THURSDAY, DECEMBER 27, 1906.

THE THEORY OF AGGREGATES.

The Theory of Sets of Points. By W. H. Young and G. C. Young. Pp. xii+316. (Cambridge: University Press, 1906.) Price 12*s.* net.

CONDESCENDING to a pun, Gauss once remarked that he was more interested in notions than in notations. The theory of aggregates is so independent of the ordinary symbolism of mathematics that it requires hardly any previous acquaintance with other branches of the science from those who proceed to the study of it. At the same time, it is full of peculiar difficulties: it abounds in seeming paradoxes; and some of its fundamental problems are at the present time the subject of keen research and controversy. A hearty welcome is therefore due to a work composed by authors who are familiar with all that has been published about aggregates, and have themselves made important contributions to the subject.

It is impossible to go into detailed criticism of this treatise without the use of technical terms which would convey no meaning to the ordinary reader; but an attempt may be made to show the general nature of this novel theory and the influence it has had, and will extend, over the first principles of other parts of mathematics.

The names of Cantor and Dedekind will always be associated with the first truly logical definition of the arithmetical continuum, or, which comes to the same thing, of the range of a real arithmetical variable. It is hardly possible to lay too much emphasis on the fact that all strictly arithmetical operations are connected with the elements (rational and irrational) of this continuum. Cantor's transcendental numbers obey laws of operation different from those of ordinary arithmetic, and the calculus associated with them ought to have another name.

With the help of a postulate, the necessity of which was first realised by Cantor and Dedekind, we can establish a one-one correspondence between the values of a real positive variable and the points of a finite straight line, exclusive of one end, if the variable is not allowed to be infinite. If we extend the postulate so as to include both ends of the segment, we have to include values 0 and ∞ for the variable, which, from this point of view, are equally definite. For convenience, we speak of a point x, instead of saying "a point corresponding to the number x."

From the arithmetical side we have to investigate the properties of the continuum and of its parts; and the special interest of the subject begins when we consider parts which contain more than a finite set of elements. The simplest of these is the natural scale 1, 2, 3, &c.; its characteristic properties are that it has a natural order with a first element, each element being succeeded by the next higher in magnitude, and there being no last element.

The set of rational numbers differs from the natural scale in some very important respects. As represented by points on a line, they have an order of position, corresponding to their order of size; but we cannot say that in this order any element is followed by a "next" element. In fact, between any two distinct rational points lie an infinite set of other rational points. But Cantor was the first to point out that the rational set may be brought into a one-one correspondence with the natural scale, for example, in the order:—

$$1, \tfrac{2}{1}, \tfrac{1}{2}, \tfrac{3}{1}, \tfrac{1}{3}, \tfrac{4}{1}, \tfrac{3}{2}, \tfrac{2}{3}, \tfrac{1}{4}, \text{ &c.},$$

where the fractions, in their lowest terms, are arranged so that the sum of numerator and denominator never diminishes, while those with the same sum are placed in descending order of magnitude. Every set which can be thus brought into correspondence with the natural scale is said to be countably infinite, or to be of potency a. Examples of such sets are: (1) the set of all algebraic numbers, (2) all points with rational coordinates in a space of n dimensions, where n is any assigned positive integer.

On the other hand, the arithmetical continuum is not countably infinite, and its potency, denoted by c, is of a higher order than a. One of the outstanding difficulties of the subject is the question whether any set exists with a potency between a and c. The most important theorem in this connection is that every perfect set is of potency c (p. 234). A remarkable illustration of this is that all the points within a sphere may be brought into one-one correspondence with the points on a definite straight line. As might be expected, the correspondence is not continuous.

One of the most troublesome questions discussed in this volume is that of Cantor's potency "aleph-one" (p. 135). Here we have a set the elements of which are sets of points: the element-sets recur over and over again, *qua* sets, and are treated as being all distinct in virtue of a criterion of order connected with a process of "derivation" and "deduction." Bernstein hopes to show that $\aleph_1 = c$.

The potency of an infinite set is analogous to the number of elements in a finite set. Cantor introduces symbols for potencies, calls them transfinite cardinal numbers, and investigates a calculus for them. As pointed out on p. 150, there is still a difficulty in the way of establishing comparisons between potencies really corresponding to comparisons of size between finite numbers; and, in any case, the calculus of transfinite cardinals must greatly differ from ordinary arithmetic.

Besides these ideas of order and potency, which are discussed in chapters i.–v., vi, xi, there is the additional one of content, which dominates most of the rest of the book. It must suffice to give a few illustrations to show the general nature of these inquiries. If on a line of finite length l we construct an infinite set of non-overlapping segments, their content, that is, the sum of their lengths, cannot exceed l. If it is less than l, there may be left over a set of complementary segments, but this is not necessarily the case, as is shown by the example on p. 78. Here we have a set of segments whose content is less than 0.2 of the original line, yet no segment exists on the line which does not lie wholly, or in part, within one of the selected set. The points not within any of

the selected intervals form a set of potency *c*. Similar theorems apply to areas and volumes: thus, if we take a unit square it is possible to "black out" a definite region within it, the area of which may be less than any *given* quantity, in such a way that no circle, however small, can be placed within the square without covering some at least of the black region, and so that the points not within the black region form a set of potency *c*. It should be specially noticed that although the black region is, or may most conveniently be, constructed by an infinite process, it is perfectly definite, in the sense that we can say whether any given point (x, y) lies within it or not.

Another point to which attention may be called is the definition of "curve" (p. 219) as a set of points having certain properties. This is quite distinct from the idea of a path traced by a continuously moving point, and leads to very curious and interesting problems relating to rectification and quadrature.

Enough has been said to show how interesting and novel are the contents of this treatise; the examples and figures are of great help in making the general arguments intelligible, and the bibliography will enable the reader to consult all the literature relating to the subject. Finally, the appendix should not be overlooked, as it contains some important additional matter, besides a few corrections. To the latter may be added "chap iv., § 20," instead of "chap. iv., § 3," on p. 77. G. B. M.

METAMORPHOSES OF PLANTS.

Jugendform und Blütenreife im Pflanzenreich. By Dr. L. Diels. Pp. 130; with 30 illustrations in text, each with several figures. (Berlin: Gebrüder Borntraeger, 1906.) Price 3.80 marks.

IN this work the author has presented much interesting information from the point of view of an inquiry into the relations between sexual maturity and the conditions attained by the vegetative organs, especially where these from any cause show tendencies to marked changes of aspect during the development of the plants. Many of his examples are drawn from his personal investigations, the inquiry having suggested itself to him during a residence in Western Australia, where peculiarities in these relations appear to be remarkably frequent, and to be often traceable to the environment. He has also made a careful study of such published works as bear on this subject, and has used the materials derived from them with good effect as regards both the facts and the causes of abnormal conditions, and the inferences to be drawn from them. His statement of the whole subject, and of the conclusions that he believes can be fairly based on what is yet known of it, is well and clearly put, and shows the need of further inquiry, as well as the risk of pressing inferences beyond their fair limits at times.

The book is deserving of attentive perusal, and will suggest to the careful reader parallels among our own plants to some of the cases described, and questions in need of investigation from the new standpoint. The book opens with a discussion of the conditions that favour the attainment of sexual maturity in the normal course of development, and also prematurely, as measured by the stage of development of the vegetative organs. By selected examples it is shown how variable are the stages of progress, when judged by the leaves especially, at which sexual reproduction may occur. Attention is also directed to the assemblages of different species that exist on dry, poor soil, and that are distinguished by the production of precocious flowers and fruits on ill-nourished dwarfs, as well as to the production of flowers in cultivated seedlings of various trees, as in the *Swietenia Mahagoni*, recorded by Mr. Hemsley (Hooker's "Icon.," 2786), where deficiency of water appears to be the exciting cause.

The unusual precocity of reproduction is most evident where there is naturally a succession of leaf-forms before the normal period of flowering is reached, some of these being regarded as characteristic of the immature, and others of the adult plant. For the definite grades in such a succession Dr. Diels employs the term "Helikomorphie," the whole being included in the "Heteroblastie" of varied forms of parts having the same morphological value. The significance of the helicomorphies, where not of the grade usually associated with flowering, is shown to differ in different plants. In some even those characteristic of the normal immature plant may not be fully exhibited. In others these may be fully shown; but those of the adult may remain undeveloped or arrested. The causes that lead to such departures from the usual course can be shown to lie in the environment in some cases; but in others they cannot yet be explained. Among the more frequent causes of arrest and retention of immature characteristics are influences that interfere with growth, such as deficiency of water in dry soils, inclement weather at high elevations, shading and overcrowding, the plants grown under such conditions showing an unusual tendency to flower while having leaf-organs of the normal immature grade.

A comparison of allied species shows that the normal youthful helicomorphy of one may be very similar to the normal adult condition of another that lives in less favourable surroundings, *e.g.* in *Ranunculus sceleratus* and *R. pygmaeus*.

The importance of a thorough comprehension of these variations, of their significance in the life of each species, and of their value as indications of relationships between species or larger groups in classification, is self-evident. Embryology has not afforded like help in systematic botany to that obtained from it in zoology. In some cases seedling plants for a brief time show characters very unlike the adults, and suggestive of the structure of less modified allied forms, as in the well-known examples of Ulex and Acacia. All such deserve careful study; and Dr. Diels has shown how they throw light on the value of "species," as in the forms of Limosella, and of "genera," as in the relation of Regnellidium to Marsilia. His discussion of the relations of certain species of Hakea, of Grevillea, and of numerous others, largely on the basis of his personal observa-

tions on the plants in their native habitats, is of great interest. The "larval" forms habitually passed through by certain plants, *e.g.*, by *Veronica epacridea*, Actinostrobus, sps., and other conifers, various Leguminosæ, Eucalyptus, sps., Aloineæ, and members of other groups, are also discussed; and the conditions under which sexual reproduction may occur in plants that retain their larval aspect are investigated. That such plants have been described and named as distinct from the usual adult forms is well known, and this is seen to have been the case in Eucalyptus and in other groups.

A chapter on the phylogenetic significance of helicomorphy sums up the conclusions of the author. Many of the forms he regards as adaptations to environment, some of which are unstable, while others show the influence of heredity and persist under new conditions, *e.g.* the formation of phyllodes by Acacias in greenhouses. Some appear to become relatively constant in a short time, *e.g.* seasonal dimorphism of *Euphrasia Rostkoviana* and *E. montana*, believed by Wettstein to have become fixed as the result of the alpine meadows being mowed, and now retained in cultivation in a botanic garden. But, while there may in some be a strong hereditary tendency to repetition of the cycle, Diels concludes that each helicomorphic stage may be the starting-point of a new phylogeny. He emphatically opposes the belief that the helicomorphy of the immature plant necessarily represents a condition similar to that of the ancestors; and asserts that the apparently ancestral form has in many cases been acquired in response to the environments of the young plant. *Acacia insolita* is quoted as an example of a species descended from phyllode-bearers that now habitually produces pinnate leaves abundantly when mature; and the position is briefly stated thus:—"We saw that Phylloglossum resembles the young of many species of Lycopodium. But Lycopodium does not for that reason follow Phylloglossum in phylogeny; Phylloglossum may just as well be younger than the greater number of the Lycopods." The assumption that the infantile form must in all circumstances represent an older stage of ancestry than does the adult is frequently in opposition to the facts. A brief review of similar phenomena in the animal world, and a short bibliography, conclude the book. It only remains to add that the illustrations are excellent, and that a good index makes reference easy to the stores of information.

THE RADIO-ACTIVE PEDIGREE.

Radio-active Transformations. By Prof. E. Rutherford, F.R.S. Pp. 287. (London: Constable and Co., Ltd., 1906.) Price 16*s.* net.

THIS work is, in the main, a reproduction of Prof. Rutherford's Silliman lectures, delivered at Yale in March, 1905, and represents his latest views on the subject. Some treatment of radio-activity in general is given, and then a detailed development of the special subject of the book. This treatment differs only from the author's previous expositions in the greater detail in which the subject is worked out. Every month seems now to bring to light some hitherto unrecognised stage in the transformation of one of the radio-elements. One would suppose, however, that this field of discovery cannot be of unlimited extent, and that the full detail of the transformations must, before long, be made out, so far at least as they are accompanied by demonstrable radio-activity.

It has been usually assumed that each radio-active atom throws off an α particle, and becomes thereby transformed into an atom of a new product. On this view, it can be seen, with a little thought, that a mineral in radio-active equilibrium ought to owe an equal proportion of its activity to each of the products of a series, and there is considerable evidence that it is often so. Lately, however, two cases have presented themselves which seem clearly inconsistent with this. One of them, that of actinium, is mentioned by Prof. Rutherford in the present work. It seems that actinium, like radium, is found in uranium minerals, and in those only. Further, that the amount of actinium is probably, as the amount of radium is certainly, proportional to the uranium content. If so, we cannot but conclude that actinium is a member of the uranium series. Now comes the difficulty. Actinium certainly does *not* contribute anything like so much to the total activity of pitchblende as radium and uranium each do.

The second case is to be found in a paper in the October *Philosophical Magazine*. Moore and Schlundt have found that uranium X, the immediate product of uranium, gives a small α radiation as well as the β radiation by which it is mainly characterised. It is certain, however, that the α radiation of uranium is not much diminished by removing all the uranium X from it, hence the α radiation of uranium X must be comparatively small. Here again the principle of equal activity in each successive product of a series is violated. This latter case has only been brought to light since the publication of the present work, and quite a new light has been shed on the case of actinium by Dr. Boltwood's letter to NATURE describing the formation of radium from actinium. This seems to make it certain that actinium is in the main line of radio-active descent, and to put out of court Rutherford's plausible suggestion that it is the head of a collateral family. The subject, indeed, progresses so fast that the reviewer of a book like this almost always has lights which were not available to the author at the time of going to press.

The subject of the possible ultimate production of lead by the radium series is here discussed in some detail. It is doubtful, I think, whether much stress should be laid on the almost invariable presence of lead in uranium-radium minerals. An interesting spectroscopic investigation by Hartley and Ramage (*Engineering*, September 24, 1897) proved that lead was present in almost every one of a very large collection of iron ores examined by them. We cannot suspect a change akin to radio-activity in this case, for lead has a much larger atomic weight than iron,

and cannot be supposed to be a product of its disintegration.

It is not necessary to dwell on the admirable lucidity and suggestiveness of Prof. Rutherford's book, for that is no more than his readers have been taught to expect. The only doubt which can be felt is whether it meets any want which was not already satisfied by his previous work, "Radio-activity."

R. J. STRUTT.

VISIBLE SPEECH.

Lectures upon the Mechanism of Speech. By Alexander Graham Bell. Reprinted from the Proceedings of the First Summer Meeting of the American Association to Promote the Teaching of Speech to the Deaf. Pp. 129. (New York and London: Funk and Wagnall's Company, 1906.) Price 1.00 dollar net.

THIS interesting book consists of a series of lectures by Mr. Alexander Graham Bell, whose name in the future may be as honourably associated with his labours in the education of deaf mutes as with the invention of the telephone. His father, A. Melville Bell, many years ago, devised a method of representing, or rather symbolising, positions of the vocal organs. To this symbolic method he gave the name of "visible speech," because anyone acquainted with the symbols could place his vocal organs in the desired positions, and then, on emitting the breath and bringing the vocal cords into action, could produce the desired sound.

"These symbols of visible speech," remarks Mr. Bell, "bear the same relation to phonetics that chemical symbols do to the science of chemistry. In dealing with the mechanism of speech, it is as necessary nowadays to make use of my father's symbols, as it is to use chemical symbols in treating of the composition of matter."

The symbols, which are very simple and ingenious, indicate the position of the lips, the position of the tongue, the condition of the larynx, and the condition of the passage between the larynx and the tongue or lips. It is evident that to produce a given sound we might have a row of such symbols. Thus, to sound the vowel *oo*, at least three position symbols would be required, and to show how to pronounce the word *moon* would require nine symbols, namely, three for *m*, three for *oo*, and three for *n*. To avoid this difficulty the signs or symbols are abbreviated or condensed, so that the word *moon* is now represented by only three symbols, curious looking things, like old Gothic letters, but quite intelligible when one has, as it were, already studied their evolution. The only comment I would make on the abbreviated symbols is that they should be printed on a fairly large scale, as a very slight mark may be of great importance, and a sharp eye is required if the symbols are printed small.

Mr. Bell then proceeds to show how the meaning of the symbols may be conveyed to the deaf. They are exhibited on a large scale in a series of charts, and with infinite patience the teacher enables, by gestures and movements, the deaf mute to comprehend their meaning. Step by step the pupil is taught how to place the lips, the tongue, the soft palate, and how to modify the form of the mouth. The child has also explained how to produce various vowel sounds, which are divided by Mr. Bell into primary vowels, wide vowels, primary round vowels, and wide round vowels. Each of these is accompanied by a symbol. To show how much may be symbolised, take three of the primary round vowels, and we have symbols indicating (1) voice, back small aperture, lip small aperture; (2) voice, back mid aperture, lip mid aperture; (3) voice, back large aperture, lip large aperture.

