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GEGENBAUR'S COMPARATIVE ANATOMY OF THE VERTEBRATA.

Vergleichende Anatomie der Wirbelthiere: mit Berücksichtigung der Wirbellosen. Von Carl Gegenbaur. Erster Band. Einleitung, Integument, Skeletsystem, Muskelsystem, Nervensystem und Sinnesorgane. Mit 619 Zum. Theil farbigen Figuren im Text. Pp. xiv + 978. (Leipzig: Wilhelm Engelmann, 1898.)

THE first volume of the long-expected work by the master has appeared. By placing the study of anatomy upon the basis of evolution he had become the founder of modern comparative anatomy, and he has raised the building to a great extent by his own hands, supported by a school of disciples, ever increasing through his stimulating and correcting influence.

No wonder that for years expectation has been keen about this book, which must necessarily be the crowning of his life's work. The present volume, besides an introduction, deals with the tegumentary, skeletal, muscular and nervous systems, and the sense organs.

It would be a hopeless attempt here to give anything like an adequate *résumé* of the nearly 1000 pages of this first volume. Only some of the salient features can be touched upon. The plan is grand; the execution can be fully appreciated only by those who have made comparative anatomy their special study, because the treatment frequently soars to such heights that the enormous amount of detail which is marshalled in the book, almost seems to disappear before the generalising ideas into which the facts have been welded and condensed. This is especially the case with the introductory chapters prefacing, or the summarising retrospects following upon, the principal chapters. But this does not make easy reading, and some of the sentences, although containing beautifully conceived ideas, are so idiomatic and so terse as to appear almost oracular. For instance, he discusses the development of the bird's wing, how the quills growing upon the patagium, and gaining preponderance over it, have become the functional wing surface, while the patagium itself loses its importance and becomes correspondingly reduced. The result of this contemplation is summed up thus: "Das Product tritt functionell an die Stelle des Bodens, auf dem es entstand."

The general introduction alone, taking up the first seventy pages, is an ideal treatise of morphology, dealing with such fundamental questions as adaptation, correlation, differentiation, inheritance, ontogeny with reference to phylogeny, value and meaning of the germinal layers, &c.

A characteristic feature, going like a red thread through the whole book, is the animosity against ontogenetic research so far as that is in the hands of those whom our author speaks of as embryographers. According to him the ontogenetic record is of no use unless it is in full concord with the results arrived at by the comparative anatomical method, and not many opportunities are missed which afford a stab at ontogeny where this has failed to elucidate a certain problem. The embryographer will, therefore, feel inclined to smile when he comes across the not unfrequent passages where, palæontology remaining mute and comparative anatomy revealing nothing, the problem in question is summarily dismissed as one fit for the ontogenetic method.

Another leading feature is the striving to derive any given organ from something else, from another one previously existing, instead of being satisfied with its origin *in situ*. Of course this is the true scientific, evolutionary method, and it is the very one by which Gegenbaur's works have become epoch-making; but occasionally the idea seems to be a little overdone, and it is then not always easy to reconcile the various arguments with each other. For instance, in the discussion of great importance, pp. 590-592, which runs approximately as follows:

It is more reasonable to derive cartilaginous parts from other existing cartilage, although their ontogeny may show them to make their appearance where they are wanted in the organism. Thus it is, for instance, preferable to assume the derivation of the Cyclostomes' gill-basket from the cranial cartilage, instead of believing that this basket-work has originated *in situ*. "It is (p. 590) very probable that the whole of the cartilaginous skeleton took its origin from the perichordal cartilage."

All this is certainly very satisfactory and uniform, but as the author himself has pointed out on p. 200, it is becoming more and more plausible that the original home of cartilage was in the integument, in the ectoderm. Its appearance in the perichordal neighbourhood would in this case be a secondary feature, owing to chondroid infiltration into the connective tissue. But if this is so, then there would be nothing unreasonable in the assumption that the gill-basket of the Lamprey had received its cartilage *in situ*. We do not want to press this derivation, but it seems unfair categorically to ask (p. 591):

"What business has a cell, or even a group of cells, to transform itself here or there into cartilage? One or a few cells, even when they become cartilaginous, do not yet possess a supporting function; at any rate the causal momentum of this transformation would remain obscure, as the result of the transformation cannot at the same time be its cause."

This certainly sounds very uncompromising, but the mystery of the origin of the cartilage is not solved by deriving it from other cartilage. The same consideration applies to the derivation of bone, and our author makes the following statement, p. 594:

"Indem wir das knöcherne Skelet nicht mehr ausschliesslich vom Bindegewebe ableiten, durch an sich unverstaendliche, weil in ihren Causalmomenten nicht darzulegenden Veraenderungen jenes Gewebe an den betreffenden Orten entstanden unsvorstellen, sondern den wesentlichsten Antheil bei seiner Entstehung in den Osteoblasten finden, werden die ersten Anfaenge der Hautskeletbildung (Selachier) mit den hoechst verwickelten Zustaenden des Skeletes der Wirbelthiere aufs innigste verknüpft."

The sentence just quoted, rather typical of the style, defies direct translation, but its sense may perhaps be rendered as follows: By referring the most essential share in the formation of the bony skeleton to the osteoblasts, we are enabled to connect intimately the first beginnings of the dermal skeletal formation (of Selachians) with the highly differentiated condition of the skeleton of the higher Vertebrata. We no longer derive

the bony skeleton exclusively from the connective tissue, and we no longer imagine that these tissues arose *in situ*, owing to changes which, as their causes cannot be explained, are by themselves not understandable.

In connection with the above consideration may be mentioned the following important views (p. 152): Although treated as an hypothesis, it appears likely that enamel, dentine, bone substance, are all of ectodermal origin, and the same is probably the case with cartilage. And p. 200: There are reasons for assuming, although not yet absolutely sure, that the whole mass of the placoid scale, including the bone, arises from the ectoderm. Anyhow, all the hard structures, and all their bony formations are derived from the integument. In the higher creatures the bone-forming material is already mixed up with the mesoderm, and our author thinks that the perichondrium has received its bone-forming elements likewise from the integument.[1] Some skleroblasts are certainly identical with osteoblasts, and these latter become eventually bone-corpuscles.

Anyhow, at last, the bugbear of the fundamental difference between tegumentary (so-called secondary, in reality primary) and chondral bone, and that between endo- and ecto-chondral bone, is recanted. Gegenbaur himself had introduced these differences, which have been used for the last thirty years as an all-powerful conjuring formula. He has laid the ghost originally raised by himself; laid perhaps too effectively, as the old terms could easily be made to receive a corrected meaning, in harmony with the old well-meant distinction, if—instead of primary and secondary bones in the old sense—we put primary and secondary elements of the primordial skeleton.

The author (p. 186) is in favour of the connection of the so-called notochord (which he would rather not straightway call a notochord) of Cephalodiscus, Rhabdopleura and Enteropneusta, with that of the Tunicates. The lucid treatment of this important structure may be used as an example of how the conditions prevailing among Invertebrata can be made to throw light upon the more complicated Vertebrata. He argues, namely, as follows:

"The origin of the chorda from entoderm, from the gut-wall, is phylogenetically not understandable. Such a string of cells must originally have had another function than that of support. It is therefore reasonable to derive the chorda from some gut-diverticulum, such as actually does exist at the very place whence phylogenetically the chorda must have begun; the diverticulum, as well as the chorda arising, moreover, at the spot where ento- and ecto-derm meet. And although such diverticula no longer exist in Tunicates, their ancestors must necessarily have possessed them, because some of the recent Tunicates have a chorda. Moreover, the occurrence of such diverticula in several otherwise divergent forms, as, for instance, Cephalodiscus and Rhabdopleura, indicate a former, more widespread existence."

All this is very satisfactory, but how does it fit in with what we read further on about the brain and the spinal cord?

[1] It is difficult to see how this tegumentary origin of cartilage (for which also see p. 152) can be reconciled with the statement made on p. 241—"An additional argument against the exclusive origin of cartilage from mesoderm is the transformation of chordal into cartilage cells"—even if this so-called chordal cartilage had not been shown by Zykoff and others to be an erroneously interpreted observation.

Gegenbaur, namely, has always held that the brain is the older, and the spinal cord the newer formation. Considering the importance of this question for the origin of the Vertebrata from Invertebrata, we turn eagerly to what he has now to say on this point. But instead of receiving comfort, we are led into a maze. See for this the following three statements:

(P. 724.) The phylogenetic value of the ontogenetic mode of origin of the spinal cord, namely, as a further continuation, or budding, from the brain, can be contested. Because such a mode of formation would presuppose a condition in which the spinal cord had preserved its ectodermal position in the ancestors of the Acrania. Only the epichordal nerve-string of the Tunicates represents a sort of early stage of the spinal cord, but in reality it is not yet a spinal cord.

(P. 725.) Exclusively ontogenetic treatment of this question shows that the spinal cord is phyletically produced by a successive budding from the archencephalon. But if this were really so, then the otherwise so well-founded connection with the Tunicates would disappear....

