum is difficult in the furnace, but easy when a suitable mixture of the oxides is reduced with aluminium. From the ingots thus obtained the compounds Mn_2Mo, MnMo, and $MnMo_2$ have been isolated.—Syntheses in the quinoline series. Dihydrophenylnaphthoquinoline dicarboxylic ester and its derivatives: L. J. **Simon** and Ch. **Mauguin**.—The existence of stable yeast forms in *Sterigmatocystis versicolor* and in *Aspergillus fumigatus*, and the pathogenic nature of the yeast derived from the latter type: G. **Odin**.—The "*fenêtre*" of the Plan-du-Nette and the geology of Haute-Tarentaise: W. **Kilian**.—A leakage between impermeable zones in calcareous subsoils: E. A. **Martel**.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 18.

CHEMICAL SOCIETY, at 8.30.—Presentation of the Longstaff Medal to Prof. W. Noel Hartley.—The Amino-dicarboxylic Acid derived from Pinene: W. A. Tilden and D. F Blyther.—The Preparation and Properties of Dihydropinylamine (Pinocamphylamine): W. A. Tilden and F. G. Shepheard.—Determination of Nitrates: F. S. Sinnatt.—The Nature of Ammoniacal Copper Solutions: H. N. Dawson.—Malacone, a Silicate of Zirconium containing Argon and Helium: S. Kitchen and W. G. Winterson.—The Relationship of Colour and Fluorescence to Constitution, Part i., The Condensation Products of Mellitic and Pyromellitic Acids with Resorcinol: O. Silberrad.—The Colouring Matters of the Stilbene Group, Part. iii.: A. G. Green and P. F. Crosland.—(1) Separation of *aa*- and *ββ'*-Dimethyladipic Acids; (2) Action of Alcoholic Potassium Hydroxide on 3-Bromo-1: 1-Dimethyl-hexahydrobenzene: A. W. Crossley and N. Renouf.—(1) The Compounds of Pyridine with Dichromates; (2) The Normal Chromates and the Unsaturated Character of the Chromate Radical: S. H. C. Briggs.—(1) Interaction of Succinic Acid and Potassium Dichromate, Note on a Black Modification of Chromium Sesquioxide; (2) Derivatives of Polyvalent Iodine; the Action of Chlorine on Organic Iodo-derivatives, including the Sulphonium and Tetra-substituted Ammonium Iodides: E. A. Werner.—(1) New Derivatives of Diphenol (4-4'-Dihydroxydiphenyl); (2) The so-called "Benzidine Chromate" and Allied Substances: J. Moir.—The Interaction of the Alkyl Sulphates with the Nitrites of the Alkali Metals and Metals of the Alkaline Earths: P. C. Rây and P. Neogi.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Auriferous Rocks of India, Western Australia, and South Africa; M. Maclaren.—Sand Sampling in Cyanide Works: D. Simpson.—Treatment of the Precipitate and Manipulation of the Tilting Furnaces at the Redjang-Lebong Mine, Sumatra: S. J. Truscott.—A Combined Air and Water Spray: T. White.

FRIDAY, OCTOBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion*: Railway-motor-car Traffic: T. H. Riches and S. B. Haslam.—*Paper*: Some Notes on the Mechanical Equipment of Collieries: E. M. Hann.

SATURDAY, OCTOBER 20.

ESSEX FIELD CLUB (at Epping).—Annual Fungus Foray—all day Meeting.—The Ecology of Fungi: George Massee.

CONTENTS.