The teacher must have a feeling of great delight when he hears for the first time the required sound coming from the mouth of the deaf mute. Mr. Bell's criticism of methods is both wise and interesting, as we show by the following quotation:—

"Now in teaching a deaf child you present to him a symbol for some difficult sound. If he has been taught to analyse the symbols in the manner shown, the symbol conveys to his mind a direction what to do with his mouth. That is what your pupil has to aim at, but in ninety-nine cases out of a hundred he may not get it, at least at the first shot. Now what are you going to do? Are you going to say, 'No, no! that's not right. Try again'! Let him try once more, and the chances are that he fails again to give the sound intended. The no-no method only aggravates the difficulty by discouraging the pupil and disgusting him with articulation. . . . The deaf child must know *what he did when he failed*. . . . The knowledge of that realism will guide him in his next attempt. For example:—If he knows that his tongue was too far forward in the mouth, in his next attempt he aims at having his tongue further back, and probably gets too far in that direction. If, then, he is told the result of this attempt also, he makes due allowance the next time he tries. He may fail a hundred times. Now the position may be a little too far forward, now a little too far back, or the tongue may be too high or too low, but his knowledge of the effect of each effort causes him to approach more and more closely to the exact position desired, till at last he gets it. The time spent in studying and representing the incorrect positions is not wasted, for it gives the pupil mastery over the instrument of speech itself, and the struggle to get exactitude of position with one difficult sound gives him power to get any other, just as the ability to hit one bull's-eye qualifies a man to shoot at any mark" (p. 70).

These wise remarks apply to many methods of practical instruction, in the laboratory and elsewhere. Mr. Bell's lectures were delivered to teachers of deaf mutes, and often at the close of a lecture Mr. Bell was interrogated. This Socratic method drew from the teacher many valuable remarks, and sometimes "asides," which showed the fertility of the lecturer's thought. Altogether this little book is full of interest to students of phonetics, a department of science often a wilderness of dreary discussion, but here, in the hands of Mr. Bell, a subject of living interest. To be able to teach deaf mutes how to communicate with their fellow mortals is an achievement worthy of one who has, in another province, made his mark on the technical science of the day.

JOHN G. MCKENDRICK.

THE GEOLOGY OF ARMENIA.

A Treatise on the Geology of Armenia. By Dr. Felix Oswald. Pp. vii+516. (Iona, Beeston, Notts: Published by the Author, 1906.) Price 1*l.* 1*s.* net.

THIS is a remarkable book from the point of view of the mere collector, and, in all seriousness, libraries should hasten to secure it. It has been hand-printed by the author, page by page, almost in the Caxtonian manner, and we are informed in a manuscript note that only 100 copies exist. That it was printed at all is due in the first instance to the rather stringent requirements of the University of London, to which it was presented as a thesis. It served its purpose there, but obviously deserved a wider circulation. It now appears with numerous hand-printed and hand-coloured geological sections, and some expressive, but not equally necessary, plates of fossils. The result is a book which is typographically a pleasure to read, each page being firmly printed in letters which are really black; and the hard travelling which lies at the back of its production is almost equalled by the subsequent and skilful industry of the author.

Dr. Oswald's work should stand on shelves of reference beside Mr. H. F. B. Lynch's fine volumes on Armenia, since the geological observations on which it is based were made when the two authors travelled together through a region of immense geographical and historic interest. About half the book describes Dr. Oswald's own original results, and the remainder contains a valuable review of what has been previously written on the geology of Armenia. It is clear that we have here an unusually full work of reference; and the author-compositor has not shrunk from completing it by an index of sixteen pages.

The mountain-folding that determines the structure of Armenia (p. 9) seems to have occurred in Lower Permian, ante-Tithonian, and post-Oligocene epochs. The pressure in each case came from the south—Dr. Oswald writes "resultant pressure," which we presume refers to the resultant of various forces within the crust. "The northern limit to all this mountain-folding was formed by the great granitic '*horst*' of the Meschic Mountains." The Caucasus is held to owe its present development to post-Miocene pressure from the north-east, which broke up the Armenian sediments into blocks. While Prof. Penck in a recent publication prefers to regard such blocks as the result of vertical forces, Dr. Oswald sees in them (p. 10) "as much an expression of the tangential stresses in the earth's crust as the folds of the Caucasus itself." The volcanoes of Armenia have arisen along the post-Miocene lines of fracture, and the larger ones occur at points of intersection.

The most striking contribution of the author to our geological knowledge is the account of the Nimrud volcano (chapter ix.), the first survey of which was made by him and Mr. Lynch in 1898. We all may be grateful to the Vali of Bitlis, who caused fifty soldiers to encamp in the crater in order to keep off bandits during these scientific investigations. The crater is five miles across, and its rim rises four thousand feet above Lake Van. The account of its structure and petrography is thus by itself no mean achievement.

The existence of Mr. Lynch's book has left the present author little scope for picturesque description; but one landscape at least (p. 252) is brought vividly before us, where the broad dioritic downs of Kazikly Dagh end suddenly in "precipices seamed by torrents," and the country drops 5000 feet in four miles to the Meiriman Dereh.

Dr. Oswald's review of preceding literature contains many useful criticisms and suggestions (pp. 355 and 356, for example). The book is not intended to be read from cover to cover as a narrative of travel; but it should obviously be made accessible to all future travellers in Armenia. G. A. J. C.

OUR BOOK SHELF.

Position-line Star Tables: for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation. By H. B. Goodwin, R.N. Pp. xiv+96. (London: J. D. Potter, 1906.)

THERE are several tables in use which will enable a mariner to derive the correct meridian altitude of an object when the altitude near the meridian is known. Mr. H. B. Goodwin has constructed tables which will give a correction of a similar character to obtain from observed altitudes near the prime vertical the correct altitude on that circle. If the object does not cross the prime vertical, the author employs the circle of maximum azimuth. The tables are not general, but refer to certain bright stars, eleven in the northern and six in the southern hemisphere. Seeing that some of the declinations fall very close together, as those of α Andromedæ, Pollux, α Coronæ, &c., there might have been some advantage in computing the tables for regular intervals of declination rather than for selected stars.

It is not difficult to derive a system of corrections which give the corrected altitude on the prime vertical, but are such tables necessary? The problem is to derive most readily the hour angle from an observed altitude of a known object in a given latitude. The advantage of referring the object to the prime vertical is not equally apparent; but the object of the author in a great measure is to avoid logarithmic calculation. This he has effected, and his arrangement is apparently convenient and sound from the analytical point of view. But if the suppression of logs. is to necessitate such multiplication as $303{\cdot}2 \times 2{\cdot}97$ and $418{\cdot}4 \times 3{\cdot}23$ (numbers taken from the examples given), it is hard to see what improvement has been made.

We have worked out some of the examples both by means of these tables and also by solving the ordinary triangle ZPS. We have no hesitation in preferring the old-fashioned method. But we admit it requires great familiarity with tables before their full value is appreciated, and possibly anyone who has given the same amount of study to these tables that the writer has been obliged to give to logs. would prove the superiority of Mr. Goodwin's tables. But some people seem positively mad on tables. Would any sane man, or anyone who could work such a sum in decimals as that just quoted, use a table for converting seconds of time to the decimals of a minute? Yet such a table is given here, evidently with the idea that someone would use it to find out that 24 seconds was equal

to 0·4 of a minute. We suspect that Mr. Goodwin knows a good deal more about the capacity of the men for whom he is writing than we do.

W. E. P.

The Horticultural Note Book. Compiled by J. C. Newsham. Pp. xx+418. (London: Crosby Lockwood and Son, 1906.) Price 7*s.* 6*d.* net.

THE contents of this book are as disconnected as are the words in a dictionary. Anything like a "review" is, therefore, out of the question. We can only state the general nature of its contents and give an opinion as to the way in which the compiler has accomplished his task. As to its contents, they comprise "practical rules, data, and tables for the use of students, gardeners, nurserymen, and others interested in flower, fruit, and vegetable culture, or in the laying out and management of gardens."

This is a fairly comprehensive enumeration, but it is not complete, for we also find various tables which will be of service to those who have to deal with woodcraft or the sale of timber. The compiler has done his work well; he is evidently familiar with the ordinary requirements of his readers, and he has fulfilled them with judgment and accuracy.

With such a mass of detail to deal with it would be wonderful if misprints did not occur, but they are remarkably few. On p. 299 there is, however, a crop of such blemishes which should be removed in a future edition. We may suggest also that the tables on pp. 251, 252 be expunged as inadequate, and in point of accuracy not equal to the rest of the volume. We are glad to see various metrical tables added. No one who compares the regular definite proportions of the metrical system with the confusion of the ordinary lineal and land measures, to take one instance, can doubt the advantages of regular system over chaos. It is permissible to envy the next generation, whose labours will be so materially lightened by the general adoption of the new system.

The author has given not a few "miscellaneous" weights and measures, but he might have added more from the Covent Garden repertory, where cabbages are sold by the "mat," carrots by the "pad," cauliflowers by the "tally," to say nothing of "bundles," "bunches," "cases," and other indeterminate measures. A book of this kind is intended for reference purposes, and its value must be tested by frequent consultation. Tried by this test, we may say that we have found the book very serviceable. In a future edition a list of the commoner fungi and the plants on which they are parasitic would be desirable; for instance, we find no reference either to the ordinary or the American mildew attacking gooseberries, or to the fungous pests which commit such havoc with grapes, tomatoes, and cucumbers.

Funzioni poliedriche e modulari. By G. Vivanti. Pp. viii+437. Manuali Hoepli, 366–367. (Milano: Ulrico Hoepli, 1906.) Price 3 lire.

THE author tells us in his preface that he found Klein's "Vorlesungen über das Ikosaeder" and Klein and Fricke's "Theorie der elliptischen Modulfunctionen" "pretty stiff reading." Probably most students will sympathise with him and will give a ready welcome to this little book, which is intended to prepare the reader for the study of these classical treatises. The ground covered is approximately that of the last four chapters of Forsyth's "Theory of Functions" (excluding automorphism), but the subject-matter is discussed in much greater detail. The first part of the book deals with groups formed by substitutions of the form $z' = (\alpha z + \beta) \div (\gamma z + \delta)$, especially with the five finite (polyhedral) types of group and with the infinite (modular) group in which α, β, γ, δ are integers such that $\alpha\delta - \beta\gamma = 1$. In the first few pages a group is defined and some of its more elementary properties proved. It must be confessed that these introductory sections are not quite satisfactory, and it is doubtful whether they would be readily intelligible to anyone who had no previous knowledge of group-theory. For instance, the author fails to make clear the distinction between a group and a semi-group, or that between an abstract group and the particular application he has in mind. The rest of part i. is, however, clear and readable, and should serve effectively the purpose intended by the author.

In the second half of the treatise the author discusses the invariants of the polyhedral and modular groups, the connection of the Schwarzian equation with polyhedral and modular equations, and the application of the polyhedral groups to the solution of algebraic equations. This part appeals to a very different class of readers; in fact, the author assumes a knowledge of elliptic functions, Riemann's surfaces, the existence theorem, Noether's curve, the Galois field theory, &c. The lack of balance between the two parts in this respect is unfortunate, if unavoidable. There are a few errors; for instance, the statement of § 104 seems to require modification when $n=6$, while on pp. 208 and 209 the difference between (n), $[n]$, and $\{n\}$ is not at all clear.

Hermann von Helmholtz. By Leo Koenigsberger. Translated by Frances A. Welby, with a preface by Lord Kelvin. Pp. xvii+440. (Oxford: Clarendon Press, 1906.) Price 16*s.* net.

THE German original of this book appeared in 1903, and was reviewed at some length in NATURE of July 2 in the same year (vol. lxviii., p. 193). The work of translation is admirably done in every way, and the English public owes a debt of gratitude to the translator for enabling it to study in its own language one of the most interesting careers of the nineteenth century. A moderate all-round scientific training is necessary and sufficient to enable the reader to follow the description of the greater part of Helmholtz's work; but, though mathematical symbols are avoided, probably no one who has not specialised to some extent in applied mathematics will find intelligible the account of his more abstruse mathematical researches.

Though Herr Koenigsberger makes the very most of the space at his disposal, yet the reader lays aside a book of 440 pages with a feeling that he has seen the merest sketch of Helmholtz's life. Probably no better comment could be made on the industry of the great man of science or on the versatility of his genius. To do full justice to his career a treatise of three times the length would perhaps be needed. As it is, the reader is bewildered at the rapidity with which his attention is turned from one epoch-making discovery to another, and tries in vain to follow the steps by which Helmholtz was led from one subject to another when, during the space of three years largely occupied with his professorial duties, he discussed in turn optics, nerve transmission, acoustics, hydrodynamics, geometry, electricity, hay-fever, and so on.

Though, on the whole, the book lays more stress on Helmholtz's work than on the details of personal interest, yet the author has a true instinct for recording just those incidents of Helmholtz's life which throw most light on his character and ideals, and reveal most clearly the influences which surrounded him. We lay down the book with a feeling of very real sympathy for the frequent illness and bereavement which cast a perpetual shadow over the plea-

sures of a happy home and world-wide reputation, while we are conscious of a genuine admiration for the firm resolve to "make the most of his time" and to keep perpetually before him the remembrance of "how injurious megalomania may be for a student."

H. H.

Illustriertes Handbuch der Laubholzkunde. By C. K. Schneider. Pts. iii. and v. (Jena: Gustav Fischer, 1906.) Price 4 marks each.

THE general plan of this handbook on trees cultivated in Europe was explained in the notice of the first two parts that appeared in NATURE, November 24, 1904. The third part was issued early last year, and the fifth part—somewhat enlarged—completes the first volume.

The third part contains the final portion of the Berberidaceæ, the orders Menispermaceæ to Crassulaceæ, and part of the Saxifragaceæ, the largest genera being Berberis, Mahonia, Magnolia, and Ribes. The Drupaceæ and Pomaceæ, generally regarded as suborders of the Rosaceæ, here treated as orders, form the subject of the fifth part. Prunus, Padus, Pyrus, Sorbus, and Cratægus are large and difficult genera.

It becomes more apparent that Dr. Schneider favours subdivision, for, in addition to the suborders mentioned, subgenera such as Chænomelei are raised to generic rank, and some of the species would certainly be regarded by other authorities as varieties; also it is noticeable that the author does not confine himself to trees in cultivation. The book thus becomes more of a dictionary and less of a practical manual; but due credit must be given to the author for the enormous amount of energy expended, and for the searching and critical investigation of specimens that has been accomplished. The advantage of the rules laid down at Vienna last year becomes evident from the list of changes noted in the supplement.

Old-fashioned Flowers and other Open-air Essays. By Maurice Maeterlinck. Translated by A. Teixeira de Mattos. With illustrations by G. S. Elgood. Pp. vii+115. (London: George Allen, 1906.) Price 3*s.* 6*d.* net.

PUBLISHERS have to cater for readers of various tastes, and so we suppose there are some to whom the present little book will appeal. For ourselves we can but wonder that anybody thought it worth translating. The text is mostly purely rhapsodical, reminding us of Ruskin at his worst. There is very little said about flowers as flowers, and the moral and philosophical reflections present no striking novelty. The illustrations are attractive but over-coloured, and probably do not do justice to the artist's original drawings.

LETTERS TO THE EDITOR.

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

The January Meteors.

THE January meteors are seldom visible in England under favourable aspects, the weather being often adverse at this season. Moonlight will partly veil the display in 1907, and the best times to look for it will be on the evenings of January 3 and 4 during the two or three hours preceding moonrise.

The shower is sometimes as rich as an ordinary return of Perseids, and it always furnishes some bright, long meteors of an unusually conspicuous character. We have gathered a large number of double observations of Perseids and Leonids, and know their average heights very well, but very few real paths of the January Boötids (or Quadrantids) have ever been computed. It is desirable, therefore, that observers who are fortunate enough to notice any members of the latter shower should record their apparent paths with the greatest accuracy which the circumstances allow, with the view of finding their heights and radiants.

The position of the radiant point has been already well determined at 230°+53°, and it is not probable that we shall ascertain it more precisely until photography can effectively take the place of the eye in meteoric observation.

W. F. DENNING.

Stereoscopic Lantern Slides.

PROBABLY many people who have taken interest in stereoscopic photography at one time or another have regretted that there should be no simple means for showing the effect to a large audience.

As a matter of fact, this can be done very easily in either of two ways. A stereoscopic lantern slide is first made by photographing an ordinary stereoscopic pair of pictures. This pair of pictures is then projected upon the screen with an ordinary lantern. The stereoscopic effect is obtained by using either a mirror stereoscope or a prism stereoscope. The former consists of two small pieces of mirror held one in front of each eye. The observer has the screen, not in front of him, but on one side, say about 60° from the direction in which he is facing.

In each mirror the pair of pictures is seen, and by tilting one mirror with respect to the other, so that the two outside images are superposed, the picture suddenly leaps into relief. Of course, if the wrong pair be superposed the familiar inverted relief will appear. It is easy to mount the mirrors in a sort of spectacle frame, one of them being fixed and the other capable of rotation about a vertical axis.

It would not be difficult to explain to an audience of average intelligence the method of using such spectacles; the spectacles could be made at a very small cost, and the beauty of the effect would appeal to many.

Cases frequently arise in university lectures in which a stereoscopic presentation of slides would greatly simplify explanations, *e.g.* in biology.

The other method is to use a single small achromatic prism, which is held in front of one eye, the refracting angle being vertical and directed towards the other eye. Of course, prisms of different angles are required for different distances, but a single prism can be made to suffice for a large range by twisting it about a vertical axis, without greatly impairing the "stereoscopism."

At first sight one might think that the effect could only be seen by observers situate in or near a plane bisecting the screen at right angles, but this is not the case. Indeed, anyone who has worked with stereoscopic photographs must have been struck with the ease with which the eyes will adjust themselves to pictures which are not correctly aligned, and experiment also shows that the two pictures need not be of the same size.