On p. 779 the author holds that the mode of formation of the cord in Petromyzon and in Teleostei, as a solid string with subsequent appearance of a central canal, is more primitive than the early formation of a semi-canal of the medullary plate as observed in all the other Vertebrata.

These three statements are not easily reconciled, and that ontogeny supports the budding mode is an assertion at least surprising. But behold, on p. 718 and p. 719, concerning Tunicates, we are told that:

"Die Medullarplatte senkt sich in die Tiefe, besonders hinten, wodurch eine Taschenform entsteht. Die nach vorn sich weit oeffnende, hinten geschlossene Tasche erstreckt sich immer weiter nach hinten, indess ihre aeussere Oeffnung sich verengt, und als Neuroporus weiter besteht."

At first sight the reader will think that *nach hinten* is a *lapsus calami*, instead of *nach vorn*, but this is not the case. The sentence also reads as if neuropore and blastopore were the same, but a few lines further on we are categorically informed that certain other features, for instance the neurenteric canal, "are cenogenetic, and have to be passed over." In fact the author translates into growth backwards what ontogeny clearly shows to be the opposite, namely, the closing in of the canal from the blastopore forwards. Consequently the secondary nature of the spinal cord, as a budding from the brain, receives no support from ontogeny, while according to the author himself it can be contested upon phylogenetic grounds!

For the rest we cannot do more than single out a few paragraphs as samples, be they typical illustrations of the masterly treatment of the whole work, or be they falling short of, or running contrary to, our expectations.

The author emphasises the great difference between Sauropsida and Mammalia, and as we read further through the book all the differences are made much of, until the only group worthy of possible ancestral relationship are the Amphibia, notably Anura. This old view has been revived, and it is difficult to say if this unfortunate notion of Amphibian descent "mit Umgehung der

Sauropsiden" is a conclusion arrived at from structural grounds, or if it in turn is responsible for the acceptance of certain morphological conclusions. One, out of many, is the sanction given to the startling attempt made by his prosector, to derive the hair from something older than Sauropsidan structures, namely, from certain degenerating sense organs of Amphibia. A very able criticism of this hypothesis has, by the way, been given by Keibel in Merkel and Bonnet's periodical. The same idea of relationship underlies the treatment of the skin-glands, the skeleton of the limbs, the homologies of the ear-bones, &c.

The paragraphs dealing with the vertebral column are not a success; the question is left where Klaatsch left it in 1895, and that does not go beyond the cartilaginous fishes; the rest is written on the old futile lines. Nor can much praise be bestowed upon the treatment of the ribs, in which—instead of his old well supported teaching—a compromise has been made adopting the view of the existence of upper and lower ribs, mixing up thereby true ribs and other parts, which, although likewise differentiations of ventral arches, are not, nor ever were ribs. At the same time there is a tenacious pleading for the correctness of his original view. One of the causes of this uncertain state is the wholesale adoption of the results arrived at by one of his assistants.

Perhaps all through the book an easily understood, but nevertheless somewhat undue preference is given to papers published in the *Morphologische Jahrbuch*. Herewith is connected a peculiar treatment of the literature, which shows many deficiencies, more due to design than to accident, because the author says pointedly that he has restricted himself to the most important writings. Anyhow, this may be said in explanation: The MS. seems to have been practically finished several years ago, and little notice has been taken of what has been published since, except the work done by those with whom the author has been more or less in contact, bringing thereby some additions down to even last year's publications.

The genesis of the Chelonian carapace is a most suggestive chapter, but difficult reading, especially since, a page or two further on, the right of existence of an alternative view is conceded, namely, that neural and costal plates may after all be of dermal origin. Dermochelys, in support of the leading view in the text, is pronounced to be a low, most primitive form, but a little further on the mosaic shield of this turtle is confessed to be in a state of retrogression.

The visceral, branchial skeleton of the Cyclostomes (p. 415) is of ectodermal origin. "It must, however, have been derived from the cranial cartilage, for we cannot possibly side with the old teleological notion that this cartilage arises in the ectoderm *in situ* of the future branchial skeleton, and develops itself into the necessary branchial arches. A small interbranchial bit of cartilarge, consisting perhaps of a few cells only, would be of no use, and, moreover, why should such isolated bits of cartilage cells turn up there? But the assumption that the branchial apparatus arises as little processes of the already existing cranium, gives them at once a supporting function." Then follows a beautiful, lucid description of the branchial skeleton of the Gnathostomata, the whole long chapter, from Elasmobranchs to the highest Mammalia, with all the marvellous modifications, ultimately into hyoid, epiglottic and laryngeal apparatus being welded into an harmonious illustration of onward evolution.

On p. 460, in winding up with a fascinating *résumé* concerning the emancipation of the head from the rest of the body, the author takes the opportunity of severely reproaching the embryologists.

"Comparison teaches us that the visceral arches of the Amniota are derived from branchial arches; the descriptive method reveals only the differences, and takes no stock of the fact that these gill-less visceral arches were once gill-bearing arches. This knowledge is the result of the comparative method and of conclusions based upon these facts, conclusions which stand in contradiction to ontogenetic experience. But while this has not prevented any one from acknowledging the homologies of visceral and branchial arches, the same kind of conclusion when applied to the cranium [namely, to its metameric origin] meets with objections."

But was this outburst necessary? Who, having followed the last ten years of extremely active, and chiefly embryological research, does now object to the metameric composition of the head?

Curiously enough, his famous theory of the origin of the limbs and their girdles from visceral arches is only sketched in the very outlines. He devotes but a few very critical remarks to the important support, which his theory has gained from ontogenetic research, and how far ontogeny can be expected to yield results. This is surprising, because nobody, unless he has studied the whole question and the literature attentively, will be convinced by the perusal of the few pages 461–466. We had the right to expect a critical marshalling of the whole apparatus of comparative anatomy, with the numerous points in favour, drawn from the skeletal, muscular, and nervous systems, and refutation of the almost equally numerous mistaken contrary comments. The derivation and evolution of the free limb is, however, done splendidly, although we miss a discussion of the axis of the dactyloid limb. The author himself says, in the preface, that he could not treat everything with equal fulness, but there are not a few points on which we should have liked this very authority's opinion. We look, however, in vain for more than a passing remark under epitrichium, subnotochordal rod, proatlas, pisiform bone, os acetabuli, &c. He holds that there were never more than five fingers "unless a creature can be shown which normally possessed more." All the so-called vestiges of additional fingers and toes are discarded summarily; but might not Kükenthal's discovery of excalation of fingers in the Cetacea have been given at least passing consideration?

More than 100 pages are devoted to the muscular system, making quite a new feature in a text-book, considering how scantily it had been treated hitherto from a general point of view. It is the first successful attempt to bring the mass of accumulated observations into one frame, beginning with the invertebrate conditions as the fundamental starting-point, and then paying especial attention to the muscles of the head, and to the derivation of those of the limb from the truncal system. The nerve-supply is of course taken as the guide, while the almost

endless modifications are in many cases followed back to more primitive conditions. It is scarcely necessary to say that Gegenbaur himself initiated this treatment, culminating in the elaborate researches of Fuerbringer and Ruge.

The grouping of the cranial nerves is also quite new, but any attempt to arrange the cranial and cranio-spinal nerves without reference to their origin in the central ganglionic columns, must needs lead to failure; and that is the case here. The metamerism of the cranial nerves implies a problem which is not only morphological but essentially physiological, and here was a chance for the morphologist to join hands with his physiological brother, instead of the usual complaint about the abstaining attitude of the latter, and absolutely ignoring his histological and experimental work.

Whilst discussing the modifications of the visceral arches, concerning the formation and the homologies of the ear ossicles (this vexed question has entered a new phase, far from being at rest), he makes the following remark: "Although none of these cases [certain reptilian modifications] are immediate preparations for the mammalian condition, they nevertheless appear as attempts towards this new modification." This is by no means the only instance of his speaking of attempts, or preparations, precocious and aborted, anyhow unsuccessful in one group, foreshadowing arrangements in others; *e.g.* bipedal gait of Dinosaurs with reference to birds.

The last 127 pages are devoted to the sense organs. After a masterly general introduction follows a most interesting chapter on the organs of the "Hautsinn," taste, ear, eye, nose, each with an invertebrate prolegomenon, full of descriptive detail and all turned into a broadly conceived, well composed and carefully finished picture.

There is no book like this one on comparative anatomy. In broadness of plan, depth of conception, and critical execution it cannot be surpassed. Instead of being a fund of detailed facts, as some of its predecessors, it is a mine of wealth of most suggestive ideas.

If we have in some respects found fault with the book, the explanation suggests itself that the architect and master-builder has too trustingly taken over his material as sound and flawless from the bricklayers, carpenters, and other helpers. But the partial disappointment may also perhaps be a fault of our own, of those who expected too much from their old master, whom they look up to with a gratitude and reverence bordering on veneration.

H. GADOW.

ELEMENTARY QUANTITATIVE ANALYSIS.

An Introduction to Practical Quantitative Analysis. By H. P. Highton, M.A. Pp. 211. (London: Rivingtons, 1898.)

MR. HIGHTON appears to belong to the growing class of teachers of chemistry who believe that the practical work of beginners should be of a quantitative character. Qualitative analysis may, it is true, be made an excellent drill; it attracts most young students, and its practice, if it be properly taught, undoubtedly promotes the formation of orderly habits, develops the powers of observation, and encourages the use of the reasoning faculties. But if it be ill taught, few studies are of less value.

It has been pointed out again and again that when the classes are large and the teachers few, when the available time for study is brief, and if the students come unprovided with a fair elementary knowledge of chemistry qualitative analysis is sadly apt to degenerate into the futile pursuit known as test-tubing. Moreover, this branch of work does not offer a very good selection of clear and simple illustrations of the fundamental laws of chemistry; and it is these, after all, which we especially want to impress upon the minds of those young students who learn chemistry for the sake of its educational effect, and not, at first, in order to become chemists.

These and other similar considerations, as we all know, have led many schoolmasters to postpone qualitative work to a later stage than that at which it was formerly commenced, especially in schools where it is the practice to turn whole classes of young boys into the laboratory, instead of making them listen to lectures of a more or less formal and didactic character in the lecture-room, according to the older practice. It is natural, therefore, that of late years many attempts should have been made to produce a book suited to the needs of the juniors of to-day, as the "Small Roscoe" and "Little Miller" provided for those of earlier generations, in the times when the number of school laboratories might have been counted on the fingers of a single hand. And although nothing seems yet to have been produced which exactly supplies the existing need, several of the new books have been helpful and suggestive.

Mr. Highton's little book certainly takes rank with this latter class. It contains eighty-six carefully selected experiments, which have all been performed by boys in the Rugby Laboratory. These eighty-six experiments cover a fairly wide field, they are clearly described and illustrated by a number of helpful diagrams, they include several exercises in those parts of physics which are of the most direct importance to students of elementary chemistry, and several of them are quite easy; but their character as a whole suggests that they will be found to be more suitable for the senior boys, than for beginners in the lower forms. For the former they ought undoubtedly to be useful, in spite of a certain want of suggestiveness, in the arrangement of the book, which seems likely to impair the educational value of the course, by leading the student to look upon the experiments as mere bits of manipulative and mental gymnastic, and to overlook their relation to the science as a whole. This is a defect, however, which may be remedied by the teacher, by means of verbal discussions of the results obtained, and by rearranging the order of the experiments to suit his methods of teaching.

Whether Mr. Highton's book will soon find a sufficient field of usefulness, we cannot say. We hope it may, but we fear it may not; for, alas! too many teachers are still very much at the mercy of the examiner, and qualitative analysis still rules supreme in many of the leading examinations at which public school boys compete. Doubtless it is very difficult to make fundamental changes in an examination syllabus, and it must be admitted that the Examining Boards would

provoke howls of disapproval if, in the year 1899, they should suddenly ordain the complete abolition of qualitative analysis. But it is a question whether the time has not now come for a forward movement in this matter.

We will conclude with a suggestion. Is there any reason why those who control "certificate examinations," "army examinations," "scholarship examinations," and the like, should not, on and after some reasonably early date, permit candidates in chemistry to choose between qualitative and quantitative practical work? Such an ordinance would herald a new era of progress in the chemistry teaching of our schools. Nor would the change be so difficult to carry out as might, at first sight, seem probable, for scholarship examiners at the Universities have long since shown us how to examine boys in quantitative analysis. Indeed, had they not unfortunately made the initial mistake of requiring a knowledge of quantitative work without definitely reducing the range of the qualitative previously required, the University Examiners would long since have solved the whole problem. Even as it is, some good has been done—for a start has been made. But in the interests of sound teaching it is vitally important that this mistake should not be repeated, and that those who are responsible for these matters should remember that the time which has been found to be insufficient to afford a sound training in qualitative analysis cannot possibly be sufficient for both qualitative and quantitative work, especially if inorganic preparations are also to be made by the students as they should be. W. A. S.

OUR BOOK SHELF.

The Illustrated Annual of Microscopy. Pp. 164. (London: Percy Lund, Humphries, and Co., Ltd., 1898.)

THE first number of this publication is a very creditable production, from whatever point of view it may be regarded. It is written primarily for the amateur, although some of the articles included could be read with interest by any microscopist, for they indicate the work that has been undertaken and carried out during the year. Perhaps, however, it is in this very direction that the book is deficient, as in some of the articles, instead of treating only those parts of the subject which are of recent interest, a large amount of matter is included that can be found in any good work on microscopy. It might safely be assumed that those who are sufficiently interested in the subject will have the necessary knowledge to enable them to understand the points under discussion without this preliminary instruction. This fault, if it may be called so, is perhaps almost inseparable from the first number of a work of this kind; but no doubt in future numbers there will be less difficulty in attaining the object the publishers state they have in view.

Of the papers calling for special mention, those on bacteriology are all deserving of notice, not the least interesting to the amateur being that by Rev. W. Spiers on "Amateur Bacteriology," in which various simple devices are described, enabling those who have no special apparatus to do a considerable amount of bacteriological work. This is all the more important, as it is thought by many that the study of bacteria is limited to those who have the resources of a bacteriological laboratory at their disposal, whereas there is a considerable field of work open to any one who has a microscope, without entailing any but the most modest expenditure. A paper on "The Diphtheria Group of Bacilli" deals with an important subject, and one to which considerable attention has been given of late. The paper on "Multiple Colour Illumination," by J. Rheinberg, describes a simple method of effectively exhibiting microscopic objects which, of themselves, do not possess any colour contrast. The microscope and its optical parts comes in for a good share of attention. There is an article on "The Microscope in 1897," by Dr. Henri van Heurch, the mention of whose name is sufficient guarantee of its interest. Mr. Edmund J. Spitta treats of "Achromatics *v.* Apochromatics," and endeavours to show, by a series of photo-micrographs, the immense superiority of the latter. Nearly all branches of microscopy have been touched upon, and into whatever channel the interest of the reader may be directed he is almost sure to find something of interest. Altogether, the book is admirably produced; the illustrations, which are nearly all reproductions from photographs, being of the highest class, and comparing favourably with any of the kind that have been published. It is to be hoped that the publishers will find it possible to continue the issue of this annual, as it cannot fail to be of interest and value to microscopists.

J. E. B.

Wild Animals in Captivity. By A. D. Bartlett; edited by E. Bartlett. Pp. viii+373, illustrated. (London: Chapman and Hall, Ltd., 1898.)

THE late Mr. Bartlett had such an extensive and almost unrivalled practical acquaintanceship with animals in menageries, that the publication of the notes kept by him during a long life might naturally be expected to be an event of more than usual interest. But, although there is much to attract general attention, and not a little worthy the notice of the practical zoologist in the present volume, we cannot help rising from its perusal with a certain feeling of disappointment. It appears, indeed, that a very large proportion of the notes that have any real value have been published elsewhere. And although this is a matter of little or no moment when the subject is good and attractive, it is essential that such republished notes should be well arranged and edited. In our own opinion efficient editorship is sadly wanting in this instance. The various notes and papers are far from being well arranged; and there is a considerable amount of repetition, as well as much irrelevant "padding," which might advantageously have been omitted. As a glaring instance of the former fault, the reader may be referred to pp. 164 and 165, where he will find precisely the same anecdote, with identical dates, repeated under two distinct headings; the only difference being that one account is more detailed than the other.

The diction, too, in many places, if not actually ungrammatical, is decidedly inelegant; and the need of competent scientific editorship is strikingly apparent in the concluding chapter of the book, which treats of the food of animals in captivity, and is one of the most valuable in the whole volume. Misprints, also, are by no means absent; the substitution of the word "joints" for "points" rendering a sentence on p. 27 almost unintelligible.

Neither do we consider the preliminary biographical notice of a decidedly remarkable man all that it might be; and, while the rest of the volume might be much abbreviated with advantage, this part would well bear expansion.

With regard to the merits of the book, all readers will admire the many anecdotes of the striking personal courage and devotion displayed by the late author in his dealings with the animals under his charge. There is much, too, in regard to their general habits in confinement which cannot fail to be of importance to all

connected with menageries; while many of such notes are valuable clues to their mode of life in a state of nature.

A subject in which Mr. Bartlett took especial interest is that of hybrids; and to him, amongst others, belongs the credit of showing that sterility is by no means such a general attribute of the products of crossing as has been supposed. The chapter on hybridisation is, therefore, worthy of the best attention of naturalists.

R. L.

Wild Life at Home. How to Study and Photograph it. By R. Kearton, F.Z.S. Pp. xv + 188. (London: Cassell and Co., Ltd., 1898.)

THIS delightful book, by the author of the well-known "With Nature and a Camera," deserves a wide popularity. It should be of value in spreading the love of the "bloodless and harmless sport," of which Mr. Kearton writes so enthusiastically. The beautifully reproduced photographs are in themselves more than justification for the addition of the volume to the numerous bird-books already in existence, and the careful and practical instructions which are given to the reader, to enable him to secure similar trophies to those illustrated, will tempt many nature-lovers to follow in the footsteps of Mr. Kearton and his brother, Mr. C. Kearton, who has provided the photographs. In addition to illustrations and notes on birds, the volume contains chapters, with striking pictures, on mammals, insects, and other forms of life.