G. A. SHAKESPEAR.

The University, Birmingham. December 17.

Emerald Green Sky Colour.

WHILE on a short stay at St. Moritz I was much struck by the peculiar colour of the sky on the evening of December 10. It had been threatening snow most of the day, and a few flakes fell during the afternoon, the sky being overcast. At about 3.30 p.m. to 4 p.m. the sky cleared over the mountains towards the east, and revealed, instead of the usual blue, a fairly large expanse of vivid emerald green. None of us had ever seen it before, so that we all stopped. I should be much pleased if any of the readers of NATURE could give me some idea of the cause of this unusual phenomenon.

J. W. NOBLE.

Kurhaus Lenzerheide, St. Moritz, December 18.

THE FRENCH SAHARA.[1]

(1) M. FOUREAU has already told in a popular form the story of the expedition which he conducted with so much skill and success from the shores of the Mediterranean to the mouth of the Congo. Crossing the little-known country of the Touaregs, making the circuit round Lake Chad, descending the Shira and Ubangi Rivers, he had ample opportunity for examining the French possessions in Africa, and studying the prospects of their future development. During the six years that have elapsed since his return from this expedition he has been engaged in arranging and discussing the scientific results, some of which are now presented to the public. The first and second fascicules give details of the astronomical and meteorological observations, with a description of the water systems, the topography of the district, and the geological action of local winds. It is fortunate that the atlas of maps, which are drawn on a very elaborate scale, accompanies these handsome volumes. Since the geography of this part of Africa is somewhat uncertain, these are necessary in order to follow the exact route taken by the expedition.

M. Foureau is well known as an African explorer. For nearly thirty years he has traversed the Sahara in all directions, but his ambition to penetrate to the Sudan has always been foiled by the action of the Touaregs. In his many expeditions he has naturally been assisted by the Government and by learned societies, but he has never had at his command a force sufficient to overawe this warlike tribe and to make himself independent of its assistance or good will. In 1898, by a fortunate accident, he found himself placed in a more hopeful position. Through a legacy from M. Renoust des Orgeries to the Société de Géographie, a considerable sum of money became available for the purposes of exploration. The object of this bequest was to assist such expeditions as were undertaken with the view of bringing the independent tribes in the interior of Africa under the influence or protection of France, and which should by pacific measures tend to weld into a homogeneous whole the French possessions extending from Algeria to the Senegal and Congo. These funds were placed at the disposition of M. Foureau, who found himself in the autumn of 1898 at Wargla, at the head of a small army of some 300 men, a thousand camels, and the usual equipment of a well-organised expedition. M. Lamy, of the army of Algeria, was associated in the command of the expedition, and had charge of the military dispositions. Unfortunately, this energetic officer and able colleague, whose very ready assistance is warmly acknowledged, lost his life in an encounter with the natives.

The astronomical observations would perhaps be more fittingly described as geodetical, since they are naturally limited to the determination of the position of stations. The observations were made by M. Foureau and Lieut. Chambrun. For his longitudes, the former relied mainly on the methods used at sea, supplemented by a few occultations and phenomena of Jupiter's satellites. The author carried four available chronometers, and remarks that the error in longitude arising from the accumulated error in the rate of the chronometers during 102 days amounts to only seven minutes of arc. It is not quite clear how this seven minutes is reckoned, but it certainly implies excellent performance of the watches and great care in their manipulation. It should be added, too, that wherever a comparison between the longitudes derived by different methods is possible, the agreement is quite satisfactory. M. Chambrun trusted to equal altitudes of moon and stars, and transits of the moon across the meridian. The latter, like some of the lunar distances taken by M. Foureau, were not found to possess sufficient accuracy. For latitudes both observers measured the altitude of Polaris and meridian altitudes of sun and stars. These results call for no remark, though it is impossible not to admire the energy which enabled these observers to prosecute their work after the fatigues of hard travel. M. Foureau also made some measures of the magnetic declination and horizontal force.

The meteorological or climatic observations are particularly welcome. These observations are, of course, spread over a large area, and it is not the climate of any one district that is presented. Concerning temperature, the author remarks that the thermometer fell below zero (C.) twenty-five times, the minimum reading being $-10°.2$ (14° F.) at a height of 1144 metres. The highest temperature experienced was $48°.3$ (119° F.), in March, 1900. Throughout the region the minimum temperature occurs about 5 a.m., and the maximum between 1 and 2 p.m. During the 645 days on which observations were possible, the sky was entirely free from cloud on 132 days, slight cloud was noticed on 227, while the sky was more or less overcast on 286. Dew was noticed on fourteen occasions, and rain fell on 116 days, but of these only forty-six were marked by severe storms; but violent atmospheric effects, whether of wind, or lightning, or sandstorms, were of frequent occurrence. In the Aïr highlands, almost every afternoon the sky was blackened, while violent thunder and lightning were experienced. The entire horizon would be continuously illuminated during whole minutes by brilliant flashes of lightning. Sudden hurricanes and appalling outbursts would keep men and animals in a state of tense excitement. Slight friction on the manes and tails of horses would bring forth, not electric sparks merely, but "des nappes de lumière."

The description of the Grand Erg and the character of the country through which the expedition passed,

FIG. 1.—Large sand-dunes in the Erg region, Sahara.

[1] "Documents scientifiques de la Mission saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad)." By F. Foureau. (1) Parts i. and ii., Observations, astronomiques et météorologiques. Pp. iv+551. (2) Part iii. Pp. 555-1210; with an atlas containing 16 maps. Geology, Petrography, Palæontology, &c. (Paris: Masson and Co., 1903-1905.)

its plateaux, its mountains, its profile, are all well brought before us, the illustrations are admirably reproduced, and the maps and plates make the text clear. Naturally M. Foureau had ample opportunity for studying the effect of wind erosion. On the Sahara its work is patent. The great variation in temperature by day and night brings about a constant cracking and crumbling of rocky corners, grinding each other into smaller fragments, which are ever being blown about by winds powerful enough to whirl along lumps of stone like feathers. Thus the constant manufacture of sand goes on, the friction of the particles of which gives to hard, compact rocks a polish like that of the lapidary's wheel. Other rocks of unequal consistency yield irregularly. The author traces the effects on various kinds of rock, granites, and sandstone, and shows the fret and honeycombing that follow. Having produced the sand by hard wear and tear, it is comparatively easy to construct the dunes, so conspicuous a feature on the comparatively level plains of the Sahara. Wherever obstructions intervene, such as prominent rocks, bushes, inequalities in the distribution of sand-level, a steep talus of grains gathers in the sheltered lee, while a more gentle sloping bank gradually rises on the windward side of the obstruction until this is finally buried. The weird

FIG. 2.—Weathered pegmatite, showing the appearance of rock masses in the Sahara.

shapes into which this sand is blown, the strange curves it assumes, seem to be in many parts of the Grand Erg the only variation in a desolate landscape (Fig. 1). The author's description of Lake Chad is very interesting. This lake has about it something mysterious, and it is much to be regretted that the examination was not more thorough, with the view of unravelling what is obscure. To picture the lake as a compact sheet of water is quite inadequate. Whether the lake may be considered as containing an archipelago, or whether it runs away into numerous lagoons, creeks, swampy stretches, disconnected from the main body, is not yet cleared up. Whether these detached patches of water were originally parts of the lake, and now represent the deepest portions of the original bed, indicating that the lake is gradually disappearing, is one of those problems upon which more information is required. In these detached lakelets the water is brackish, but in the main body of the lake the water is fresh. The author raises the point whether some of these separate lagoons are not fed by subterranean water, which might explain the presence of salt. Where communication with the lake is probable or suspected there is very little salt in the water, but where the two are clearly distinct the presence of salt is very pronounced in the smaller body. M. Foureau directs attention to some very interesting points concerning the currents in this lake or in extensions of it, and discusses whether these currents are due to wind or evaporation; but into this, as into many other important points examined in these volumes, we have not space to enter. W. E. P.

(2) Now that so much new light has been thrown on North African geology by the explorations in the Lake region in the east, on the one hand, and in the territories of Germany, France, Great Britain, and the Congo Free State in the west, the largest of the unexplored tracts left of the once "Dark Continent" is that of the French Sahara, lying between Algeria on the north and the Congo territories on the south. Of this vast area a preliminary survey has been accomplished by the Mission Foureau-Lamy, which, setting out from Algeria in November, 1898, reached the Congo by way of Lake Chad in July, 1900. Ample collections were made along this almost unknown route, and detailed observations recorded on the topography, hydrology, and geology of the countries on the line of march. The results of the examination of the botanical, zoological, geological, and ethnological specimens, in the light of observations made during the journey, are now published by the Geographical Society of France with the aid of subventions made by the French Government, the Academy, and the French Association for the Advancement of Science. Needless to say, the work before us (part iii.) has been issued in a form worthy of the highest traditions of French science, and with a great wealth of valuable illustrations.

In the geological notes made by the travellers along the line of route are found many very interesting observations on the mode of weathering of rocks in tropical districts. The illustrations reproduced are excellent examples of the action of sun and wind upon rocks in a desert region. The rocks passed over consist of granite, which appears to occupy a very large area, crystalline schists, and sporadic masses of various volcanic rocks, with representatives of Silurian, Devonian, Carboniferous, and Cretaceous formations. In addition to these, there are sandstones of which the geological age could not be determined, and various superficial deposits.

The rock specimens were entrusted to M. L. Gentil, of the Sorbonne, a pupil of Prof. Lacroix, for description, and his report on the petrography of the regions traversed is a contribution of great value. Interesting laterites, diatomaceous earths, and travertines are among the most important of the materials of aqueous origin. The igneous rocks exhibit a great variety, and include, besides many varieties of granite, ophitic diabases, andesites, rhyolites, trachytes, phonolites, tephrites, and basalts. One very interesting feature exhibited by many of these rocks is their richness in the alkalies—the soda augites and hornblendes, like riebeckite, ægerine, &c., abounding in them. These facts, taken in conjunction with the studies by Mr. Prior, of the British Museum, on the rocks of the Lake district of Africa, of Prof. Bonney on those of Socotra, and of Prof. Lacroix in the Somali country and Madagascar, lend support to the view enunciated by the last-mentioned geologist that

a belt of alkaline igneous rocks surrounds the African continent.

The extensive collections of fossils brought home by the members of the Foureau-Lamy mission were placed in the hands of the late Prof. Munier-Chalmas for description, and on the lamented death of that palæontologist were transferred to his successor, Prof. Émile Haug. Valuable assistance in the work of determining and describing these fossils was received from Profs. Zeiller and Douvillé and from M. and Madame Œhlert. The result of these studies is to show that, in addition to the granitic and metamorphic rocks which at present cover such wide areas in the French Sahara, fossiliferous strata belonging to the Silurian, Devonian, Carboniferous, and Cretaceous systems also occur.

At a place called Tindesset, about 764 miles due south from Philippeville, there is found a series of

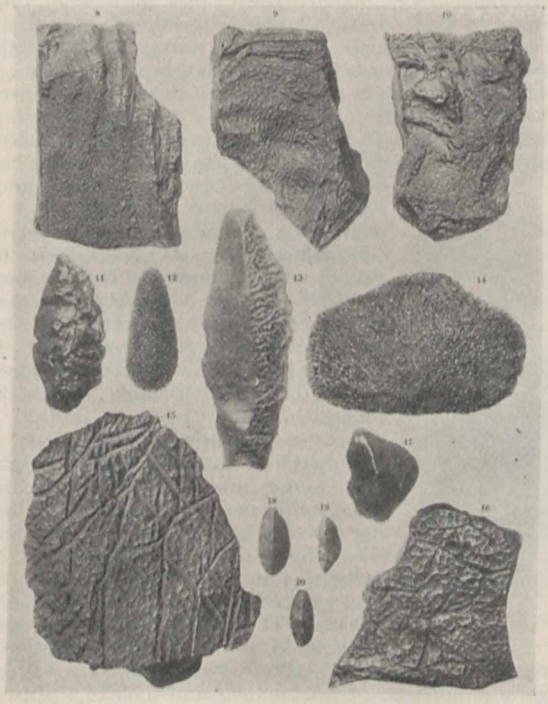


FIG. 3.—The larger specimens illustrate the fine fretted patterns produced on the surfaces of limestone rocks by the continued action of impinging sand grains driven by the wind. The four smaller specimens (17, 18, 19 and 20) illustrate the wearing down of fragments of siliceous rock, acted on by the natural "sand-blast." These are similar to those described by Mr. Enys from New Zealand.

shales cropping out from below the Devonian sandstones. The point at which they occur is nearly 4000 feet above the sea, and was reached with great difficulty by the members of the expedition. On splitting specimens of these shales that were brought home, the late Prof. Munier-Chalmas found undoubted examples of graptolites belonging to the genus Climacograptus. At that time strata of Silurian age were not certainly known to exist in the Sahara or in any part of northern Africa, but subsequently M. Flamand described graptolite shales as occurring in the Sahara at a locality about 250 miles north-west of Tindesset. As these belong to the Llandovery (Gothlandian) stage, the fossils of Tindesset may not improbably be referred to the same age.

The Devonian strata cover a wide area in the northern part of the district traversed by the mission. Strata of this age were recognised by Overweg so far back as 1850, the fossils being determined by Beyrich. In the district of Tassili they form a plateau consisting of sandstones passing into quartzites. Besides the obscure fossils referred to, Spirophyton, Arthrophycus, Nereites, Crossopodia, Nemertites, and Medusina, undoubted examples of Homalonotus, Melocrinus, and various brachiopods occur, which justify the placing of these strata at the very base of the Devonian. In addition to these, a number of separate valves of a lamellibranch shell, mineralised by hæmatite, were found. These are referred by Munier-Chalmas to a new genus (Desertella), and the beds containing them are doubtfully assigned to the Middle Devonian.

The Carboniferous system, also first recognised in North Africa by Overweg and Beyrich, has been found at many points in the Algerian Sahara, and a fairly large series of fossils (principally plants and brachiopods) was brought back by the members of this mission. The strata of sandstone and limestone appear to rest quite conformably upon the Devonian sandstones, and to represent low horizons in the Carboniferous system (Ouralian and Moscovian). As is well known, Upper Carboniferous strata also occur over considerable areas in North Africa.

The Cretaceous strata consist of the widely-spread beds of limestones forming extensive plateaux, and containing *Ostrea columba* with other characteristic Cenomanian fossils. The escarpments formed by these limestone plateaux have a height of from 300 feet to 350 feet, and at their base it has long been known that variegated clays with beds of gypsum occur. Up to the time of the dispatch of the Foureau-Lamy mission, however, no fossils had been found in these beds, and their age remained doubtful. The discovery of the remains of Cretaceous types of Ceratodus with other fishes and some reptilian bones led Munier-Chalmas to assign these strata to the same age as our Gault.

In addition to the fossiliferous rocks referred to above, tracts of sandstone strata, which yielded no trace of fossils, were found, and the exact geological age of these must remain for the present in doubt.

Two plates of the work are devoted to illustrations of the structures developed in limestone rocks by æolian action—the impinging on rock-surfaces of sand grains driven by the wind. These are well known to all geologists who have studied desert formations, but the examples so beautifully figured in this work are of exceptional interest (see Fig. 3).

In the ethnographical section of this volume, which is very full and admirably illustrated, facts of very considerable geological interest are recorded. Most important of these is the account of the occurrence of implements formed of sandstone and quartzite, which are of undoubted Palæolithic types. The whole of the ten examples appear to be of the large, elongated, and pointed form so common at Saint-Acheul, none of the smaller oval type having been found. Neolithic types of both polished and unpolished implements abound, and are very fully illustrated.

Both the authors and publishers of this very important work are to be heartily congratulated on the discoveries made and the manner in which they are given to the world.

J. W. J.

SCIENTIFIC WORK ON MONT BLANC.[1]

THE sixth volume of these reports upon the observations made in the highest experimental station in Europe contains an account of some valuable results obtained by the director, M. Vallot, as to the respiratory changes associated with prolonged residence at the altitude of 4350 metres. The observations were begun at Chamonix in 1886; this preliminary inquiry led to extended experiments with improved methods mainly in 1898, 1899, and 1900. The object of the inquiry was to ascertain the physiological condition, as regards respiratory efficiency, of an individual living for some little time in the observatory and carrying on his ordinary avocations. Many observations were made by M. Vallot upon himself, but these were supplemented by those obtained from a skilled collaborateur, M. de Goumoens.

It cannot be said that this prolonged and laborious inquiry presents that extent of scope which was such a characteristic feature of the work carried out by Prof. Zuntz, but the results are in some respects quite as valuable as those of Zuntz and his colleagues; for, in the first place, they are trustworthy observations made during a prolonged sojourn at an altitude exceeding that of the Margherita Cabin on Monte Rosa, and, in the second place, the fact that they are confined to one narrow field gives them an additional scientific exactitude. It is undoubtedly an advantage, in any study of the exceedingly complex changes which the living organism undergoes at high altitudes, to focus the attention upon one point of fundamental importance. It is obvious that such a point is the total respiratory ventilation during a stay in high altitudes, for the modification of the respiratory acts is a familiar incident in the experience of all those who have had the opportunity of reaching the summit of the higher Alps. Moreover, the detailed study of respiratory modification through diminished atmospheric pressure must be carried out before drawing any physiological conclusions as to the significance of those general metabolic changes which have been so ably brought forward by Zuntz. There is consequently a distinct gain in the concentration of effort displayed by M. Vallot. It is possible that the technique employed by him might be now improved; each succeeding Alpine investigator of a scientific character learns something from a predecessor, and this truth is plainly displayed in the account given by Zuntz already referred to, and in the more recent memoirs of Durig published this year in vol. cxiii. of the *Archiv f. d. ges. Physiol.* But the methods used by M. Vallot appear to be fully adequate to determine the special points which he brings forward, and the results undoubtedly reveal certain features of the respiratory mechanism of no little special and general interest.

It is common knowledge that the degree of the pulmonary ventilation is continually changing, this being due to alterations both in the frequency and the amplitude of the respirations; but if the amount of the air breathed in and out is estimated during the whole of a considerable period, these variations practically disappear. It is thus possible to obtain a series of total volumes of pulmonary ventilation, each number in the series being that of some given period, such as an hour, or a day of twenty-four hours. The work described by M. Vallot consists in framing such series, both for himself and for M. de Goumoens, when resident in Chamonix, during a prolonged stay in the Mont Blanc Observatory, and again on return to the Chamonix level. His observations have thus been made continuously for considerable periods, and each period has comprised the ascent to the observatory, residence there, and the return to Chamonix. On comparing the observations made respectively first at the low level, then at the high altitude, and finally at the low level again, certain differences are brought to light.

In the first place, M. Vallot shows that his method is adequate to display the diurnal variations in the total pulmonary ventilation which occur at ordinary levels independently of the muscular exercise, and which are undoubtedly related to food assimilation. With regular meals and sound digestion these variations occurred in the results obtained in Paris, and in Chamonix; their general character was a series of rises in the total amount of the hourly ventilation; each rise came on after a meal, and lasted for a given period before it declined towards its old level. These diurnal food variations in the pulmonary ventilation persist, according to M. Vallot's observations, when the subject is living at a high altitude, and their character is unaltered provided the regimen of diet remains the same and there is no obvious impairment of the digestive system.

The most important part of the observations is, however, that which contains a series of the daily ventilation aggregates. In regard to these, M. Vallot considers them from two standpoints:—(1) that in which the aggregate volumes of the respiratory tidal air are measured at the temperature and pressure which they have in the lungs—this he terms the "real ventilation"; and (2) that in which the same aggregate volumes are all reduced to what they would be at 0° C. and 760 mm. Hg pressure—this he terms the "absolute ventilation." The "real ventilation" he takes as an index of the amount of the total thoracic enlargement, and thus of the mechanical work of respiration, whilst the "absolute ventilation" he takes as an index of the quantity of air and of its oxygen component introduced into the lungs for the purposes of the organism. His general results may be briefly set forth under these two aspects.

(1) *Changes in "Real Ventilation."*—All observations of an extended character on real ventilation quantities show in each individual occasional variations occurring irregularly, and not accounted for either by muscular movements or, apparently, by food. These irregularities became far more conspicuous during prolonged residence in the observatory, and indicate that the organism, when in elevated regions, is in a condition of greater instability as regards its body processes; with due caution M. Vallot declines to give any more definite hint as to their meaning. If these irregularities are put on one side, the mean level of a whole series of daily aggregates is seen to be considerably affected by the high altitude of 4350 metres. The effect is a rise, which in M. Vallot (regarded as a trained subject) was immediate on arrival at the observatory; it amounted to a total daily increase in "real ventilation" of 30 per cent. over the Chamonix figures. It was very slightly increased during the stay in the observatory, and immediately fell on descending again to the lower level. It was not the consequence of the muscular efforts involved in the ascent, and appears to have been a direct response of the organism to the lower atmospheric pressure; there is thus an increase in the mechanical work of the thorax and lungs at high altitudes.

In the case of M. de Goumoens, who is described as an "untrained subject," this immediate rise in "real ventilation" was still more prominent, amount-

[1] "Annales de l'Observatoire météorologique, physique et glaciaire, du Mont Blanc." Tome vi. Pp. vii+218. Publiées sous la direction de J. Vallot, Fondateur et Directeur de l'Observatoire. (Paris: G. Steinheil, 1905.)

ing to 45 per cent. over the Chamonix figures; it was increased during the prolonged stay at the observatory, and on descending to Chamonix it only partially fell to the level of the ventilation before the ascent, an excess remaining for many weeks.

(2) *Changes in "Absolute Ventilation."*—The importance of this series of calculations rests on the possibility of comparing these changes with those in the "real ventilation," for it will be clear that if the views advanced by M. Vallot are sound, then such comparisons will indicate how far the augmentation in the "real" values through extra thoracic enlargement has sufficed to compensate for the diminution in the actual quantity of oxygen as the result of the diminished air pressure. In the case of M. Vallot, who by frequent visits and ascents was a "trained subject," it appeared that the high altitude always caused on arrival at the observatory an immediate fall in the total value of the absolute ventilation; this fall, although not large, was quite distinct, so that the increased thoracic work was apparently insufficient to compensate fully for the diminution in the quantity of inspired oxygen caused by the lowered atmospheric pressure. This continued for some days of the residence in the observatory, and then gradually became almost inappreciable, the deficiency being decreased by 50 per cent., indicating the gradual development of an acclimatisation compensation. As in the real ventilation, so here the descent to Chamonix was necessarily associated with an immediate and complete return to the normal condition.

The case of M. de Goumoens is still more interesting because more marked. He is spoken of as the "untrained" subject, and in his case the "absolute" value of the daily ventilation immediately fell considerably more than in the case of M. Vallot. This considerable fall occurred in spite of the circumstance that the compensatory thoracic work had shown a very marked increase. The continued life in the observatory was in M. de Goumoens's case associated with a much more notable adjustment of the absolute ventilation value than M. Vallot (the "trained" subject) showed, so that by the second week the deficit had diminished by 80 per cent. The descent to Chamonix was associated with the disappearance of the deficiency, but since the "real" value remained persistently increased, this caused the "absolute" value to be so much that instead of a deficiency there was now an excess of 30 per cent. over the previous Chamonix figures. Hence it appears that the respiratory mechanism responds by a compensatory increase, as regards mechanical work, when the subject is brought into a low atmospheric pressure, that this response is immediate, but is at this high altitude insufficient, and that the degree of insufficiency is less in those who have frequently undergone the experience. A further compensatory increase is then gradually brought into play which adds to the total and makes the whole compensation more nearly adequate, but this does not, as the immediate one does, cease when the subject returns to lower levels. It would thus seem probable, although M. Vallot does not himself give any definite suggestions on this point, that the immediate adjustment is one involving the respiratory nerve centres, whilst the slow adjustment involves the actual framework of the thorax.

The total change in respiratory ventilation value, whether "real" or "absolute," being itself brought about by either greater amplitude or greater frequency of respiration, it was necessary for M. Vallot to ascertain the share taken by each of these factors. The changes in frequency were often very pronounced, but their periodicity and general character were so irregular that no direct relation between the real ventilation values and the frequencies could be ascertained. On the other hand, the results as regards amplitude were far more definite, and it would appear that this is the chief factor in the production of the compensatory effect. The details of the observations given by M. Vallot under this head need not be referred to, since their general character will be sufficiently indicated by the foregoing remarks. As regards the whole investigation, it will be evident that since several such series of experiments were undertaken, the researches described in this volume of the *Annales* indicate an immense amount of laborious and prolonged work, and M. Vallot is to be congratulated upon the solidity of the contribution which he has made to the physiology of respiration, and upon the pertinacity which he has displayed in his conduct of the whole inquiry; this pertinacity, combined with a rigorous limitation of the inquiry to one issue, has resulted in genuine achievement.

Two other short memoirs are bound up with the volume. The first of these deals with meteorological observations made on the Glacier de Tête-Rousse by M. Mougin and M. Bernard during the following periods:—August 1 to October 18, 1901; June 1 to October 10, 1902; and July 1 to October 13, 1903. The occurrence of rain, snow, dew, &c., is noted, and the daily temperatures, minimal and maximal, are tabulated. A series of special experiments was made as to the temperature of internal parts of the glacier. It appears from these that at a depth of 15 metres the temperature remained constantly at 0° C. throughout all the months of the year.

The third memoir is one by M. Henri Vallot. In this the author gives some further particulars as to the method which he has employed for mapping out the details of the Mont Blanc summit with its extensive glacier fields. F. G.

SUCCESS OF ANTI-MALARIAL MEASURES.

TWO reports recently issued prove in a striking manner that malaria may be stamped out by the application of scientific measures directed against the malaria-bearing mosquitoes. The first report deals with Ismailia.[1] Malaria was introduced into Ismailia in 1877, and since 1886 nearly all the inhabitants have suffered from the disease. In 1901, on the initiative of Prince Auguste d'Arenberg, president of the Suez Canal Co., Prof. Ronald Ross was consulted, and, acting on his advice, a series of measures instituted which has had the welcome result of completely freeing Ismailia from malaria. These measures consisted in the destruction of mosquitoes, principally by filling in and draining the pools and marsh land, or treating these with petroleum where the Anopheles breed, concreting water courses, &c., and instructing the inhabitants and protecting their household water supplies. This has been attained at an initial cost of 50,000 francs, and an annual outlay of 18,300 francs.

These measures were commenced in 1903, and from that time the ordinary mosquitoes disappeared from Ismailia, so that mosquito nets are no longer necessary. Since the autumn of that year not a single Anopheles larva has been found in the protected zone, and no fresh cases of malaria have occurred. The number of cases of malaria per annum in Ismailia has been as high as 2500, and in 1902, before the

[1] "Suppression du Paludisme à Ismailia." (Compagnie Universelle du Canal maritime de Suez, Paris, 1906.)

anti-malarial campaign, there were 1550! The report is illustrated with interesting plans and diagrams.

At Port Swettenham, Federated Malay States, anti-malarial measures were commenced in 1901 and 1902, and the latest report,[1] by Drs. Travers and Watson, shows how great a measure of success has been attained. Among the Government employees, for example, in 1901 236 sick certificates were issued and 1026 days of leave were granted on account of malaria. In 1905 the figures were respectively four and thirty. Comment is needless.

NOTES.

AT a special general meeting of the Royal Society of Edinburgh, held on December 21, the council presented a report on the new accommodation to be provided for the society in consequence of its proposed removal from the Royal Institution, under the provisions of the National Galleries (Scotland) Bill. We learn from this report that in March last a memorial was presented to the Secretary for Scotland directing attention to the needs of the society, and asking for a free grant of 600*l*. a year. In a semi-official reply to this memorial the general secretary of the society was informed that a proposal was being entertained by the Government to devote the whole of the Royal Institution to the purposes of art, and that the Royal Society must contemplate the necessity for finding accommodation elsewhere. As it appeared from correspondence and an interview with the Secretary for Scotland that the Government had definitely decided to allot the whole of the Royal Institution for the purposes of art, the council resolved, with great reluctance, to accept the necessity for removal, and to do its best to secure adequate reinstatement. An accommodation committee was therefore appointed by the society to advise the Secretary for Scotland regarding sites and buildings suitable for new premises for the society, with the result that the committee unanimously recommended the building at present occupied by the Edinburgh Life Insurance Office, Nos. 22 and 24 George Street. At an interview on November 22 Mr. Sinclair offered, subject to the consent of Parliament, to purchase and adapt the George Street building on certain conditions, and in addition to give a free grant for the scientific purposes of the society. The conditions proposed were approved by the representatives of the society present as being, in the circumstances, an equitable settlement of the claims of the society. In a letter received by the general secretary, indicating the nature of the proposals which Mr. Sinclair intended to make in committee on the Bill in question, it was made clear that the society was to occupy the building on identical terms with those of the occupancy of the Royal Society at Burlington House. In the speech of the Secretary for Scotland on December 13, during the debate in Committee of the House of Commons on the Galleries Bill, the final proposals regarding the accommodation and grant to the society, recorded in last week's NATURE (p. 179) were described. Briefly, the arrangements are that a sum of 25,000*l*. will be used for the purchase of a building, and 3000*l*. to cover the expenses of fitting up, redecorating the new premises, and transferring the library and other effects of the society from the Royal Institution. The Treasury will also give the society a grant of not more than 600*l*. a year. The council expresses the opinion that these proposals meet the claims of the Royal Society both in respect of an additional grant and of reinstatement in suitable new premises. In conclusion, the council remarks in the report that the society owes a debt of gratitude to the Scottish Members of Parliament, to various members of the Royal Society of London, and to the British Science Guild for their loyal support in a time of difficulty. The report of the council was, on the motion of Sir William Turner, seconded by Prof. Bower, received and unanimously approved by the society at the special meeting on December 21.

[1] *Journ. of Trop. Med.*, July 2.

THE death is announced of Dr. A. W. Panton, tutor and lecturer on mathematics at Trinity College, Dublin. Dr. Panton made several useful contributions to mathematical science, and was the author, in conjunction with his colleague, Prof. W. S. Burnside, of a standard work on "The Theory of Equations."

THE *Petit Parisien* recently invited its readers to vote on the question of the relative preeminence of great Frenchmen of the nineteenth century. The result is recorded in Monday's *Times*. Fifteen million answers were received; and Pasteur's name headed the list with 1,338,425 votes, Victor Hugo, in the second place, being more than one hundred thousand votes behind him. In addition to Pasteur, the following is the order of the names of men of science who appear among the first twenty in the list:—Prof. Curie; Dr. Roux; Parmentier, who introduced the potato into France; Ampère; Arago; and Chevreul, the chemist. It is clear from the results of this *plébiscite* that the French people cherish the memories of the scientific investigators whose work has contributed, not only to national renown, but also to the advancement of knowledge throughout the world.

REUTER reports the following severe earthquake shocks during the past few days:—*December* 22, *Kopal, Semirechensk*.—An extremely violent earthquake shock, lasting one and a half minutes, was felt in this district at 11.20 p.m. *Rome*.—The seismographic instruments at the observatories of Bologna and Florence recorded in the evening a violent earthquake estimated to have originated at a distance of 7000 kilometres. *December* 26, *Santiago de Chile*.—A strong shock of earthquake is reported from Arica. Shocks were felt at Iquique and Pisagua.

A REUTER message from Naples states that a portion of the crater of Vesuvius fell in on December 20, with the result that a shower of ash fell over Naples for twenty minutes so thickly as to obscure all view of the volcano. Later in the day the ash ceased to fall at Naples, but continued in the direction of Portici and Pompeii.

THE St. Petersburg correspondent of the *Globe* reports that an expedition for the exploration of the Arctic regions is being equipped under the leadership of Lieut.-Colonel Sergeyeff. The expedition will last for several years, and will start from Yeniseisk, and try to reach Bering Strait.

IN the September number of *Terrestrial Magnetism* Prof. G. B. Rizzo states that on September 7, 1905, some hours before the Calabrian earthquake of last year, a land surveyor at Monteleone found the needle of his compass so much disturbed that he was compelled to discontinue work. In Japan great earthquakes have been known for some time to be preceded by magnetic disturbances, but we are not aware that any of these have been so large as that recorded by Prof. Rizzo.

THE annual conversazione of the Royal College of Science and Royal School of Mines Students' Union was held on December 19 at the College in Exhibition Road, South Kensington. There were exhibits and demonstrations

in mining and metallurgy, mechanics, geology, botany and zoology, and the Solar Physics Observatory was thrown open for inspection. Prof. W. Gowland gave an illustrated lecture on "Stonehenge," and two lantern lectures were given by Dr. W. J. S. Lockyer on "The Photography of Clouds and Lightning."

A TELEGRAPHIC message in the *Times* of December 17 announces that Prof. Koch, who has for some time been engaged in investigating the causes of sleeping sickness in German and British East Africa, has proved that atoxyl is an effectual remedy against the disease. The treatment is reported to have been successful in all cases which have so far been dealt with, and it now only remains to test the permanence of the cures effected. If this news proves to be true, Prof. Koch is to be congratulated on finding a cure for this deadly disease, which has already spread over the Congo Free State, has depopulated some of the most fertile districts of Uganda, and is threatening the Sudan on the north and Rhodesia on the south. It is, however, probably somewhat premature to speak of cures in a chronic disease such as this, which may run without treatment for several years. Nagana, which is closely related to sleeping sickness, is an acute disease in horses, killing them in three or four weeks. By giving the animals arsenic, however, they may be kept alive for a year or more. If one must wait a year to test the permanence of a cure by arsenic in an acute disease such as nagana, how much longer must one wait in such a slow, chronic disease as sleeping sickness, which may have a natural duration of years instead of weeks? Prof. Koch's preliminary report will be awaited with interest.

THE annual meeting of the Association of Economic Biologists will be held at Cambridge on January 9, 10, and 11. The laboratories in the pathological department of the University and the zoological laboratory will be thrown open for the occasion. On January 9 the president, Mr. F. V. Theobald, will deliver an address on sea fisheries. The following papers will be read during the meeting:—Red-water fever and allied diseases, Prof. Nuttall, F.R.S.; cereal breeding, H. R. Biffen; new hemipterous fruit pests in Britain, F. V. Theobald; Intorno agli esperimenti contro la Mosca delle olive (*Dacus oleae*, Rossi), Prof. A. Berlese; on the American gooseberry-mildew, an epidemic fungus disease now invading Europe, E. S. Salmon; the successful extermination of the black currant gall-mite, W. E. Collinge; the geographical distribution, natural and artificial, of the principal rubber plants, W. G. Freeman; notes on insect pests in the British East African Protectorate, F. V. Theobald; the spruce-gall and larch-blight diseases caused by "Chermes" and suggestions for their prevention, E. R. Burdon; a description of an infectious disease occurring in hares, T. Strangeways; the blood changes in man caused by the presence of metazoan parasites, and their aid in diagnosis, E. G. Fearnsides; on the use of an economic museum in the teaching of geography, W. G. Freeman.