A Pocket Dictionary of Electrical Words, Terms and Phrases. By Edwin J. Houston, Ph.D. Pp. iv + 945. (London: Swan Sonnenschein and Co., 1898.)

THE growth of the terminology of electrical science has been so rapid, that the new terms and phrases coined since the publication of the last edition of the author's larger dictionary, exceed in number those which were originally in use. This necessitated a re-casting of the previous work; and to avoid the production of a cumbersome volume, the greatest attention has been paid to conciseness of expression, with the result that this handy little epitome has been produced. It is even now too large for a pocket dictionary, and it would perhaps have been better to have reduced the bulk by omitting many of the words which are familiar enough to need no explanation.

Ricettario Industriale. By I. Ghersi. Pp. 562. (Milan: Ulrico Hoepli, 1899.)

This book, which is one of the latest additions to the well-known series of "Manuali Hoepli," contains some 940 recipes used in the arts. Among these there are many which will be of value to scientific workers. Of the subjects treated, the following are a few of the more important:—Coloration, plating and cleaning of metals; paper, celluloid, cements, ebonite, matches, preservation of fruit, flowers, eggs, &c.; bleaching, ink, oils, perfumes, soap, varnishes, ivory, glass, wine. So far as we are able to judge, the recipes given are practical and up to date.

Deutscher Botaniker-Kalender für 1899. By P. Sydow. Pp. 198. (Berlin: Gebrüder Borntraeger.)

THE dates of the births or deaths of distinguished botanists, mostly natives of Germany, are indicated in this pocket diary for 1899. In addition, the rules of nomenclature followed by officers in the Imperial botanical gardens and museums of Berlin are given; and there are lists of works on cryptogamic plants, of botanical gardens in Germany and elsewhere, botanical and natural history museums and collections, and an alphabetical list of the officers in botanical museums and great herbariums.

LETTERS TO THE EDITOR.

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The Anthropological Expedition to Torres Straits.

THE members of the Cambridge Anthropological Expedition to Torres Straits have now completed their investigations in the Straits. Dr. Rivers and Mr. Wilkin have left for England, while the other members of the expedition have proceeded to Borneo to study the anthropology of the Baram district of Sarawak. The health of the party has been excellent.

The natives of Murray Island were studied with most detail, as, owing to their isolation, they have been less modified by contact with alien races. Some of the party stayed about four months on the island, while others had only a couple of months, owing to a trip having been made to the mainland of New Guinea.

The New Guinea contingent visited the coast tribes between Kerepunu and the Mekeo district, and several excursions were made for short distances inland. There was not enough time spent at any spot for a thorough investigation of the natives, but a considerable amount of information was obtained in most of the branches of anthropology with which the expedition is concerned, which will prove of value for purposes of comparison.

The researches on the Murray islanders were fairly thorough, and will form a basis for comparison with the other islanders and allied peoples. Over a month was spent in Mabuiag (Jervis Island) by all the party, with the exception of Messrs. Myers and MacDougall, who had previously started for Borneo. Although the time spent in Mabuiag was short, a satisfactory amount of work was accomplished owing to the conditions being favourable. Observations were also made on several other islands in Torres Straits and in Kiwai, which is situated in the mouth of the Fly River.

A large number of photographs have been taken, and considerable collections have been made, which are now on their way to Cambridge. A. C. HADDON.

Thursday Island, November 7.

Transference of Heat in Cooled Metals.

SEVERAL observers [1] have noticed a rise of temperature at the cooler end of a bar of metal when the hot end was suddenly cooled. As this would be a most surprising effect, and as Johns Hopkins University has been mentioned in connection with the subject, Dr. H. A. Rowland has requested me to examine the matter.

Iron and steel bars of about one-half inch diameter were used, and iron-copper thermo-electric couples were soldered to the cooler end and the side. A reflecting galvanometer was used that gave a deflection of 1 mm. per 0°·05 C. The end of the bar was heated by a Bunsen compound burner, or in a muffle furnace with a blast lamp. The hot end of the bar was cooled either with blocks of ice or by plunging into ice water.

After errors, due to jarring the galvanometer, and to changes in the magnetic field of the galvanometer, caused by motion of the bar, had been eliminated, even under the most trying conditions no effect was observed. The temperature of the cooler portion of the bar did not increase when the hot end was suddenly quenched.

The most severe test imposed included the sudden quenching in ice water of the end of the bar, three inches of which was above the red heat. The thermo-couple then was only nine inches from the glowing end of the bar.

The galvanometer, of course, showed the usual slow change of temperature due to conduction. There was then a comparatively long time after quenching before any change of temperature was indicated, and then the change was only a reduction of temperature. CARL KINSLEY.

Johns Hopkins University Physical Laboratory,
Baltimore, U.S.A., December 9.

[1] NATURE, June 30, 1898 (observed by M. Bourget in Paris, 1898); September 1, 1898 (observed by Mr. Bartlett in Cavendish Laboratory, 1889); October 20, 1898 (observed by Mr. Stone in Johns Hopkins Laboratory, 1888).

Where do we stand in Brückner's Weather-cycle?

THE problem of future weather is one which has a fascination for many. Our present inability to get beyond (or much beyond) the daily forecast, may well, at times, seem a reproach, considering the immense amount of industry that has been given to weather studies. Where is the professional meteorologist in this country (we vainly ask), who, on the basis of some cycle, or proved recurrence, or other facts, will tell us, even in the most general way, what the coming years have in store for us?

Yet the time may not be so very distant, I think, when science will be able to say, *Nous avons changé tout cela.* The evidence of cycles is growing; and their character is being more exactly fixed. An attentive reader of that excellent record, the *Meteorologische Zeitschrift*, may observe, now and again, a feeler (so to speak) put forth into the obscure; a serious attempt to extend the range of prevision, a suggestion, by some well equipped mind, as to the course of weather in coming years or seasons. Have we not in such the hopeful beginnings (hopeful even in case of failure) of a new and difficult art?

There are two weather-cycles, which have lately been (shall I say?) knocking for admittance; that of 11 years, and that of 35 years. It is well to bear in mind that these are not mutually exclusive. They may be found to usefully supplement and help each other.

Brückner's views as to the recurrence, at intervals of about 35 years, of cold and wet periods, alternating with warm and dry ones, seem to have hardly received, as yet, in this country, the attention which they deserve. They are destined, I believe, to have a large influence on future thought about such matters. It may be useful to ask how our London weather is related to this 35 years' cycle; and I propose to do so here from the standpoint of barometric pressure.

The method adopted is this: Each month, in a long series of years (from 1786), is first characterised as + or −, according as its pressure has been above or below the average. (Tables by Eaton and Glaisher have been used for the purpose.) Then the plus months in each year are counted, and the series of numbers so obtained is smoothed by additions of 10 (*i.e.* adding the first 10, then from the 2nd to the 11th, the 3rd to the 12th, and so on, each sum being put down in the *fifth* place). This gives us the dotted curve A in the diagram, in which may be seen, underlying minor variations, a succession of long waves. The general outline of these waves may be more clearly brought out by a further smoothing process (continuous curve).[1]

In order to clear understanding of this curve A, consider, for a moment, its lowest point, that for 1842; this means, that, in the 10 years, 1838–47, there were 50 months of + barometric pressure, out of 120. Similarly, the highest point (that for 1891), means that in the 10 years 1887–96, there were 67 months of + pressure out of 120.

Note the intervals between minima of this curve A. From 1813 to 1842, 29 years; 1842 to 1876 (34 years). Or, taking the twice-smoothed curve, we get 35 and 32 years. On the other hand, the two completed waves are approximately bisected by the vertical lines for 1830 and 1860 (interval 30 years).

At the top of the diagram are two linear series representing, the one, Brückner's warm and cold, the other, his dry and wet, periods (warm and dry, continuous lines, cold and wet, dotted lines). These two series, for temperature and rainfall, are not, it will be seen, exactly coterminous; the latter tend to lag somewhat on the former. Brückner's general figures may be given, so far as they here concern us.[2]

Temperature.		Rainfall.	
Warm ...	1791–1805 (15 yrs.)	Dry ...	1781–1805 (25 yrs.)
Cold ...	1806–1820 (15 ,,)	Wet ...	1806–1825 (20 ,,)
Warm ...	1821–1835 (15 ,,)	Dry ...	1826–1840 (15 ,,)
Cold ...	1836–1850 (15 ,,)	Wet ...	1841–1855 (15 ,,)
Warm ...	1851–1870 (20 ,,)	Dry ...	1856–1870 (15 ,,)
Cold ...	1871–1885 (15 ,,)	Wet ...	1871–1885 (15 ,,)

Now, it will be noticed that our barometer curve A at its lowest points is generally about the middle of the cold periods, while the middle of the waves is about the middle of the warm periods. Also, that the parts of the twice-smoothed curve above the average line are about coterminous with warm periods; while the parts below the average line are in general coterminous with cold periods.

[1] Here the sum of 10 items is put down in the *sixth* place.