A BILL has been deposited in Parliament to incorporate the Channel Tunnel Company, and to authorise the construction of works which shall form part of the scheme intended to connect England and France by means of a railway in tunnel under the English Channel. It is estimated that the scheme will involve a total outlay of 16,000,000*l*. Half that amount is to be raised in this country, and the remainder is promised in France as soon as the scheme shall have received Parliamentary sanction in England. It is proposed to construct two parallel tunnels, the total length of which under the sea is to be twenty-four miles, and with the land approaches on either side thirty miles. The tunnels, each 18 feet in internal diameter, are to be driven from Dover to Sangatte throughout the whole distance in the grey Rouen chalk. Power for the electric motors which are to be employed in the tunnel traffic is to be obtained from large generating stations, which are likewise to supply the current required for lighting and the compressed air necessary for the purposes of ventilation.

No. 7 of vol. xvi. of the Proceedings of the Royal Physical Society of Edinburgh is devoted to the second part of Dr. T. Scott's catalogue of the crustaceans inhabiting the basin and estuary of the Forth, this portion dealing with the ostracods, copepods, and cirripedes.

To the November number of the *American Naturalist* Prof. H. F. Osborn contributes the first portion of an article on the causes of extinction of species in mammals, more especially the larger kinds. After referring to the views of Darwin, Wallace, and Lyell, the author discusses in turn the influence of changes in the shape of land-masses and their connections; of climatic changes, especially increasing cold and varying degrees of humidity; of changes in the flora of countries brought about by climatic alterations; and, finally, the effects of insect-life. The concluding portion of the paper must be awaited before a summary of the author's views can be given. In another article Dr. Raymond Pearl discusses variation in the number of seeds in the lotus, *Nelumbium luteum*, while in a third Messrs. J. A. Cushman and W. P. Henderson give the results of a preliminary study of the finer structure of the "test" of the fresh-water rhizopod Arcella.

IN the November issue of the *Quarterly Journal of Microscopical Science* Dr. Georgina Sweet continues her account of the anatomy of the marsupial mole (*Notoryctes typhlops*), dealing in this instance with the vestigial eye. This organ, despite the fact that its owner spends much of its time on or near the surface of the ground, is much more completely atrophied than in the mole, the optic nerve and lens being wanting, while the other structures connected with vision are degenerated in a greater or less degree. The eye itself has sunk deep beneath the skin, which passes over it unaltered except for the presence of sensory (? tactile) organs developed from the lachrymo-nasal glands and ducts. This complete degeneration of the eye may be attributed to the irritating effects of the particles of heated sand amid which the creature dwells, the development of the glandular structures into sense-organs being in all probability a compensation for the loss of vision.

AMONG other articles in the November issue of the *Quarterly Journal of Microscopical Science*, one, by Mr. F. A. Potts, is devoted to the modification in the sexual characters of hermit-crabs induced by the parasitic cirripede Peltogaster. Two articles, one by Mr. E. Potts, of Philadelphia, and the other by Mr. E. A. Browne, of University College, London, treat specially of the medusæ of the American fresh-water polyp Microhydra, with notes on the two other known forms of medusa-producing polyps. In a fourth article Mr. C. Shearer describes the structure of the nephridea of the annelid Dinophilus, which proved to be closed internally by "flame-cells," or "solenocytes," similar to those of certain polychæte annelids, the lancelet, and one form of the Phoronis larva. The two remaining articles deal respectively with the canker of apple trees and Dr. R. Goldschmidt's recent monograph on the lancelets of the genus Amphioxides.

THE report of the Board of Health on Plague in New South Wales in 1905 includes reports on the fifth outbreak of plague at Sydney, by Dr. Ashburton Thompson; on outbreaks of plague on the Clarence and Richmond Rivers, by Mr. R. J. Millard; on an outbreak of plague at Newcastle, by Mr. R. Dick; and appendices on the kind of printed forms used in investigating plague and on the epidemiology of plague, the latter being an address by Dr. Thompson. Again clear evidence is brought forward of the correlation between rat plague and human plague in the four localities of the outbreaks, and Dr. Thompson's address gives a valuable summary of the epidemiology of the disease. The report is illustrated with five maps and a chart.

THE last Bulletin of the Madras Museum, under the editorship of Mr. E. Thurston, contains an interesting monograph on the Paraiyan or Pariahs of southern India. The name of this caste seems to mean "drummers," and the Rev. A. C. Clayton, the author of the monograph, accepts the theory that they are a people who in former times were priests of the non-Aryan or Dravidian races, and that the detestation shown by the Brahmans to them is based on religious rivalry rather than on their foul course of life—the eating of carrion and the like. Mr. Clayton gives an interesting account of their religious rites, social and domestic ceremonies. These have clearly suffered much modification under the influence of their Hindu neighbours, and they now retain little that is really primitive. Thus they seem to have discarded the totemistic exogamous system of groups, and their religion has been largely influenced by Hinduism. This contribution to the ethnology of southern India gives a useful account of an interesting and little-known people.

PARTS i. and ii. of the fifth volume of *Biometrika* were issued together as a double number at the beginning of this month. The volume opens with a full and interesting memoir of the late Prof. Weldon, joint founder and co-editor of the journal, who died last spring at the early age of forty-six; many of our readers may be glad to note that this memoir is also obtainable separately from the Cambridge University Press. The following article is by Prof. Raymond Pearl, on the variation of *Chilomonas paramoecium* under favourable and unfavourable conditions; it is shown that the individuals under unfavourable conditions are smaller than the others and of somewhat different shape, and the relation of these facts to the theories of Driesch and others is discussed. The promised issue of the memoir by the same writer, on which some controversy recently took place in our correspondence columns, has, however, apparently been deferred to the next part. Dr. F. A. Woods and Mr. David Heron, in two independent articles, conclude that neither in man nor in the horse is there any significant inheritance of the sex-ratio, nor is there any evidence of Mendelian inheritance—important contributions to the literature of this subject. Dr. Macdonell contributes a second study of the English skull, based on crania discovered during excavations in Liverpool Street, and Prof. Pearson discusses the relations between intelligence and various physical and mental characters, all such relations appearing to be very light. The concluding article gives an account of an important investigation, by Dr. J. W. Jenkinson, on the relation between the first furrow, the sagittal plane, and the plane of symmetry in more than 800 frogs' eggs; the results of this investigation show that the conclusions of some previous writers, based on the examination of very inadequate numbers of eggs, have been stated much too confidently, the variation exhibited being very large indeed. The miscellanea, as usual, contain a number of shorter articles, chiefly on minor points of statistical theory. We note that Dr. Macdonell, Mr. Elderton, and Prof. Pearl are now associated with Prof. Pearson in the editing of the journal, and it may be hoped that this assistance will lead to a more regular issue than in the past.

IN the second number of the Botanical Journal of the Imperial Society of Naturalists in St. Petersburg, Mr. and Mrs. B. Fedtschenko present an article collating the species of Campanulaceæ from Russian Turkestan. In the course of an article on the flora of a district in the Government of Riazan mention is made of the discovery of pollen and seed from pine trees in the peat that would indicate the previous extension of coniferous forests many miles further south. A description of plants newly recorded from the Crimea is contributed by Mr. A. Younghé.

ON the subject of cotton cultivation in the Bombay Presidency, Mr. F. Fletcher contributes an instructive article to the *Agricultural Journal of India*, vol. i., part iv. Premising that the better the quality the longer the cotton takes to mature, five regions are distinguished according to the nature of the soil and the amount of rainfall. Of these, the Surtee-Broach and Karnatak tracts are said to be capable of producing the best indigenous cottons, while on a portion of the Sind tract that is irrigated excellent Egyptian cotton has recently been grown. In the matter of new cottons a promising hybrid is announced from the Surat farm, and cautious but sanguine views are expressed with regard to tree cottons, of which two are discussed as forms of *Gossypium peruvianum* and *G. barbadense*.

AN interesting account giving practical details of the construction of a tramway in connection with the extraction of timber from the forests of Goalpara, in northern India, is furnished by Mr. W. F. Perrée to the September and October numbers of the *Indian Forester*. For working the forests in question, situated north of the Brahmaputra towards the Bhutan border, neither sufficient labour nor animals could be maintained; further, no water was available in parts of the district; for these and other reasons an experimental tramway was laid down, and subsequently extended for a distance of nine miles from the Brahmaputra. Short logs, sleepers, and water tanks are conveyed on single trucks, while large logs are placed on movable frames mounted on the trucks as bogies. The details of construction and cost provide useful items for reference.

DR. E. HOWARD ADYE, whose careful "Twentieth Century Atlas of Microscopical Petrography" has already been noticed in these pages, is now issuing in parts a work entitled "Studies in Micropetrography," accompanied by actual rock-sections, as well as coloured illustrations. A prospectus and sample plate can be obtained from the publisher, Mr. R. Sutton, 43 The Exchange, Southwark, S.E. The rock-sections are of the same beautiful character as those issued with the previous atlas, and the subscription price of 4*l.* 4*s.* for forty-eight of these and twelve parts of the work cannot be regarded as excessive. The plates and detailed descriptions should enable the student to go a very long way in self-instruction, while the series of preparations would be welcome in any laboratory. With a view to systematic arrangement later, we could have wished that the descriptions had been printed on separate and unpaged sheets. The interesting volcanic ash of Mont Pelée is included in the first part issued. Surely, however, it would be possible for Dr. Adye to quote published litera-

ture concerning this material. He states that he has found none at present.

THE physical papers read at the seventy-eighth meeting of the German Association of Naturalists and Physicians are published in No. 20 of the *Verhandlungen* of the German Physical Society, and also in Nos. 21 and 22 of the *Physikalische Zeitschrift*. A striking case of "chemiluminescence" is described by Prof. E. Wedekind; the interaction of chloropicrin with magnesium phenyl bromide in ethereal solution is accompanied by the production of a green flame beneath the ether, without the latter, however, being caused to kindle or explode. In a dark room the luminescence appears very intense. An interesting lecture on the so-called "liquid crystals" was delivered by Prof. Lehmann at a general meeting of the association; its general scope was to illustrate how the development of such "crystals" appears to mimic the phenomena usually supposed to be characteristic of the simplest forms of living matter.

A COPY of a paper entitled "Niederschlag, Abfluss und Verdunstung auf dem Landflächen der Erde," prepared by Dr. Richard Fritzsche to attain his doctorate (Friedrichs Universität Halle-Wittenberg), has been received. The paper is an attempt to re-calculate from recent data the total yearly rainfall over the earth's surface, and to indicate the transference of water between land and sea. The flow of water through the world's rivers is, of course, also considered in detail, and in this connection a very full list of authorities and references is given, adding greatly to the value of the thesis. In most cases the figure used is compared with that given by Murray. The unit adopted is the cubic kilometre per year. The total rainfall over the whole world is given by Fritzsche as 465,300 cubic kilometres per year, which is equivalent to a uniform depth of 91 centimetres; Brückner gave 94 centimetres. The rain falling on land is estimated by Fritzsche as 111,940 cubic kilometres per year, by Brückner at 122,540 cubic kilometres, and by Murray at 122,318 cubic kilometres per year. The amount given by Fritzsche is equivalent to a depth of 75 centimetres. Considering only the land which is drained by rivers into the sea, it is calculated that only 30 per cent. of the water returns to the sea in this way, the remaining 70 per cent. being removed by evaporation. The tables which accompany the paper are very full and interesting.

SINCE the publication of the first edition of his "Sinnesorgane im Pflanzenreich zur Perzeption mechanischer Reize" (Leipzig: Engelmann) in 1901, Prof. G. Haberlandt has continued his investigations of the sense organs, or organs of perception, of plants, and he includes his new observations in the second edition of his work just published. The original volume was reviewed in NATURE of April 10, 1902 (vol. lxv., p. 529).

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY, 1907:—

Jan. 2. 7h. Neptune in opposition to the Sun.
3-4. Epoch of January Meteors (Boötids, radiant 230°+53°).
4. 6h. Venus at maximum brilliancy.
7. 9h. 56m. to 12h. 56m. Transit of Jupiter's Sat. III. (Ganymede).
9. 17h. 44m. to 18h. 20m. Moon occults γ Libræ (mag. 4·1).
10. 17h. 12m. Moon in conjunction with Venus. Venus 0° 17′ N.
13. Total eclipse of Sun, invisible at Greenwich.
14 13h. 13m. to 16h. 13m. Transit of Jupiter's Sat. III. (Ganymede).
Jan. 16. Venus. Illuminated portion of disc = 0·353.
17. 11h. 28m. Minimum of Algol (β Persei).
20. 8h. 17m. Minimum of Algol (β Persei).
21. 9h. 7m. to 10h. 12m. Moon occults ξ^2 Ceti (mag. 4·3).
24. Neptune ¼° N. of 36 Geminorum (mag. 5·2).
26. 2h. 4m. Jupiter in conjunction with Moon. Jupiter 2° 37′ N.
,, 6h. 40m. to 7h. 45m. Moon occults ν Geminorum (mag. 4·1).
28-29. Partial eclipse of Moon, invisible at Greenwich

COMETS 1906*h* (METCALF) AND 1906*d* (FINLAY).—From observations made at Mount Hamilton and Rome, Herr M. Ebell has calculated a set of elliptic elements for comet 1906*h*, after finding that the observed places could not be satisfied by a parabola. The time of perihelion passage, according to these elements, was October 10.794 (Berlin), and the period of the comet is 7·588 years. The elements exhibit a similarity to those of comets Faye, Wolf, 1892 V., 1896 V., and 1900 III., but it is improbable that comet 1906*h* is identical with any of these, although it probably belongs to the same family. An ephemeris extending to January 28 is also given by Herr Ebell, but, as the comet is so extremely faint, it is not worth while to reproduce it here.

On December 8 Prof. Hartwig, at the Bamberg Observatory, examined the neighbourhood of the comet, and of the star B.D. −3°·696, with a 10-inch refractor, for the nebulous objects seen at Bordeaux on November 22, but was unable to find them (*Astronomische Nachrichten*, No. 4141).

An ephemeris extending to March 22 is given for comet 1906*d* in No. 4140 of the *Astronomische Nachrichten* by M. L. Schulhof. This object is now very faint, and is about 1½° south of Pollux.

TWO STARS WITH A COMMON PROPER MOTION.—In vol. lx. of the Monthly Notices of the Royal Astronomical Society, Mr. Bellamy announced that the two stars AG Berlin B 5072-5073 have a common proper motion, and this was confirmed later by Prof. Kreutz. Additional confirmation now comes from Prof. Millosevich, who has compared the available observations since the year 1881 with more recent ones, the last of which was made at Rome at the epoch 1906·39, and finds the proper motion on a great circle to be 1″·385 in the direction 142° 7′ (*Astronomische Nachrichten*, No. 4132).

OBSERVATIONS OF VENUS.—Continuing his articles on "Planets and Planetary Observation" in the *Observatory*, Mr. Denning discusses the observation of Venus in No. 377, and points out that the difficulties attending such observations have hitherto prevented any final determination of the planet's rotation period, or of the nature of her surface markings.

He also states that the best times to observe the planet are during the evening apparitions in the early part of the year and the morning apparitions which occur in the latter half of each year, when Venus is above the horizon for a long time after sunset or before sunrise. The chief observations of reputed surface markings which have been made since the time of Galileo are discussed at some length in Mr. Denning's notes.

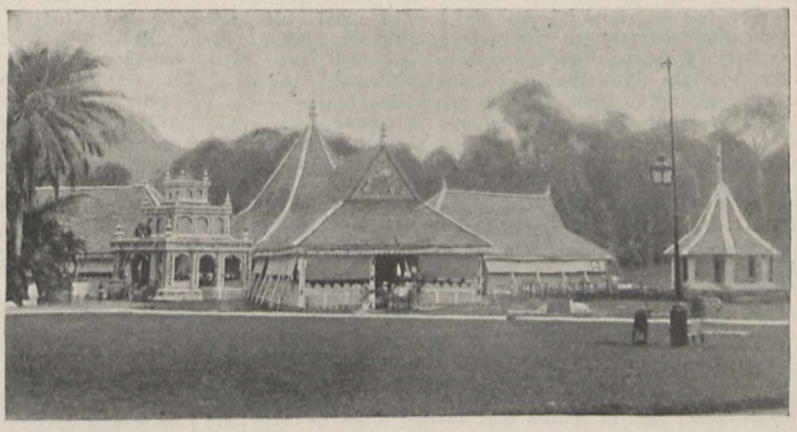
A BRILLIANT METEOR.—Mr. H. E. Wood, of the Government Observatory, Johannesburg, records, in No. 4141 of the *Astronomische Nachrichten*, the observation of a brilliant meteor on July 16 in various parts of South Africa. An observer at Mbabane, in Swaziland, describes the object as a large white ball with a long trail of sparks, and states that it split into two masses each larger than the full moon, whilst a loud explosion accompanied its disappearance. Attempts to locate the object, which apparently struck the earth near to Mbabane, have been unsuccessful. Mr. Wood himself saw a meteor, which he believes to have been the same object, at Johannesburg, two hundred miles away, at 8h. 45m. p.m. (standard time of 30° E.), but he heard no detonation, although the object was very brilliant and left a trail of sparks. As a similar body was observed in Germany on the same evening, Mr. Wood suggests that possibly the earth encountered a stream of meteoric bodies on July 16, and that both the observed meteors were members of the same stream.