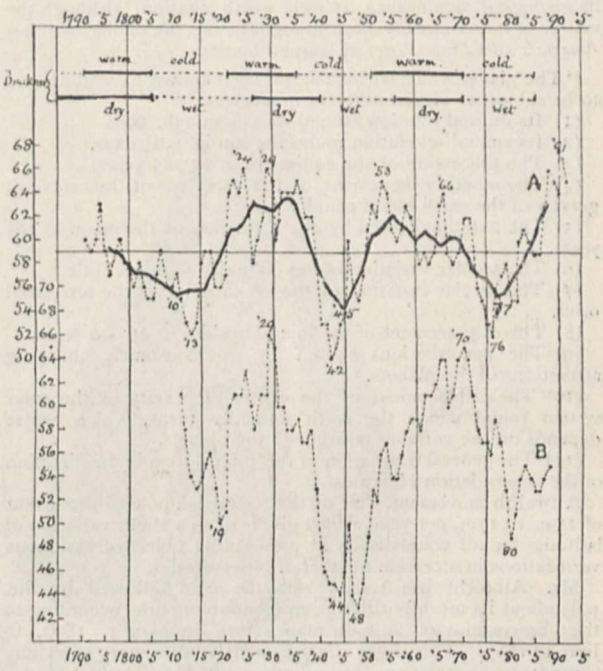
[2] *Klimaschwankungen*, p. 236.

It is surprising, I think, that an agreement so considerable can be brought out by a method so rough

Do not these facts throw some light on the future? An interval of 35 years from the last minimum, 1876, brings us to 1911, about which time (perhaps a little earlier) we might fairly look for another minimum, the middle of another cold and wet period. At present we are still, apparently, in the warm and dry period commencing about 1886, and probably near the end of it, as (say) 15 years from 1885 brings us to the end of the century. We next enter (by programme!) on another time of cold and wet, with preponderance of low barometers. Thus our curve A should be turning down soon towards its next minimum (situated somewhere between 1906 and 1911).

The rainfall aspect of the current warm and dry period may be put thus: Of the fifteen years, 1883–97, twelve have been dry, and only three wet. 1882 seems to mark the end of a long time of preponderance of wet years.

The curve B is one for Paris, made out in the same way as A (the data, however, extending only to 1893). It shows much the same kind of fluctuation. One curious feature is a lag in the three minima behind those of the London curve.



Regarding barometric pressure in these regions, Brückner considers that in a dry period there is a deepening of the usual cyclone in the North Atlantic (on an annual average), and an intensifying of the ridge of high pressure reaching from the Azores to the interior of Russia, especially in Central Europe; also a general increase of amplitude in the yearly variation (*Klimaschw.*, p. 217). In wet periods, the pressure differences (both from place to place and from season to season) are lessened.

There can be little doubt that this cycle of Brückner's touches life at many points, and that a promising field of study is thus opened up. Take health for example. Brückner himself shows how the mortality from typhus at Bâsle has varied with the cycle (being worst in the dry periods). In a recent valuable work on epidemic diphtheria, Dr. Newsholme correlates the mortality from that disease in England with the thirty-five years' cycle, showing that a succession of dry years afford the most favourable conditions for growth of the disease.

ALEX. B. MACDOWALL.

Soakage into Glazed Porcelain.

I MIX salt with water for occasional gargling, and keep it in a porcelain pot with a lid. Some weeks ago I began to use for the purpose a small well-glazed pot, in which cold cream had been bought a long time since. It was thoroughly washed by a

careful servant, and the salt put into it. However, after a few weeks the salt became so strongly impregnated with the odour of rancid grease that it was not fit to be used, and I threw it away. The pot was washed a second time with scrupulous care; it seemed to me quite pure and free from odour; a new supply of salt was put into it, and now for the second time the salt has began to smell intolerably rancid. The interests of this is two-fold. First, it shows how large an amount of impurity is able to penetrate glazed porcelain, as photographers know to their cost; and secondly, it proves the possibility of concentrating odour. An imperceptible discharge from the porcelain was accumulated and stored in the salt until, when the lid was removed, it was found to be overpoweringly strong. The scent may therefore be said to have been *magnified* by these means, as much as a sound is magnified by a ear-trumpet, or a visible object by a lens. F. G.

The Twelfth Movement of the Earth.

UNDER the above heading a short article appears in the *Bulletin de la Soc. Astronom. de France*, October 1898, p. 449, which on account of its interest and of its brevity, as well as its geological significance, is well worth citation, although the matter of it has already been brought before the public by other *Journals* and *Proceedings* of learned bodies.

"The planet which we inhabit has been known by astronomers to be subject to eleven different movements.

(1) Its diurnal rotation around its axis in 23h. 56m.

(2) Its annual revolution round the sun in 356¼ days.

(3) The precession of the equinoxes in 25'765 years.

(4) The monthly movement of the earth about the centre of gravity of the earth-moon couple.

(5) The nutation caused by the attraction of the moon in 18½ years.

(6) The secular variation of the obliquity of the ecliptic.

(7) The secular variation of the eccentricity of the terrestrial orbit.

(8) The displacement of the line of apsides in 21'000 years.

(9) The perturbations caused by the constantly changing attractions of the planets.

(10) The displacement of the centre of gravity of the solar system round which the earth annually turns, which centre depends on the variable position of the planets.

(11) The general translation of the solar system in the direction of the constellation Hercules.

A twelfth movement, that of the terrestrial pole to the extent of 15m. to 17m. per year, which gives rise to a slight variation of latitudes for all countries, is at present the object of assiduous verifications in a certain number of observatories.

Mr. Albrecht has traced out the path followed by the pole about its mean position from month to month, according to the observations of latitude made since January 1, 1890, to June 1, 1897. This slight displacement is due more especially (surtout) to a variation of equilibrium produced by the movements of the atmosphere of the ocean."

It appears singular that this movement of the pole (and consequent variation of latitude) thus clearly determined to be taking place, has not led to any appreciations as to its possible and probable significance in geology. Amongst the many causes advanced to account for the derangements of land and ocean, and consequent changes of climate at various geological periods, has been a supposed displacement of the axis of the earth, which astronomers have been unwilling to admit as having taken place to any notable extent, and which up to the present it was not possible to prove as having really ever existed. Sir Arch. Geikie, in his "Text-book of Geology" (1885), p. 15, discusses the question sufficiently fully, and arrives at the conclusion (p. 17): "Under the most favourable conditions, therefore, the possible amount of deviation of the pole from its first position would appear to have been too small to have seriously influenced the climates of the globe within geological history."

Secular contraction is admitted as a consequence of the slow cooling of the earth, but the rate at which it acts, or its estimation as a force, is hardly attainable. That it may be, and is frequently a cause of earthquake action is admitted. Hence, considering it as a force acting at all parts of the earth's surface with greater or less energy, it is presumable that it is maximum in certain places, and may be so at points in the vicinity of the equator. Its energy may, indeed, here in places, have reached the point, from time to time, of balancing the centrifugal force proper to these places; and in this case it is evident that the ground in such places might be considered as being in unstable equilibrium, and liable to elevation or depression on the occurrence of very slight differences between the two forces in question arising from one cause or another. Now, under such conditions of equilibrium, it is just possible that a very slight variation of intensity of the centrifugal force at the place considered, could give rise to a derangement of the earth's surface such as would be attributed to an earthquake. This variation in the intensity of the centrifugal force might be the result of the movement of the polar axis, and possibly of a very slight movement such as recently observed. But if it be admitted that this movement is continuous, and if it be supposed that it may have been much more intense and much more frequent in former times, it is evident that it may have been a potent agent in bringing about alterations in the relative distribution of land and water in the zone of the equator, and it is reasonable to examine the actual state of this zone for some evidence of such former movements of the polar axis. Now, the equatorial zone lying between 10° to 15° north and south of the equator, is markedly characterised by the predominance of the ocean surface. The equatorial line only traversing land in Africa and South America, Borneo and Sumatra over a total length of about 90°, the remaining 276° of its extent lying on the Pacific, Atlantic and Indian Oceans. The localities where it traverses the land surface are remarkable in respect to their level as regards the sea. Thus the African part of the belt covers a large extent of the watershed valley of the Congo River, and the Victoria Nyanza basin. In a quite recent article in the *Scientific American Supplement* (Sept. 24, 1898, p 19008), the basin of the Congo "has (it is said) been compared by geologists to the dried up bed of an interior sea." In South America the southern portion of the zone represents the watershed valley of the Amazon, that is, a low-lying tract of land. The course of the zone where it traverses the Indian Ocean and the islands of Borneo, Sumatra, and Celebes, is over one of the most disturbed portions of the earth's surface, that is, where alterations of level, with accompanying seismic and volcanic phenomena, have been frequent and almost continuous. Furthermore, one of the results of a change in the position of the polar axis and variations of the intensities of the centrifugal force on the equatorial zone would be, that for points diametrically opposed, the decrease of centrifugal force at one point would necessarily imply an increase of the force at the opposite point, so that if subsidence took place in the one, elevation should be the result in the other, so that wherever the equator traverses land (representing elevation) it should be found traversing ocean (or low land) at the opposite end of the diameter corresponding to this elevated land surface. This practically holds good, since to the African belt is antipodal, a certain extent of the Pacific, while to the South American belt corresponds diametrically the portion of the Indian Ocean occupied by the islands of Sumatra, Borneo and the Celebes, so markedly characterised by the evidences of former and present seismic and volcanic actions. There is, therefore, some probability that in the present arrangement of land and water in the equatorial zone, there may be the traces of former changes of the polar axis. It is well to bear in mind, as regards these small movements of the axis frequently recurring, if not continuously, and giving rise consequently to small but repeated changes in the relative intensities of secular contraction and centrifugal force, that they may really be most potent agents of change, and that therefore, however small, they acquire great significance if found to be recurrent and tending to repeat themselves at more or less regular intervals, and intervals much shorter than those usually assigned to geological phenomena. J. P. O'REILLY.

The Geminid Meteors.

WILL you allow me to supplement the observations of the Geminids recorded in the first paragraph of your "Astronomical Column" in NATURE of December 19, p. 157, by mentioning some of my own? They may be interesting as showing the continuance of the shower, as I was unable to begin to keep watch until 12h. 30m. on the 12th. Twenty-seven meteors which appeared in the south and south-east were charted between that hour and 14h. 45m., when clouds finally covered that part of the sky. Of these, sixteen were from one or other of three radiants in Gemini, the most brilliant occurring at 12h. 42m. (= 1st magnitude), at 13h. 35m. (= magnitude 1½), at 14h. 16m. (= 1st magnitude), and at 14h. 23½m. (= Jupiter in bright-

ness). It will be seen, therefore, that with regard to frequency of meteors this later portion of the shower was not to be compared with that witnessed before midnight. Twelve meteors, including one of the first magnitude and two even brighter, were mapped between 11h. 30m. and 13h. on the night of the 9th; four of these were Geminids. W. E. BESLEY.

70 Vincent Square, S.W., December 16.

Slug following a Closed Trail.

MY attention was drawn a few days ago to a brown slug, about 2½ inches long, which had made for itself a closed iridescent track on the concrete flooring of a conservatory. I could not find at what point it had got on to the curve, which ran at one end into a damp part of the concrete, but, in four hours from the time I first saw the slug, it had made three complete circuits and two-thirds of a fourth, always keeping the whole of its body on the trail. The latter, of a uniform breadth of 3/16 inch, varied considerably in curvature, but nowhere presented any very sharp corners, and measured, roughly, forty inches round. Though the rate of progression was sufficiently slow, the slug rested on the track for seven hours, after which, thinking it dead, I touched it and found it had not quite dried up. Indeed, without elongating its body, it began to move and laboriously shifted its position by about an inch. There it remained (the time being then 10 p.m.), waiting, perhaps, for the influence of a more humid atmosphere, for morning found it moist and healthy, breakfasting more than a yard from the near and damp end of the track, which it must have reached by completing the fourth circuit, as there was no trail other than the closed one alluded to. If slugs are in the habit of following old trails, it does not appear that the present specimen had any previous experience of a re-entrant path, but that it depended solely on ocular intelligence of the path in advance.

VINCENT DANIEL.

151 Crwys Road, Cardiff, December 13.

Animals Feeding on Poisonous Plants as Food.

APROPOS of the various instances quoted of animals feeding on poisonous plants, it may be of interest to mention that in this part of India (the North-west Provinces), goats frequently eat, without any ill effect, the leaves and green stems of the "Akaúa" or "Madar" (*Asclepias* or *Calotropis gigantea*), the milky juice of which is an acrid poison for human beings, and is frequently used as such in infanticide cases.

CHAS. A. SILBERRAD.

Muttra, India, November 18.

THE FUMIGATION OF TREES.[1]

THE San José Scale was first discovered by Prof. J. H. Comstock, near San José, California, in 1879, and was named by him *Aspidiotus perniciosus*. It has been found in various parts of the world, and its original habitat has not yet been ascertained with certainty, but is conjectured to be Japan. In 1893 it was first discovered in the Eastern States, having been introduced about six years before with some infested plum-trees from California, in the attempt to obtain an improved plum which should be proof against the attacks of the plum-weevil; but this laudable object proved the means of introducing a much worse pest into the Eastern States. According to the pamphlet before us, it has now been introduced into no less than thirty-three States, besides Canada and British Columbia, chiefly from the centre of infection in New Jersey. The State of Maryland is badly infested, large orchards of plum, pear, peach, cherry, &c., having been almost entirely destroyed by it in some localities. The insect attacks trees and plants in a similar manner to other *Coccidae*, attacking a great variety of plants, and spreading over leaves, trunk, branches, and fruit indiscriminately. The effects of various remedies are discussed by Prof. Johnson, spraying with whale-oil soap, and fumigating with hydrocyanic acid gas, appearing to be the most satisfactory and efficacious remedies.

FIG. 1.—Placing a tent in position over a plum-tree.

[1] "Report on the San José Scale in Maryland, and Remedies for its Suppression and Control." By W. G. Johnson, A.M., Entomologist. (*Bulletin* No. 57 of the Maryland Agricultural Experiment Station, College Park, MD., August 1898.)

The accompanying illustrations, selected from those in the Report, illustrate the mode of applying the latter remedy.

We may add that other countries have become alarmed at the ravages of the San José Scale in America; and in Germany, in particular, it is not only absolutely forbidden to import any living plants of any kind from America, but even from any other country, without a satisfactory declaration that they are not of American origin.

W. F. K.

FIG. 2.—Experimenting with hydrocyanic gas in a block of 2500 Bartlett pear-trees infested with San José Scale.

CURIOSITIES OF ORCHID BREEDING.

A FEW years ago the raising of hybrid orchids was entirely in the hands of a few English experts, but quite recently it has been taken up with great success by many growers of these rare and beautiful plants, not only in England, but also on the continent and in America.

Consequently orchid hybrids have become very numerous, while new ones are constantly being brought to light. Up to the year 1860, we find but four flowered hybrids recorded, raised from distinct crosses: during the thirty years following the numbers gradually increased, until in 1890 there were about 200 enumerated. But it is in the present decade that the most rapid strides have been made, the numbers having increased by leaps and bounds until at the present time there are on record no less than 800 orchid hybrids, raised by hand from distinct crosses These have all flowered in gardens, and have been duly described or recorded in various journals. And when we remember that many of these 800 crosses have been repeated in the same garden, and in other gardens, and that many individual plants may have been obtained from each capsule, we can form an idea of the large numbers of hybrid orchids that have been raised by hand.

Primary Hybrids.

Of the 800 hybrids from distinct crosses, now on record, some 500 are primary hybrids, *i.e.* hybrids of the first generation between two different species. A careful examination of these primary hybrids shows that, as a rule, they are fairly intermediate between their parents, partaking of the characters of both, and at the same time perfectly distinct from either. The latter fact is most remarkable, and at once serves to distinguish primary hybrids clearly from all other hybrids. For example, *Cypripedium* × *Leeanum* is a typical primary hybrid, and has perhaps been raised more frequently and in larger numbers than any other orchid hybrid. It was obtained originally by crossing *C. insigne* (Wallich), ♀, with *C. Spicerianum* (Rchb. f.), ♂, both well marked and distinct species. The hybrid is fairly intermediate both in its outward characters and in its inner structure (see Prof. Macfarlane on "Minute Structure of Plant Hybrids," *Trans. Roy. Soc. Edin.*, 1891, xxvii. p. 245), and although it has innumerable minor and individual varieties, yet it is always perfectly distinct from both of its parents.

Nor has any intrinsic difference been observed in the reciprocal cross, the same forms appearing equally in the obverse and reverse crosses. Often many varieties are obtained from the same capsule, differing slightly in colour, form and size, but all are specifically *C.* × *Leeanum*, and cannot be mistaken for anything else. As it is with *C.* × *Leeanum* so it is with other primary orchid hybrids, so far as experiments have been made. In short, we find that primary hybrids are, as a rule, so intermediate between their parent species, and so com-

paratively uniform in character, that they are specifically distinct from both parents.

Generic Hybrids.

Of the 500 primary hybrids on record, about 100 are generic hybrids, *i.e.* the parents belonging to different genera. In this respect alone these hybrids are interesting, though no doubt the systematic botanist views them with mixed feelings. It is not so long since generic hybrids were looked upon as anomalies, some of the older naturalists even regarding them as impossible, and forthwith proceeded to beg the whole question by classing those genera which were fertile with one another as species of one. Orchid growers, at all events, have almost ceased to regard generic hybrids with curiosity, familiarity with them having bred a certain amount of indifference.

A list of the generic hybrids on record up to the end of 1897, together with a diagram showing how twenty-six different genera have been linked together by artificial hybridisation, has been prepared by the writer and was published in the *Journal* of the Royal Horticultural Society (vol. xxi., April 1898), and to which those interested in the details of generic orchid hybrids may be referred.

Generally speaking, primary generic hybrids follow the rule of specific hybrids in bearing the intermediate characters of their parents, with a narrow range of variation.

But there are a few remarkable exceptions to this rule.

(1) *Epiphronitis* × *Veitchii*, a hybrid out of *Sophronitis grandiflora* (Lindl.) by *Epidendrum radicans* (Pav.).