RUBBER CULTIVATION IN THE EAST, AND THE CEYLON RUBBER EXHIBITION.

AN exhibition of "rubber" has lately been held in the Royal Botanic Gardens at Peradeniya, in Ceylon, with the most unqualified success, and the time is opportune to see where we stand, and to sum up the work of the scientific institutions which have been engaged in starting this new, and now very prosperous, industry.

Rather more than thirty years ago it began to be evident that there was a possibility that, as in the previous case of cinchona, the natural wild rubber supplies—which were then almost solely South American—would in time be exhausted, and an expedition was sent by the Indian Government, aided by the Royal Botanic Gardens at Kew, to the valley of the Amazon, where seeds and plants of the Para rubber—*Hevea brasiliensis*—and other rubber-yielding plants were obtained and safely conveyed to Kew. From Kew they were sent to the East, and as it was fairly evident that at that time there was no place in India suitable for their growth, they were sent to the care of Dr. Thwaites, in Ceylon, the then director of the botanic gardens in that colony. A few were also sent to Singapore and elsewhere. These plants arrived in Ceylon in 1876, and were planted chiefly in the low-lying garden of Henaratgoda, which was specially opened for their reception.

The trees began to seed about 1882, and from that time onwards practically all the seed has been used. Of the earlier crops a large part was sent to other countries, but in later years most of the seed was used in the island. In 1888 the late Dr. Trimen, Thwaites's successor, began to tap one of the original trees at Henaratgoda, and in that year, working in the rough way then practised, 1 lb. 12 oz. of dry rubber were obtained from it. V-shaped cuts were made with a chisel, and the milky latex allowed to run down into cocoa-nut shells and to dry naturally. The tree was given a rest in 1889, and in 1890 gave 2 lb. 10 oz. It was again tapped in every second year following, and by 1896, in which year the experiment came to an end, it had yielded 13 lb. 7 oz. in the five tappings, and was twenty-two years old. The average yield was thus about 1½ lb. a year, but the tree was twelve years old when the experiments began, and was also, instead of being of the average size, the largest tree in the plantation. At this rate, therefore, there was but little prospect for success, especially with the price at the comparatively low figure which it then occupied.



Buildings of the Rubber Exhibition held at Peradeniya, Ceylon, on September 13–27.

The next stage in the work was in 1897, when the writer found that the average yield of a plantation of trees about twelve years old might be about 120 lb. an acre, and also made the very important discovery of the "wound response." It is found that the second tapping of a given area, provided it is made within about ten days, will yield a larger flow of latex than the first. Thus, in the experiments just mentioned, the average yield per tree in the first week was 0·73 oz., in the second week 1·48 oz., in the third 0·97 oz., fourth 0·80 oz., and only in the fifth did it fall below that obtained in the first week, being only 0·67 oz. This is a discovery of very great importance, and one of which a scientific explanation is very desirable. From these figures it was calculated that a rubber plantation might show a profit of 27 per cent. at the tenth year, and with this the taking up of the industry began in Ceylon, being handicapped only by the very limited supply of seed.

In the following year Mr. John Parkin came out to Peradeniya as assistant, and was at once started to work at rubber. He worked out the whole question of the wound response, and, further, worked out in detail a new method of preparing rubber in far purer condition than had previously been the case. Biffen had shown that the essential elements in the smoke used in South America were acetic acid and creosote, and Parkin applied this to the preparation of rubber in the East by collecting the latex in tins containing a little water (to prevent immediate coagulation) and mixing it with the calculated quantity of acetic acid and a little alcoholic solution of creosote. The milk being filtered before treatment, the result was to clot it into a perfectly clean "biscuit," which, when rolled out and dried, gave more than 93 per cent. of caoutchouc, a much higher proportion than had ever before been found in any sample of crude rubber. These biscuits were analysed by Messrs. Michelin and Co., of Clermont-Ferrand, and after going through the washing machine emerged 99 per cent. to 100 per cent., against about 80 per cent. for any of the best wild rubbers.

This work caused a still further demand for rubber seed, but it was still only in limited supply, though the older trees upon private estates were now beginning to come into bearing, and by 1902 there was almost unlimited seed available. At the same time a demand was also springing up in the Malay Peninsula, stimulated by the action of the director of the botanic gardens at Singapore (Mr. H. N. Ridley), who has steadily pushed rubber for many years.

For the next three or four years planting went on slowly, and then about the latter half of 1902 began to be rapid, with the increasing supply of seed. By the middle of the present year, 1906, there were in Ceylon alone more than 104,000 acres of land planted in rubber, almost solely the Para variety. Of the other South American rubbers, the Ceara sort, *Manihot Glaziovii*, was largely planted in Ceylon in the early 'eighties, but never quite realised expectations, and has never been more than a minor crop, though the export has never actually ceased. The other, *Castilloa elastica*, is a very puzzling tree as yet. It grows with great rapidity at first, and then slows down, and though it yields very freely at first tapping, it has no wound response, and dies if too severely handled. It has only, consequently, been planted on a very small scale as yet. Para rubber, on the other hand, seems to grow freely up to a small elevation in any part of "wet" Ceylon, and can be very roughly handled without, so far as can be seen, suffering any serious injury. None of the other rubber-yielding trees has given remunerative returns.

Not only are there already so many acres in Ceylon, but the Malay Peninsula has about 50,000 or 60,000 acres, and many other eastern countries have also considerable areas, all practically under Para rubber only, while in the west, Mexico has, it is said, about 20 millions of trees of Castilloa planted, or, allowing 200 trees to the acre, an area of about 100,000 acres. This we believe to be an overestimate, but at any rate there is a very large area in that country. Altogether it is probable that at the present time there are about 275,000 or more acres planted to rubber. Allowing that the Para rubber yields twice as much as the Castilloa, this will represent about

230,000 acres, upon which, taking the present Ceylon figures, the eventual yield will be about 400,000 cwt., or 20,000 tons, about a quarter of the probable world's consumption at that date; and planting is going on at a very rapid rate.

The market for a short time looked askance at the biscuits, but they speedily came into favour, and have for a considerable time been receiving a higher price per lb. than the best wild rubber of the Amazon. But this must by no means be taken to mean, as it often is taken, that the plantation rubber is better than the "wild," for the latter contains about 20 per cent. of moisture, while the former is dry, so that in reality the wild rubber is getting about 16 per cent. more in price. Examination of the two qualities will at once show the reason for this difference; the plantation rubber is not quite so elastic, and when much stretched does not at once return, as does the wild rubber, to its exact pristine shape. What the reason for this difference may be is the great problem now before the scientific institutions working at the chemistry and botany of rubber in the tropics.

During the last four years the prices of rubber have continued to rise until they have now reached a height previously undreamt of. The result has been that the early pioneers of rubber cultivation have reaped enormous profits, amounting to as much, in some cases, as 60*l*. per acre per annum, and this has still further stimulated the rush into rubber planting.

The one topic of conversation in planting circles in the East is now rubber, and almost everyone, whether a planter or not, has invested in the industry, with the result that shares have risen very considerably, being, in the case of companies owning bearing rubber, now from three to eight times their par value. With this degree of interest excited in it, it is hardly surprising that a proposal was made that Ceylon, the country in which most rubber was cultivated, should hold a rubber exhibition, and this was actually held in the famous Royal Botanic Gardens at Peradeniya from September 13 to 27.

Buildings upon a fairly extensive scale were erected in Kandyan or mountain-Sinhalese style, and a large display of every kind of rubber was obtained, mainly, of course, from Ceylon and Malaya. There were also exhibits of tapping knives of every kind, and two large sheds were filled with the machinery that is rapidly coming into use upon rubber plantations. A very successful feature of the exhibition was the series of lectures upon every branch of rubber cultivation, shipment, and manufacture that was given during its progress, and which will shortly appear in a book, which should be at the hand of everyone interested in rubber.

The bulk of the Ceylon exhibits were in the form of biscuits, the form originally adopted by Mr. Parkin in the laboratory having been long adhered to. The Malayan were in the form of sheets of larger size; but the most conspicuous things in the show, from this point of view, were some large blocks of rubber exhibited by the Lanadron Estate, in Jahore, made by pressing what is known as crepe rubber (obtained by aid of a washing machine) into solid blocks by powerful hydraulic pressure. Not only does this form offer less surface to oxidation, but it packs more closely and thus saves freight, and it also sells for more upon the market.

The tapping knives for Para rubber exhibited much ingenuity, but not those for the other rubbers. It is worth pointing out here that persons interested—and who is not?—in introducing rubber cultivation into other countries should keep a sharp eye upon the development of the tapping knife in Ceylon and Malaya. Recent experiments in the West Indies, for instance, were carried out with a knife long since discarded in Ceylon, and the verdict was against this knife and in favour of the hammer and chisel, which form a very primitive tool indeed.

Some of the most interesting exhibits in the whole show were the samples of vulcanised and coloured rubbers, rubber and fibre mixtures, and other things shown by Mr. M. Kelway Bamber, Government chemist in Ceylon. These were referred to by Prof. Dunstan at the meeting of the British Association at York, and have aroused universal interest. Several technical papers have already given vent to the view that they can never be put to practical use, because each manufacturer has his own processes, which he will keep secret, for mixing and otherwise treating the rubber, apparently assuming that it is hopeless for the mere scientific man to find out such matters, or even to improve on them, or for one company, old or new, to take up the new process. Others, going on insufficient knowledge, have said that it is not possible to work with chloride of sulphur, or to mix other substances with the latex. In actual fact, the process is very simple, so simple that it seems a marvel that no one has found it out before. Instead of first drying the rubber into lumps or sheets, then macerating it, and mixing it with sulphur or other vulcanising material and colouring matters, these things are done *in the milk*, when the sulphur compounds will, of course, mix with the caoutchouc in a way that it is hopeless for any other method to equal, and when anything that can be wetted can also be easily incorporated, more especially colouring matters. In this way, by subsequent coagulation, a rubber is produced containing the vulcanising, colouring, and mixing reagents or substances in complete admixture. This can then be worked up in the ordinary way into any article that may be required, and finally heated, when it becomes vulcanised. Some of the most interesting exhibits shown by Mr. Bamber were the mixtures of rubber and fibre. The fibre is mixed with the milk in large quantity, the milk being previously sulphurised, and the mass is then dried, compressed under very great hydraulic pressure, and heated, resulting in a solid brick or tile containing but a very small proportion of rubber, and yet strong and elastic enough for the purposes of tiling or other uses.

This method of vulcanising will doubtless have to be modified in detail, but in principle is absolutely new, and is much simpler, and also much cheaper, than the present one.

Taking it altogether, the creation of the now great rubber industry, and its rapid progress from very rough and crude methods to a highly progressive and scientific spirit, is entirely the work of the botanical departments of Ceylon and Singapore, and they may justly pride themselves upon the result.

Recent Important Literature of Rubber.

"Para Rubber." By W. H. Johnson. (London.) Price 7*s*. 6*d*. A very good account of the industry as it was in Ceylon a few years ago, but already more or less out of date.

"Para Rubber." By Herbert Wright. Second edition. (Colombo: A. M. and J. Ferguson.) The best and most up-to-date account of the industry.

"The Book of the Rubber Exhibition of 1906." By J. C. Willis, M. K. Bamber, and E. B. Denham. (London: Dulau and Co.) Price 7*s*. 6*d*. To appear shortly. This book will contain the lectures given at the exhibition by numerous specialists, carefully revised and edited, many pictures, reports of judges, and other valuable features. J. C. WILLIS.

METEOROLOGICAL NOTES.

"COLD Waves and Frosts in the United States" is the title of an important bulletin recently issued by the chief of the U.S. Weather Bureau. The work was prepared by Prof. E. B. Garriott; it includes a chronological account of historical cold periods in the United States since 1717, but deals more especially with the frosts that occurred from 1888 to 1902 inclusive, the conditions of which are illustrated by 328 charts. We have occasionally very cold spells in our own country, but these can scarcely be compared with those frequently experienced in the United States; as Prof. Moore has elsewhere pointed out, the area and intensity of cold waves depend upon the size of continents and their distance from the tropics. The author of the paper considers that the cold of the northern interior of the American continent is chiefly due to air that flows over that region from the northern Rocky Mountains, where its moisture has been precipitated, and to the process of radiation in its passage over Canada. The high barometer caused by the stagnant state of the air in this locality is one of the conditions that produce cold waves, another

necessary condition being the development of low barometric pressure near the southern margin of the cold-air belt, and the production of strong northerly currents, due to cyclonic circulation. To quote only one instance of the value of forecasts in connection with these cold waves:—from January 6–12, 1886, a cold wave swept the country east of the Rocky Mountains and produced the lowest temperatures noted for the last fifty years in the south-eastern States. Speaking of this wave, Prof. Moore has stated that on January 7 there was a difference of 1·1 inch in barometric pressure between Montana and southern Texas, while the isotherm in Montana was −30° and on the Texas coast 50°. The people of the Gulf States knew nothing of the danger that threatened them until warned by the telegraphic weather forecast; on January 8 the temperature in parts of Texas had fallen to zero, and, notwithstanding the timely notice, the estimated damage to crops was 3,000,000 dollars in Florida alone.

Diurnal Range of Temperature in the Tropics.—Prof. J. Hann recently presented an important treatise on this subject to the Vienna Academy of Sciences. In continuation of a former work dealing with the district between lat. 15° N. and S., the one now in question relates to places in Africa and America (including the West Indies, Madagascar, and Mauritius) lying north and south of the above latitudes, and extending to the limits of the tropics, and in some cases beyond them. The work is divided into two parts, containing, *inter alia*, (1) tables of the daily range of temperature in the form of departures of the hourly from the daily means, with a general discussion of the results, and (2) tables of the periodical and non-periodical amplitudes, and of the epochs of the daily maxima and minima, in connection with cloudiness, sunshine, and rainfall. The mean occurrence of the minimum temperature at all places in the tropics (mountain stations excepted) is approximately at 5h. 30m. a.m., both on the coast and inland. The time of the maximum differs; on the coast and in rainy districts it mostly occurs soon after midday, at inland and dry stations it is at 2h. or even after 2h. 30m. p.m. At places on the West Indian coasts the maximum occurs about 42m. after noon; somewhat more inland, at Puerto Principe (Cuba), nearly an hour later, and at the City of Mexico about 2h. 48m. p.m. The occurrence of the daily mean is retarded according to distance from the equator; twenty-seven stations in the central zone (lat. 15° N. to 15° S.) give the mean time of 8h. 26m., twenty stations in the outer zones give 8h. 40m. as compared with 9h. 27m. at fifteen places in Austria.

Diurnal Variation of the Barometer.—In the *U.S. Monthly Weather Review* for April, Prof. Cleveland Abbe directs attention to an article in *Gaea* for August, 1905, by Dr. Korselt, of Annaberg, Germany, in which he attempts to show how the diurnal oscillation of the barometer is an important link in the chain of phenomena due to the unequal warming of the atmosphere by solar radiation, and its unequal cooling by terrestrial radiation. One of his conclusions, which may be recommended to the notice of meteorological organisations the telegraphic reporting stations of which generally possess self-recording barometers, is that the minute study of the daily barometric oscillation may be of great value for practical weather forecasting, because it ought to give information about conditions in the atmosphere at altitudes which balloons have not yet been able to attain. A weather chart showing the observed difference between the barometric ranges by day and by night during the preceding twenty-four hours would, he thinks, probably show that any temporary area of low pressure has a tendency to move toward the region where the difference of the ranges is a minimum. Prof. Abbe points out, however, that these ranges are so small that they would often be completely masked by larger non-periodic changes, so that misleading errors would seem to be inevitable.

Influence of the Ocean upon Continental Precipitation.—In the same number Mr. F. O. Stetson (assistant editor) directs attention to a recent paper read before the Société helvétique des Sciences naturelles on the interchange of moisture between land and sea, by Prof. E. Brückner. The author estimates that 93 per cent. of the water evaporated from the ocean is returned to it in the form of precipitation, leaving only 7 per cent. available for distribution over the land; and that of the total precipitation over the land 20 per cent. is supplied directly by the ocean, while the remainder is due to the re-condensation of vapour evaporated from the continents. We cannot give here the data upon which Prof. Brückner's figures are based, but if they are provisionally accepted as approximately correct, they indicate that the direct influence of the ocean upon rainfall over the land is less than has been generally supposed; but Mr. Stetson points out that the accurate determination of evaporation is a problem not yet solved, and that the rainfall over extensive tracts of land still remains unknown.

Wind Currents in the Vicinity of the Canary Islands.—In a recent note to the *Comptes rendus* of the Paris Academy, M. Teisserenc de Bort and Mr. Rotch have confirmed their opinion that the south-west winds observed on the Peak of Teneriffe correspond to a general phenomenon and are identical with those which would obtain over the open ocean, and consequently represent the regular anti-trade. This view is not in accordance with that held by Prof. Hergesell, to which he has again directed attention in *Beiträge zur Physik der freien Atmosphäre* (vol. ii., part ii.). He maintains that his observations with kites in 1904, and the balloon observations of the *Princess Alice* in 1905, show that in the latitude of the Canary Islands during summer north-west winds prevail to the greatest heights, and that there can be no question of a regular south-west current in that part of the Atlantic, the occasional south-west wind observed on the Peak of Teneriffe being due to local effects. Prof. Hergesell in no wise denies the existence of the regular south-west anti-trade wind, but maintains that at all seasons it is only to be met with some degrees south of the Canaries.