(2) *Epi-Cattleya* × *matutina*, a hybrid out of *Cattleya Bowringiana* (Veitch) by *Epidendrum radicans* (Pav.)

(3) *Epi-Laelia* × *radico-purpurata*, a hybrid out of *Laelia purpurata* (Lindl.) by *Epidendrum radicans* (Pav.).

(4) *Epi-Laelia* × *Charlesworthii*, a hybrid out of *Laelia cinnabarina* (Lindl.) by *Epidendrum radicans* (Pav.).

These four generic hybrids are very curious indeed, inasmuch as all agree in reproducing the generic characters only of the pollen parent Epidendrum, without the slightest trace of the peculiar structure of the seed-parents, Sophronitis, Cattleya and Laelia. Yet in minor characters, in colour, form and size, the four hybrids distinctly differ from one another and from their Epidendrum parent.

A close examination reveals the fact that these minor differences correspond with the peculiar differences in the parentage, thus showing that the crosses have really been effected: yet at the same time it must be candidly admitted that did we not know the parentage, we could never have determined it, so overwhelming is the influence of the predominant partner *Epidendrum radicans*. It will, no doubt, be observed that *E. radicans* is the pollen parent in each of the above cases. Curiously enough, when this reed-like *E. radicans* is crossed with the pseudo-bulbous *E. vitellinum* (Lindl.), ♀, a similar result is obtained, the offspring *E.* × *radico-vitellinum* being scarcely distinguishable from the reed-like *E. radicans*. Again, when the reed-like *E.* × *O'Brienianum*—itself a hybrid out of *E. evectum* (Hook. f.) by *E. radicans*—is crossed with the pseudo-bulbous *E. vitellinum*, ♀, a similar result is obtained, the offspring being reed-like in habit as in the pollen parent. Yet when the reed-like *E. radicans* is crossed with other reed-like species of Epidendrum, and again when the pseudo-bulbous species of Epidendrum are crossed with species of Laelia, in every case normal hybrids are produced intermediate between their parents.

Though we cannot pretend to unravel this tangled skein, yet, so far as experiments have been made, it seems quite clear that (1) the species of Cattleya, Laelia, Sophronitis, and the pseudo-bulbous species of Epidendrum, when intercrossed, produce normal hybrids intermediate in character.

(2) The same result is obtained when the reed-like species of Epidendrum are united with one another.

(3) But when the reed-like species of Epidendrum are united with the pseudo-bulbous species of Epidendrum, or with species of Cattleya, Laelia and Sophronitis, abnormal hybrids are produced, having the essential characters of the reed-like Epidendra. From these facts it might easily be argued that a reed-like Epidendrum was the ancestor not only of the pseudo-bulbous Epidendra, but also of the more highly specialised genera Cattleya, Laelia and Sophronitis. In that case the pseudo-bulbous Epidendra would form an interesting connecting link between the lowly reed-like Epidendra and the gorgeous aristocratic Cattleya and Laelia.

Prepotent Generic Crosses.

Perhaps the strangest curiosity in the history of orchid hybridisation is the remarkable prepotency of the genus Zygopetalum over the three genera Odontoglossum, Oncidium and Lycaste, so far as experiments have been made. *Zygopetalum Mackayi* (Hooker) has been crossed with four distinct species of Odontoglossum, viz. *O. Pescatorei* (Linden), *O. crispum* (Lindl.), *O. grande* (Lindl.) and *O. bictonense* (Lindl.), also with one species of Oncidium, *O. unguiculatum*, and one species of Lycaste, *L. Skinneri* (Lindl.), by more than one hybridist, and the result has always been the same, namely *Zygopetalum Mackayi* pure and simple, without a trace of the peculiar structure of the pollen parent in any case. This result is very perplexing and exceedingly difficult to account for. I have made careful inquiries into the details of all these cases, and have satisfied myself that accidental self-fertilisation is out of the question, the pollen of the mother parent having been carefully removed in every case previous to pollination. Parthenogenesis, too, is evidently a broken reed to lean upon, for the seedlings from the same seed-pod differed among themselves in colour and other minor characters, which would hardly have been the case had they arisen from parthenogenetic seed-buds. Neither is *Z. Mackayi* naturally prepotent over other species when crossed, there being at least three cases to the contrary. Nor is the genus Zygopetalum naturally prepotent over other genera, as two distinct and intermediate hybrids between Zygopetalum and Colax testify. As in the case of the Epidendrum crosses, mentioned above, it may be suggested that Zygopetalum is the ancestral genus of Odontoglossum, Oncidium and Lycaste, and that the characters of the ancestral genus remain latent in the more recent genera, with the result that when the latter are crossed with the former, the mixing of the germ-plasms causes these original characters to dominate, the outcome being a reversion to the ancestral genus Zygopetalum.

A rather interesting fact has come to light which certainly lends colour to the above speculation:—The seedling Odontoglossums, raised in the gardens of Baron Rothschild, of Paris, during the first eighteen months of their growth, are said to have resembled Zygopetalum more than they did Odontoglossum. This coincides with the established fact that living beings tend to resemble their ancestors in the early stages of their development. However, for the present we must suspend our judgment, and wait patiently for further facts: it is to be hoped that future experiments will throw more light upon these curious generic crosses.

Another curious fact in connection with generic crosses may perhaps be of interest, and that is the remarkable crosses between the East Indian species of Cypripedium and the South American species; these two sections of the old genus Cypripedium have recently been raised to generic rank, under the names of Paphiopedium and Phragmipedium respectively, by Mr. R. A. Rolfe, of Kew,

and seem to form two distinct and natural groups. Hybrids between these two new genera are peculiarly interesting, inasmuch as the former has a one-celled ovary, while the latter has a three-celled one, showing that this condition is no barrier to fertilisation. More than twelve distinct crosses between different species of these two genera are on record, and many plants have been raised, but so far all resolutely refuse to flower, notwithstanding the many inducements that have been put in their way, and many of them are now large vigorous plants, long past the usual flowering age. One plant of these crosses is recorded to have flowered in the United States, but as it flowered exactly the same as the mother plant in genus, species and variety, one cannot be quite sure that the cross was really effected.

Many of the remaining plants (the writer has several in his collection) are distinctly intermediate in their foliage and habit of growth, and clearly bear the stamp of their recorded origin.

Secondary and Tertiary Hybrids.

Of the 800 distinct crosses mentioned in the foregoing, some 270 are secondary hybrids, *i.e.* hybrids of the second generation, one or both parents being a primary hybrid; while thirty are tertiary hybrids, *i.e.* hybrids of the third generation, one of the parents, at least, being a secondary hybrid. So far no hybrid orchids are recorded to have flowered beyond the third generation, but perhaps it may not be premature to mention that unflowered hybrids of the fourth generation are known to be in existence. The writer has in his collection six hybrids of the fourth generation, five years old, all raised from the same capsule, and which contain in their pedigree five distinct species and three distinct hybrids. So that in the near future there will be ample material in this direction at the disposal of the student of heredity; with this distinct advantage, that orchids being individually valuable, their pedigree is carefully and systematically recorded, which unfortunately is more than one can say of the great majority of garden hybrids.

A careful examination of secondary hybrids, shows them to be very different from primary hybrids in their range of variation. As we have already seen, primary hybrids are comparatively uniform in their characters; so much so that, as a rule, they are quite distinct from their parents. On the other hand, secondary hybrids have a much wider range of variation, often approaching either parent, and sometimes even reverting wholly to one or the other. For instance, to take the simplest form of a secondary hybrid, *i.e.* a hybrid crossed with one of its parent species. We find that the offspring, as a rule, are very variable, a few reverting to the parent species and a few to the parent hybrid; but the great majority are intermediate forms approaching either parent, the whole forming a series of links between one parent and the other. In short, we find that secondary hybrids have a far wider range of variation than have primary hybrids.

Natural Hybrids.

The existence of natural hybrids was formerly thought by some naturalists to be highly improbable, if not actually impossible. But now, when absolute facsimiles of supposed natural hybrids have been raised by hand in gardens, from the same two species among which they naturally grow, they can no longer be regarded as pious speculations, but are indeed accomplished facts. The number of proved natural hybrids in orchids alone is now very considerable, with the result that many intermediate and doubtful forms, hitherto classed as distinct species, are now placed in their proper position as natural hybrids. Mr. R. A. Rolfe, of Kew, has done yeoman service in reducing the chaos of natural hybrid orchids to something like order. And so it has come to pass that artificial hybridisation, which it was supposed would lead systematic botany into the direst confusion, by the irony of fate, seems destined to be the only trustworthy means of saving systematic botany from its own confusion; and the systematist, however orthodox he may be, can no longer afford to ignore artificial hybrids.

Fertility of Hybrids.

The question of the fertility of hybrids is a highly interesting one, and especially important to the student of evolution; and I venture to think that recent experiments in orchid hybridisation have added considerably to our knowledge of the subject.

One of the principal objections to Darwin's theory of the origin of species was the supposed general sterility of hybrids.