The Hong Kong Typhoon, September 18.—The Zi-ka-wei Observatory (near Shanghai) has sent us some interesting details relating to the progress of this most disastrous storm, which reached Hong Kong on September 18. The first signals of its approach were given by the Japanese observations in the islands east of Formosa on the morning of September 15, but owing to the distance of the stations from the central vortex it was not until the following day that it was clearly shown to be moving towards Formosa and China. The supplement to the Zi-ka-wei Daily Weather Report of September 30 contains some important extracts from ships' logs, which clearly show the definitive track of the storm. The U.S. transport *Caesar*, bound from Cavite (Bay of Manila) for Shanghai, was at noon of September 15 in lat. 19° 53′, long. 120° 20′; at 4h. p.m. she had a steady wind from N.W., freshening in force to 7; the usual diurnal barometric range was still observed, but at 8h. p.m. the barometer, which stood at 29·66 inches, began to fall, the wind freshened and veered to N.N.W., and the ship was forced to steer S.W. to avoid the centre of the approaching storm. The observations were:—at 1h. a.m. on September 16, barometer 29·36 inches, wind N.W. 11; at 2h. a.m., 29·37 inches, W.N.W. 11; at 3h. a.m., 29·40 inches, W. 11; during this period the rain was continuous and excessively heavy. The centre of the storm passed between the ship and the south Cape of Formosa on September 16, shortly after 1h. a.m.

The P. and O. SS. *Delhi* was just entering the passes of Hong Kong when the typhoon burst upon the colony; at noon on September 17 she was in lat. 17° 58′, long. 111° 35′, about 420 miles from the vortex, wind S., force 2, and a distinct E.N.E. sea swell was noted. It was not until 4h. a.m. next day that the breeze veered to W., with occasional squalls, barometer 29·78 inches. The ship dropped anchor near Green Island, and the wind freshened, being W. by N., 8 at 9h. 30m. and W. by S., 10 at 10h. a.m., while the rain fell with blinding violence; at 9h. 45m. the barometer reached its lowest point, 29·14 inches. The centre of the storm passed to the north of the *Delhi* between 9h. 45m. and 10h. a.m. As shown by the observations of these two vessels and those of the French mail steamer *Océanien*, which left Hong Kong for Shanghai on the afternoon of September 17, the centre of the storm travelled from Formosa to Hong Kong, about 380 miles, in 56½ hours, at a mean rate of 6·7 miles an hour; the rate of translation was probably checked by the very high atmospheric pressure to the north, but it

became faster as the centre progressed nearer the coast, where it reached 14·3 miles an hour; the high pressure to the north also made the gradient steeper, and so increased the violence of the vortex. The track of the storm was approximately W.N.W. or W. by N.

The Rev. José Algué, S.J., director of the Manila Observatory, has published an article upon the above typhoon in the Monthly Bulletin of the Philippine Weather Bureau for September. The observations at Santo Domingo (Batanes Islands) and at Aparri (Luzon) show how accurate were the warnings and particulars of the track of the storm issued by the Zi-ka-wei Observatory, and that the typhoon passed close to the north of Santo Domingo between 3h. and 4h. p.m. on September 15, the centre moving in the direction of N.W. by W.; the barometric minimum at the latter place at 2h. 30m. p.m. on that day was 29·290 inches, the mercury having fallen 0·572 inch since 8h. p.m. on September 14. Father Algué thinks it probable that a depression felt at Guam (Marianne Islands), lying to the eastward of Santo Domingo, on September 8, may have been caused by the passage of the typhoon about 200 miles to the north of that station; in this case its mean rate of progression to Santo Domingo would have been about eight nautical miles an hour.

Report of the Fernley Observatory, Southport, for the Year 1905.—This institution, which is maintained by the Corporation, occupies an important position between the Liverpool Observatory and the anemograph station at Fleetwood, and possesses an exceptionally complete equipment of standard self-recording instruments. The year was very dry, the rainfall being 26·31 inches, or 7·11 inches below the average. Owing to the position of the observatory on the coast of the Irish Sea, gales were experienced in every month, but although barometric pressure was lowest in November, this was one of the two calmest months, the other being May. The town enjoys a good amount of bright sunshine; in the year a duration of 1624 hours was recorded, or seventy hours above the average, being only about fifty hours less than at Brighton, and above 300 more than in the London district.

Annuaire météorologique, Observatoire Royal de Belgique, 1906.—Although, as pointed out by M. Lancaster, an *Annuaire* is not indispensable for a meteorological organisation, the results of its observations being given in other publications, it is a very convenient method of bringing together data useful to different classes of workers, including agriculturists, engineers, medical men, and others. The work in question is certainly most valuable, and contains, in concise and handy form, the yearly and average results of observations made at Brussels (or Uccle) since 1833, together with a summary of miscellaneous information, including tables and constants which are both useful and instructive to meteorological students of any country. To render the publication more attractive, it contains from time to time original articles by members of the observatory staff. Among those contained in the current volume we may mention one by M. Vincent on weather prediction, illustrated by fourteen maps, as well worthy of attention. The author looks for future improvement in the wider dissemination of daily weather reports and the instruction of persons interested in drawing their own conclusions from the synoptic charts, in decentralisation to some extent, in the preparation of local forecasts as in the United States, and, eventually, in each person becoming his own forecaster, from information supplied by the central offices.

Climate of Alaska.—In the *U.S. Monthly Weather Review* for June reference is made to an important memoir on this subject, by Dr. C. Abbe, jun., which forms part of Professional Paper No. 45 of the U.S. Geological Survey. Dr. Abbe summarises the materials collected during the last thirty years by the Signal Service and the Weather Bureau, and therefore supplements the useful memoir by Dr. Dall published in the Pacific Coast Pilot in 1879. The territory is divided into eight climatic provinces, for each of which much fresh information is afforded, especially as regards temperature and rainfall. The maximum shade temperature in the great Yukon basin is given as 90°, and 94°, on the Copper River plateau, is the highest reported from any of the Weather Bureau stations, instead of 112° or even 120° formerly spoken of. The lowest recorded temperature is −80°, at Fort Reliance, in January. The largest annual rainfall is 170·09 inches, at Fort Constantine; the number of rain days is 251, at Unalaska, being the highest number at any point in the United States.

Meteorological Observations, Bremen, 1905.—The publication of the results obtained at this important observatory under the superintendence of Dr. P. Bergholz forms part of the German *Meteorologisches Jahrbuch*, which is prepared on a uniform plan for all parts of the empire. The present volume is of more than usual interest, as, in addition to hourly readings and means from self-recording instruments for the year in question, it contains monthly, seasonal, and yearly means for the lustrum 1901–5, results for the thirty-year period 1876–1905, and for all observations available from 1803–1905. As the latter are not quite continuous, we quote the following data for the thirty-year period:—mean temperature, January, 32°·5, July, 62°·6; the absolute extremes were 93°·9 (May 28, 1892), −13° (December 4, 1879); means of the absolute monthly extremes, 11°·1, January, 83°·5, July. The mean annual rainfall was 27·48 inches; July, 3·64 inches, April, 1·63 inches; the greatest fall in one day was 3·39 inches (June 10, 1884). The mean percentage of bright sunshine for fifteen years was 32·4, as compared with 29 per cent. in London for twenty years.

BRITISH INLAND WATERWAYS.

THE commissioners appointed early this year to investigate and report on this important question, have exercised a wise discretion in publishing, as soon as practicable, the first portion of the evidence given before them by fifty-four witnesses, at twenty-two meetings, held between March 21 and July 31, relating almost entirely to English canals and inland navigations. This first instalment forms a fairly bulky Blue-book, with 375 pages of evidence, an index of ninety-five pages, various appendices, together with a list of English inland waterways, occupying 111 pages, and a map of the canal-systems and navigable rivers of England and Wales in two sheets at the end of the volume, coloured so as to indicate each separate system, with the name of the system printed in large letters of the same colour.

Since the evidence here recorded was taken, the commissioners have been hearing evidence in Ireland on Irish inland waterways, and have also resumed lately their sittings in London; and they further propose to obtain detailed information with regard to inland navigation in the Continental countries of Europe where it has been most fully developed, which will doubtless be published in due course. Accordingly, considering the large amount of matter with respect to inland waterways which will be gradually collected by this commission, it is very advantageous that it should be given to the public at intervals to give an opportunity of its being properly studied; and this arrangement has the further merit that it will enable future witnesses, by seeing the previous evidence beforehand, to supply omissions or correct errors.

A perusal of the engineering evidence alone suffices to show, by its conflicting nature, the magnitude of the task which lies before the commissioners, and the complicated problems which they will have to solve. The questions to be considered with regard to the improvement of inland waterways are:—first, the additional traffic that an improved waterway would be likely to attract; secondly, the size of barges which could most economically transport the traffic; thirdly, what would be the cost of a transformed waterway suitable for the passage of such barges, how far it should be carried inland, what connections should be formed with other waterways, and what return might be expected on the capital expended; and, lastly, by what means the funds might be raised for executing the proposed improvements.

The engineers of inland navigations being sometimes also the managers, or generally concerned in the management of their system, and being thoroughly conversant with the cost of improvements and with the working expenses, have for the most part dealt with the above questions in their evidence. One engineer suggests that the Government

should undertake the improvement of the tidal portions of the rivers; that above this limit the local authorities should improve the rivers by canalisation up to a town conveniently situated to form an inland port, up to which sea-going vessels of 400 or 500 tons could come, and which would serve as a distributing or receiving centre for waterways of suitable dimensions penetrating into the interior; and that in some cases, for surmounting high summit-levels, inclined planes worked by locomotives should be substituted for canals. Another engineer proposes that the Government should undertake through routes for vessels of 350 tons from Birmingham to Liverpool, Hull, the Severn, and London, and between Liverpool and Hull, and from London to Bristol, and considers that these main routes would be certain to yield a profit on the purchase of the existing waterways involved in the schemes and on the expenses of construction, which could then be utilised in acquiring and improving other waterways. A third engineer desires to make each river-basin a separate system; he considers that a barge of 150 tons is the largest barge that would pay; and instead of bringing sea-going vessels inland, he would bring these inland barges down to the tideway, where transhipment into sea-going craft would take place most conveniently. A fourth engineer considers that 100-ton barges are the largest size expedient for English inland navigation, and that in certain cases the improvement of canals to accommodate them would not pay; whilst a fifth engineer thinks that any improvements of inland waterways would prove an unprofitable and useless expenditure.

It is evident from this summary of the views expressed by some of the most experienced engineers with reference to inland navigation, that the commissioners, after having collected all the evidence available, will require some time to formulate their recommendations, and to decide how far Continental practice with regard to inland waterways is applicable to the special conditions of the United Kingdom.

THE SCIENTIFIC STUDY OF INFECTIOUS DISEASES.[1]

THE wider recognition of medical science as a rewarding object of endowment is a result of discoveries made during the last quarter of a century, and it is of interest to inquire why this increased knowledge should have borne such abundant fruit. The result is not due to any change in the ultimate aims of medicine, which have always been what they are to-day and will remain—the prevention and the cure of disease—nor to the application to the solution of medical problems of any higher intellectual ability and skill than were possessed by physicians of past generations, nor to the growth of the scientific spirit, nor to the mere fact of a great scientific advance in medicine, for the most important contribution ever made to our understanding of the processes of disease was the discovery by Virchow in the middle of the last century of the principles and facts of cellular pathology, the foundation of modern pathology.

The awakening of this wider public interest in scientific medicine is attributable mainly to the opening of new paths of investigation which have led to a deeper and more helpful insight into the nature and the modes of prevention of a group of diseases—the infectious diseases—which stand in a more definite and intimate relation to the social, moral, and physical well-being of mankind than any other class of diseases. The problems of infection which have been solved and kindred ones which give promise of solution are among the most important relating to human society. The dangers arising from the spread of contagious and other infectious diseases threaten, not the individual only, but industrial life and the whole fabric of modern society. Not medicine only, but all the forces of society are needed to combat these dangers, and the agencies which furnish the knowledge and the weapons for this warfare are among the most powerful for the improvement of human society.

[1] Abridged from an address delivered by Dr. W. H. Welch at the formal opening of the Laboratories of the Rockefeller Institute for Medical Research on May 11.

Great as was the material, intellectual and social progress of the world during the past century, there is no advance which compares in its influence upon the happiness of mankind with the increased power to lessen physical suffering from disease and accident, and to control the spread of pestilential diseases.

Before some accurate knowledge of the causation of infectious diseases was secured preventive medicine was a blundering science, not, however, without its one great victory of vaccination against small-pox, whereby one of the greatest scourges of mankind can be controlled and could be eradicated, if the measure were universally and efficiently applied. The establishment upon a firm foundation of the germ doctrine of infectious diseases, the discovery of the parasitic organisms of many of these diseases, the determination by experiment of the mode of spread of certain others, and the experimental studies of infection and immunity have transformed the face of modern medicine.

The recognition, the forecasting, the comprehension of the symptoms and lesions, the treatment of a large number of infectious diseases have all been illuminated and furthered, but the boon of supreme import to the human race has been the lesson that these diseases are preventable.

Typhus fever, once widespread, and of all diseases the most dependent upon filth and overcrowding, has fled to obscure, unsanitary corners of the world before the face of modern sanitation.

In consequence of the knowledge gained by Robert Koch and his co-workers Asiatic cholera, to the modern world the great representative of a devastating epidemic, will never again pursue its periodical, pandemic journeys around the world, even should it make the start.

Of bubonic plague, the most dreaded of all pestilences, which disappeared mysteriously from the civilised world more than two centuries ago, we know the germ and the manner of propagation, and, although it has ravaged India for the last ten years with appalling severity, it can be, and has been, arrested in its spread when suitable measures of prevention are promptly applied.

Typhoid fever, the most important index of the general sanitary conditions of towns and cities, has been made practically to disappear from a number of cities where it formerly prevailed. That this disease is still so prevalent in many rural and urban districts of the United States is due to a disgraceful neglect of well-known measures of sanitation.

To Major Walter Reed and his colleagues of the United States Army Commission an inestimable debt of gratitude is due for the discovery of the mode of conveyance of yellow fever by a species of mosquito. On the basis of this knowledge the disease, which had been long such a menace to lives and commercial interests in the Southern States, has been eradicated from Cuba, and can be controlled elsewhere.

Another army surgeon, Major Ross, acting upon the suggestion of Sir Patrick Manson, had previously demonstrated a similar mode of incubation and transportation of the parasite of malaria, discovered by Laveran, and it is now possible to attack intelligently and in many localities, with good promise of success, the serious problem of checking or even eradicating a disease which renders many parts of the world almost uninhabitable by the Caucasian race, and, even where less severe, hinders, as does no other disease, intellectual and industrial activities of the inhabitants.

The deepest impress which has been made upon the average death-rate of cities has been in the reduction of infant mortality through a better understanding of its causes. The Rockefeller Institute, by the investigations which it has supported of the question of clean milk and of the causes of the summer diarrhœas of infants, has already made important contributions to this subject which have borne good fruit.

No outcome of the modern science of bacteriology has made a more profound impression upon the medical profession and the public, or comes into closer relation to medical practice, than Behring's discovery of the treatment of diphtheria by antitoxic serum, whereby in the last twelve

years the mortality from this disease has been reduced to nearly one-fifth the former rate.

The most stupendous task to which the medical profession has ever put its hands is the crusade against tuberculosis, the preeminence of which as the leading cause of death in all communities is already threatened. Sufficient knowledge of the causation and mode of spread of this disease has been gained within the last quarter of a century to bring within the possible bounds of realisation the hopes of even the most enthusiastic, but it will require a long time, much patience, and a combination of all the forces of society, medical, legislative, educational, philanthropic, sociological, to attain this goal.

But great and rapid as the progress has been, it is small in comparison with what remains to be done. The new fields which have been opened have been explored only in relatively small part. There still remain important infectious diseases the secrets of which have not been unlocked. Even with some the causative agents of which are known, notably pneumonia and other acute respiratory affections and epidemic meningitis, very little has yet been achieved by way of prevention. The domain of artificial immunity and of the treatment of infections by specific sera and vaccines, so auspiciously opened by Pasteur and by Behring, is still full of difficult problems the solution of which may be of immense service in the warfare against disease. Of the cause of cancer and other malignant tumours nothing is known, although many workers with considerable resources at their disposal are engaged in its study. With the change in the incidence of disease, due at least in large part to the repression of the infections of early life, increased importance attaches to the study of the circulatory, renal, and nervous diseases of later life, of the underlying causes of which we are very imperfectly informed. There are and will arise medical problems enough of supreme importance to inspire workers for generations to come and to make demands upon all available resources.

In full recognition of the dependence of success in the warfare with disease upon increase of knowledge, the Rockefeller Institute for Medical Research was founded by the enlightened munificence of Mr. John D. Rockefeller, to whom grateful acknowledgment is made. Likewise to the broad sympathies and active interest of his son, Mr. John D. Rockefeller, jun., the origin and development of this institute are largely indebted.

May the hopes of the founder and of those who have planned this institute be abundantly fulfilled! May it contribute largely to the advancement of knowledge, and may the streams of knowledge which flow from it be "for the healing of the nations."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A RECENT report of President Butler, of Columbia University, refers to the salaries paid to the professors and adjunct professors of the University. This part of the report was reprinted in *Science* for November 23. President Butler says that these salaries are inadequate, and that the effects of this inadequacy are deplorable. The report shows that the present average salary paid to a Columbia University professor is but one-half of the sum fixed as necessary thirty years ago, and that the cost of living has meanwhile increased between 10 per cent. and 20 per cent. The purchasing power of the average salary of 1906 is, therefore, hardly more than 40 per cent. of the purchasing power of the salary established in 1876. In other words, the great expansion of the University, which has been brought about by the labours of the university teachers, has also been brought about at their expense. In President Butler's judgment the most important need of Columbia University at the present time is an addition to the endowment fund sufficient to enable the establishment and maintenance of a proper standard of compensation to members of the teaching staff. There are 119 professors and thirty-nine adjunct professors, 158 in all. To increase the salary of each by only 200*l.* on an average—not at all an adequate amount—would absorb the interest at 5 per cent. on a capital sum of more than 600,000*l.* The need is so imperative and the public interests affected by it are so important, the report states, that the mere statement of it ought to bring the needed sum, great though it is, from the American men and women who are the large-minded possessors of wealth.

THE scheme for the establishment at Bristol of a university for the west of England is now taking definite shape. The sum of 40,000*l.* has already been promised, and with the buildings of University College, which are worth about another 50,000*l.*, the scheme may be said to have made a good start. There was a difficulty in arriving at an arrangement between the Merchant Venturers' work in higher education and that of University College, but we understand that the Merchant Venturers have practically accepted the principle of the proposed university, and though details remain to be settled, there is good reason to believe that the movement will now go forward with every promise of success. Speaking at the Merchant Venturers' Technical College, Bristol, on December 20, Prof. M. E. Sadler referred to the energy with which the Merchant Venturers had furthered the work of technical instruction, and expressed the hope that it would be found possible to unite the Technical College with the University College, and thus to form the nucleus of a great University of Bristol. Under modern conditions universities should combine opportunities for advanced technological, commercial, and professional training with the highest tradition of literary and philosophical culture. There is still room, in spite of other recent foundations, for a new university in England with its seat at Bristol; but the nation will not gain by the establishment of a university weak because ill-endowed and insufficiently equipped with teachers, laboratories, libraries, and the buildings indispensable to the social side of university life. The rapid growth of Bristol in recent years encourages the hope that its citizens will emulate the example of Manchester, Liverpool, Birmingham, Leeds, and Sheffield in the building up of a great modern university.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 8.—"On the Occurrence of Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes Generally." By Prof. E. A. **Minchin**. Communicated by Prof. Ray Lankester.

In a former communication to NATURE (November 15, p. 56) an account was given of the results obtained by the Sleeping Sickness Commission at Entebbe, Uganda, with regard to the transmission of the *Trypanosoma gambiense* of sleeping sickness, and other trypanosomes, by *Glossina palpalis*, the dusky tsetse-fly.[1] It was shown (1) that the infection was a "direct mechanical" transmission by the proboscis, and that no "cyclical" infection, comparable to that of malaria, could be discovered; (2) that *T. gambiense* appeared to die out in the intestine of the fly after ninety-six hours; (3) that besides *T. gambiense*, the fly carried two other species of trypanosomes, named *T. grayi* and *T. tullochii* respectively.

Since the article referred to was written, it has been found that *T. grayi* becomes encysted in the hind-gut of the fly, and all analogies with other Protozoa suggest that the cysts are destined to be cast out and infect fresh hosts, probably, in this case, the vertebrate hosts from which the fly obtains the trypanosomes. This suggests the occurrence of a hitherto unsuspected mode of infection by trypanosomes, in which the parasites, when taken up from the blood of the vertebrate by the blood-sucking invertebrate, pass, in the gut of the latter, through a developmental cycle, which ends in the parasites becoming encysted. In this condition they are cast out and re-infect the vertebrate host by contaminating its food or drink. Such a mode of infection is termed "contaminative," as contrasted with the "inoculative" method seen in malaria, and hitherto vainly sought for in these trypanosomes.

[1] Mr. E. E. Austen, of the Natural History Museum, has suggested to the author that *Glossina palpalis* should be distinguished in this way from the other seven known species of tsetse-flies.

Moreover, as it may be supposed that what one species of trypanosome does another may do, the encystation seen in *T. grayi* arouses the suspicion that the disappearance of *T. gambiense* from the gut of the fly may be due also to a similar cause.

Society of Chemical Industry, December 3.—Dr. J. Lewkowitsch in the chair.—The direct estimation of antimony: H. W. **Rowell.** The sample of finely powdered ore or fine metallic sawings containing about 0·14 gram of antimony is weighed into a 500 c.c. beaker and dissolved in 25 c.c. of strong hydrochloric acid. 5 c.c. of saturated solution of bromine in hydrochloric acid are run in, and any insoluble matter is fused in caustic soda and returned to the main bulk. Three grams of sodium sulphite are added, and the mixture boiled down to 10 c.c. to drive off sulphurous acid and arsenic. The solution is titrated at a boiling temperature, after the addition of 60 c.c. of hydrochloric acid (1–3), with N/20 potassium bromate until the colour of the methyl orange indicator is destroyed. The bromate is standardised with 0·082 gram of arsenious oxide dissolved in hydrochloric acid, which is equivalent to 0·1 gram of antimony. Copper raises the result slightly, and iron very slightly, but precautions are given for obviating their effect. The method may be applied to materials containing antimony, and examples are given illustrating the accuracy of the method, the effect of copper and variations in samples of alloys.—The detannisation of solutions in the analysis of tanning materials: Dr. J. Gordon **Parker** and H. Garner **Bennett.** The authors deal with the four chief methods used for the analysis of tanning materials and extracts, and compare the official method of the International Association of Leather Trades Chemists, which consists of detannisation by means of a column of prepared hide-powder in a specially made filter bell, with the German method, with the method devised by Kopecky, and, finally, with the official American method. The authors confirm the work that has been done by Reed and other American chemists, and disprove the claims made by Paessler that a dry chromed hide-powder used in the filter bell gives the most accurate results. The authors finally recommend that the International Association of Leather Trades Chemists should at once adopt the American method, either as it now officially stands or in a modified form.

Geological Society, December 5.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The geological conditions which have contributed to the success of the artesian boring for water at Lincoln: Prof. E. **Hull.** This boring has its source of supply in strata which rise to the west, but to the east dip down towards the North Sea. The water-yielding stratum is reddish, soft, porous, sand-rock, reached at a depth of 1561 feet, and penetrated to a depth of 474 feet. About one million gallons of water rise to the surface daily. The sand-rock belongs to the New Red Sandstone. The hydraulic pressure at the bottom of the boring is that due to about 2035 feet, and the friction of the water in percolating the rock accounts for the fact that the water can be pumped down during the day, but rises again in the night. The formations penetrated are:—Alluvium and Lower Lias, 641 feet; Rhætic beds, 52 feet; Red Marl and Lower Keuper Sandstone, 868 feet; Bunter Sandstone, 454 feet. The quantity of water drawn from the New Red Sandstone amounts to not less than twenty million gallons, and the total available quantity of water percolating into the Sandstone amounts to about 300 millions.—Notes on the raised beaches of Taltal (northern Chile): O. H. **Evans.** The town of Taltal is situated partly on the dry bed of a river and partly on an inclined plain that fringes the bays of the coastal ranges to the northward, and runs up the valleys. The material of this plain consists of sands and rounded gravel derived from the rocks of the adjacent hills, mingled with shells and some isolated boulders. The formation is impregnated with salt, and there protrude through it weathered remnants of former stacks and islets. The plain rises in terraces, the highest of which are somewhat obscure, and sometimes portions of these higher terraces are preserved in the stacks and islets. A second coastal shelf also occurs, marked by a line of shallow caverns. Beds of shells in the gravel, containing whale-bones, give evidence of the marine origin of the terraces.

Chemical Society, December 6.—Prof R. Meldola, F.R.S., in the chair.—Action of reducing agents on 5-chloro-3-keto-1 : 1-dimethyl-Δ^4-tetrahydrobenzene: A. W. **Crossley** and Miss N. **Renouf.** Sodium in moist ethereal solution gives, as main product, 3-hydroxy-1 : 1-dimethylhexahydrobenzene, whereas sodium in absolute alcoholic solution yields a small amount of this alcohol, and to a much larger extent 3-hydroxy-5-ethoxy : 1 : 1-dimethylhexahydrobenzene. With zinc filings in aqueous solution, either in the cold or on heating, 3-keto-1 : 1-dimethyl-Δ^4-tetrahydrobenzene is formed, but zinc dust in either glacial or dilute acetic acid gives rise to 3-keto-1 : 1-dimethylhexahydrobenzene.—A new trinitroacetaminophenol and its use as a synthetical agent: R. **Meldola.** Mononitrodiacetylaminophenol, when dissolved in a mixture of fuming nitric and strong sulphuric acids, yields 2 : 3 : 5-trinitro-*p*-acetaminophenol, which is remarkably active as a synthetical agent owing to the extreme mobility of one (position 3) of the nitro-groups. By the action of various amines on the trinitro-compound, substituted benziminazoles are produced.—Pinene nitrolamine: F. P. **Leach.** This nitrolamine and a number of its derivatives are described.—A *pseudo*-semicarbazide from pinene: F. P. **Leach.**—Some derivatives of benzophenone. Synthesis of substances occurring in coto-bark. Preliminary notice: W. H. **Perkin,** jun., and R. **Robinson.** 2 : 4 : 6 : 3′ : 4′-Pentamethoxybenzophenone, $(MeO)_2C_6H_3.CO.C_6H_2(OMe)_3$ (pentamethylmaclurin), is obtained when aluminium chloride reacts with a mixture of veratryl chloride and phloroglucinol trimethyl ether in presence of carbon disulphide. 3′ : 4′-Methylenedioxy-2 : 4 : 6-trimethoxybenzophenone,

$$CH_2 : O_2 : C_6H_3.CO.C_6H_2(OMe)_3$$

(oxyleucotin), was synthesised by treating a mixture of piperonyl chloride and phloroglucinol trimethyl ether in carbon disulphide solution with aluminium chloride. The syntheses of other related products by similar reactions are also described.—The liquid volume of a dissolved substance: J. S. **Lumsden.** Experimental results are recorded which prove that the following law holds, though certain irregularities due to the influence of the solvent exist. When a substance in the liquid state dissolves without change of volume, the same substance when in the state of solid or gas will, when dissolved in the same solvent, change to the volume which the same weight of it would have if it were a pure liquid at the temperature of solution.—A synthesis of terebic, terpenylic, and homoterpenylic acids: J. L. **Simonsen.** These three acids were synthesised from ethyl acetylsuccinate, ethyl β-acetylglutarate, and ethyl β-acetyladipate respectively by means of magnesium methyl iodide.—Influence of light on diazo-reactions, part i.: K. J. P. **Orton,** J. E. **Coates,** and (in part) F. **Burdett.** Solutions of diazonium salts in water, methyl or ethyl alcohol, acetic or formic acid, decompose rapidly on exposure to light, the product of the reaction depending on the solvent.—The viscosity of liquid mixtures: A. E. **Dunstan** and R. W. **Wilson.** Viscosity concentration curves of mixtures of water and sulphuric acid show a well-defined maximum point corresponding with H_2SO_4,H_2O, and a minimum corresponding with $3H_2SO_4,2H_2O$.

Linnean Society, December 6.—Prof. A. W. Herdman, F.R.S., president, in the chair.—The physiology of the museum beetle, *Anthrenus museorum* (Linn.), Fabr.: Prof. A. J. **Ewart.** The mischief wrought by this species in the National Herbarium at Melbourne is great, and is only kept in check by systematic use of a chamber impregnated by the vapour of carbon-bisulphide, in which the plants are placed for several days at a time. The use of corrosive sublimate is not advisable owing to the grave danger to health in a dust-forming atmosphere. The most remarkable feature of the larvæ is their power of feeding on dry material with less than 9 per cent. of water, and yet these larvæ exhibit the usual amount in their structure, averaging 70 per cent. The author suggests that the water may be

chemically derived from decomposition of the carbohydrate food they consume. Bacteria are present in abundance in the alimentary canal of these grubs, and oxidise the carbon of the food where no transpiration of water is possible.—Note on the origin of the name Chermes or Kermes: E. R. **Burdon.** The existence of the same generic name in two families of the Hemiptera is due to the following causes:—(1) that the dye-insect of the oak, *Quercus ilex*, Linn., had been known since the Arab conquest of Spain by the popular name of Kermes all over the south of Europe. (2) That Linnæus, apparently unaware of this fact, put the Kermes dye-insect into the genus Coccus, and employed Chermes as the generic name for another group of insects, amongst which he placed the spruce gall-insect. (3) That Geoffroy, objecting to this misapplication of a well-known popular name, used Chermes as the generic name for the dye-insect which Linnæus called Coccus. (4) That Boitard used the name for the same insects as Geoffroy, but spelt it Kermes. (5) That the majority of workers at the spruce gall-insects have retained the Linnæan name of Chermes, and at the same time Coccid authorities have naturally continued to use the name Kermes for the insect which had popularly been so-called from early times. The author concludes that, in view of the wide acceptance of both Chermes and Kermes, any alteration would only make confusion worse confounded.—Part x. of the reports on Biscayan plankton collected by H.M.S. *Research* in 1900: E. W. L. **Holt** and L. W. **Byrne.** An account was given of the fishes captured. It was remarkable that no fish-eggs or larvæ were taken in any of the thirty-seven hauls of the closing-net which explored the water between 2000 fathoms and fifty fathoms; they appeared to be confined to the upper 100 fathoms, and were rare at the surface. Nine species and six genera were recognisable, the deepest of which was *Gonostoma bathyphilum*, taken in the closing-trawl between 2000 fathoms and 1500 fathoms. Several unknown larvæ are described and figured.

Royal Meteorological Society, December 19.—Mr. Richard Bentley, president, in the chair.—The Guildford storm of August 2, 1906: Admiral J. P. **Maclear.** This storm shows some very curious and interesting features in the remarkable violence of the wind, rain, and hail within a small area, and the suddenness with which it burst. There was an area of thunderstorms over the whole of the south of England on the evening of that day. The most violent storm, however, burst over Grayshott, on Hindhead, at 8.20, and pursued a narrow track through Godalming and Guildford to Ripley, five miles north-east of Guildford. The wind was of hurricane force, and blew down an immense number of trees and caused other damage, and also the loss of two lives. The rain, accompanied by large hailstones, was very heavy, as much as 1·17 inches falling at Grayshott in fifteen minutes. There was a magnificent display of lightning.—The metric system in meteorology: R. **Inwards.** The author did not discuss the general question of the advantages of the metric system over that in use by Britain and her colonies and the United States of America, but confined his remarks to the advisability of adopting some uniform system by all the meteorological observers upon the globe.

MANCHESTER.

Literary and Philosophical Society, November 27.—Prof. A. Schuster, F.R.S., in the chair.—Some Points of chemical philosophy involved in the discovery of radium and the properties of its combinations: Dr. H. **Wilde.**—A collection of land and fresh-water Mollusca collected by Mr. S. A. Neave in North-East Rhodesia: J. Cosmo **Melvill** and R. **Standen.** The areas traversed by Mr. Neave were mainly the high plateaux and mountainous lands between the Loangwa and Kafue Rivers, at an elevation of 2000 feet to 4200 feet. Mollusca were, in certain places (particularly Kapopo, in the limestone district), plentiful in individuals, but deficient in number of species. Most notable were the large agate-snails (Burtoa, Achatina, and Limicolaria), of which one elegant form, *A. rhodesiaca*, remarkable for its attenuately-fusiform contour, is new to science. *Cleopatra mterizensis*, one of a fluviatile genus, endemic in the African continent, is also until now undescribed, as is an interesting member of the sinistral genus Lanistes, which occurred at Kapopo, and is to bear the name of *L. neavei*, after its discoverer. Only twenty-two species are gathered in all, the majority being already known as natives of German East Africa, the Nyassa district, the neighbourhood of Victoria Nyanza or the Zambezi River. Little specific affinity seems to exist with the Transvaal or South Africa, excepting so far as some widely distributed species, *e.g. Melania tuberculata*, Will., and *Physopsis africana*, Krauss, are concerned.

DIARY OF SOCIETIES.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Signalling to a Distance; the Invention of the Electric Telegraph: W. Duddell.

MONDAY, DECEMBER 31.

LONDON INSTITUTION, at 4.—Volcanoes: W. Herbert Garrison.

TUESDAY, JANUARY 1.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: Modern Electric Telegraphs: W. Duddell.

WEDNESDAY, JANUARY 2.

SOCIETY OF ARTS, at 5.—Perils and Adventures Underground (Juvenile Lecture): B. H. Brough.

LONDON INSTITUTION, at 4.—The Fire Belt around the Globe: W. Herbert Garrison.

THURSDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: the Telephone and its Working: W. Duddell.

FRIDAY, JANUARY 4.

LONDON INSTITUTION, at 4.—Earthquakes and Geysers: W. Herbert Garrison.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Japan and the Japanese as I saw them: Miss A. L. Murcutt.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: Early Wireless Telegraphs: W. Duddell.

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