Darwin fully appreciated this difficulty, and, after a careful and most elaborate survey of the whole question of hybridism, came to the following conclusions:—"First crosses between forms sufficiently distinct to be ranked as species, and their hybrids are very generally, but not universally sterile. . . . The sterility is of all degrees" ("Origin of Species," 6th ed., p. 262). Again:—"The sterility of distinct species, when first united, and that of their hybrid offspring, graduates by an almost infinite number of steps from zero (when the ovule is never impregnated, and a seed capsule is never formed) up to complete fertility. . . . This high degree of fertility is, however, rare ("Animals and Plants," 2nd ed., vol. ii. p. 163). Some fifteen years later, Dr. Alfred Russel Wallace took up a somewhat similar but more definite position. He writes:—"One of the greatest, perhaps we may say the greatest, of all the difficulties in the way of accepting the theory of natural selection as a complete explanation of the origin of species, has been the remarkable difference between varieties and species in respect of fertility when crossed. Generally speaking, it may be said that the varieties of any one species, however different they may be in external appearance, are perfectly fertile when crossed, and their mongrel offspring are equally fertile when bred among themselves; while distinct species, on the other hand, however closely they may resemble each other externally, are usually infertile when crossed, and their hybrid offspring absolutely sterile" ("Darwinism," 1890, p. 152). Since that time, hundreds of hybrid orchids have been raised in gardens; as we have already seen, there are now on record some 500 distinct primary hybrids raised from distinct species, also some 300 secondary and tertiary hybrids from distinct crosses, raised from parents themselves hybrids.

In the face of these facts, therefore, we can hardly maintain that "distinct species . . . are usually infertile when crossed," and still less can we assert that "their hybrid offspring are absolutely sterile." As it is with orchids, so it is with other garden plants that have been hybridised, *e.g.* roses, rhododendrons, dahlias, chrysanthemums, carnations, begonias, pansies, &c.: the wonderful forms seen in gardens at the present day are all hybrids of many generations, being the known product of more than one species; and these are all fertile in the production of seeds. Darwin seemed to attach much importance to the different degrees of fertility in hybrids ranging from complete fertility down to absolute sterility. At present we have no means of ascertaining the relative fertility of hybrid orchids with that of ordinary species, owing partly to the fact that very few crosses have been made in gardens between varieties of the same species, and partly to the fact that many thousands of seeds are contained in one capsule, being practically innumerable. But through the kindness of Mr. Reginald Young, of Liverpool—an enthusiastic connoisseur in Cypripediums—the writer has been able to work out certain statistics

bearing on the question of the comparative fertility of hybrids (see *Journ. Roy. Hort. Soc.*, vol. xxi., April 1898).

The voluminous records in Mr. Young's stud-book cover a period of about five years, and were specially selected by the writer on account of the reputation of the breeder as a careful observer and a precise recorder. Out of the 577 crosses made by Mr. Young among thirty distinct species and fifty-three distinct hybrids of the new genus Paphiopedium, no less than 78·3 per cent. proved fertile, *i.e.* produced good seeds.

Of these, the crosses between distinct species only, 95·2 per cent. were fertile, while of the crosses in which a hybrid was concerned in the parentage 71·8 per cent. proved fertile.

This seems to show that crosses between distinct species are almost if not quite as fertile as crosses between varieties of the same species (taking the latter at complete fertility, *i.e.* 100 per cent.); while crosses with hybrids, though fertile to a high degree, are yet rather less fertile than crosses between species. A further analysis of the figures shows that while hybrids crossed with pollen of pure species give 89·5 per cent. fertile, yet pure species crossed with pollen of hybrids give but 56·7 per cent. fertile. This points to the conclusion that the slight decline in the fertility of hybrids is due in a large measure to the loss of power in the pollen of hybrids.

Why the male element in hybrids should be so much less potent than the female element I cannot pretend to say, but I venture to think that the matter is worthy of consideration as a possible factor in the evolution of species.

Evolution of Species by Natural Hybridisation.

The experimental demonstration of natural hybrids shows clearly that intercrossing between different species is carried on in a state of nature, to a far greater extent than was formerly supposed; and the comparative fertility of these natural hybrids would be of vital importance to them in their struggle for life.

If, as seems highly probable from the above experiments with orchids, it is the pollen only of hybrids that is impaired, and the capacity of the hybrid to bear seed crossed with the pollen of pure species remains practically unimpaired, it is quite clear that the natural hybrid has a part to play in the evolution of new species.

As we have already seen, hybridisation tends to increase variation especially beyond the first generation, and, naturally, the more variable the offspring the better fitted would they be to adapt themselves to changed conditions of life.

If the circumstances changed rapidly and considerably, the variable offspring of the hybrids would stand a better chance in the struggle for life than the more uniform offspring of the parent species, which were themselves specially adapted to the old conditions. In this way, as conditions changed, new species would be evolved more fitted to the new conditions of life than the old species, which they would gradually replace, and I venture to suggest that natural hybridisation is the most rapid of nature's means towards that end.

C. C. HURST.

THE MEETINGS OF THE BRITISH AND FRENCH ASSOCIATIONS IN 1899.

THE meeting of the British Association next year, as we have already announced, will be held at Dover contemporaneously with the meeting of the Association Française at Boulogne, in order that the two bodies may interchange visits. It has been arranged that the visitors from France shall cross over to Dover on Saturday, September 16, and that the return visit of the members of our Association shall take place on the following Thursday. The arrangements on both sides of the Channel, for the reception of the visitors, are not yet completed; but we understand that while the members of the British Association are at Boulogne, the interesting ceremony of inaugurating a statue of our poet Campbell will take place; and that, at Dover, Dr. Charles Richet, the distinguished professor of physiology in the University of Paris (Faculté de Médecine) has consented to deliver one of the evening discourses. Dr. Richet's interesting reply to the official request, which was sent to him through Dr. Michael Foster, the President-elect, is as follows:—

Cher maître et collègue,—Je suis trop honoré par la demande que vous me faites pour ne pas accepter immédiatement et sans réserves. Je ne sais pas encore le sujet que je prendrai; nous avons le temps d'en parler.

Si j'accepte ainsi avec joie, c'est que je considère comme vous les dissentiments qui ont séparé et qui séparent nos deux pays, faits pour s'entendre et pour s'aimer, comme absurdes et même criminels. Alors, dans la faible mesure de mes forces, je ferai tout ce qui est en mon pouvoir pour dissiper ces malentendus, et tâcher d'apaiser ces haines.

Paris, Décembre 9. CHARLES RICHET.

We trust that these visits will in no small degree contribute to bring about the result which Dr. Richet so earnestly expresses.

NOTES.

THE Prince of Wales presided at a meeting held at Marlborough House on Tuesday in furtherance of the objects of the recently-formed National Association for the Prevention of Consumption. Sir William Broadbent explained the nature and means of prevention of tuberculous disease, and stated that the objects of the Association were (1) to educate the public as to the means of preventing the spread of consumption from those already suffering from the disease; (2) to extinguish tuberculosis in cattle; (3) to promote the erection of sanatoria for the open-air treatment of tuberculous disease. Lord Salisbury moved the following resolution approving of these objects:—"This meeting desires to express its approval of the effort which is being made by 'The National Association for the Prevention of Consumption and other Forms of Tuberculosis' to check the spread of the diseases due to tubercle, and to promote the recovery of those suffering from consumption and tuberculous disease generally. It also commends the method adopted by the Association of instructing public opinion and stimulating public interest rather than the advocacy of measures of compulsion." The resolution was seconded by Sir Samuel Wilks, the President of the Royal College of Physicians, and carried unanimously. Sir William Broadbent announced that the London partners of Messrs. Werner and Beit have undertaken to erect and equip a sanatorium for tuberculous patients at an estimated expense of 20,000*l.*, the construction and management of which will be under the guidance of the Association. The organising committee have every reason to congratulate themselves on the interest which has been excited in all parts of the country. Branches are being formed in York, Norwich, Ipswich, Huddersfield, and other towns, and at York a considerable sum of money has already been raised for the erection of a sanatorium.

THE Paris correspondent of the *Times* announces that at the annual sitting of the Academy of Sciences on Monday the Lalande prize was awarded to Dr. S. C. Chandler, the Damoiseau prize to Mr. George Williams Hill, and the Houllevique prize to Mr. Branly.

THE death is announced of Prof. H. W. Vogel, the distinguished professor of photography, photo-chemistry, and

spectroscopy at the Berlin Technical High School. Prof. Vogel was born in the year 1834, and he devoted his working life and energies to the advancement of photography.

PROF. BEHRING, together with Dr. Ruppel, is reported by the Berlin correspondent of the *British Medical Journal* to have applied for a German patent for a tuberculosis serum. His claim is: "A method for producing a highly poisonous and immunifying substance from tubercle bacilli, or from cultures of tubercle bacilli."

MR. BORCHGREVINK, and the members of the Antarctic expedition under his charge, sailed from Hobart on Monday.

WE learn from the *Lancet* that Luigi Galvani, the great anatomist of the Bolognese school, and better known for his discovery of animal electricity, received on Sunday, December 4, at Bologna, the honour of a centenary celebration—that of his death, which took place on December 4, 1798. The occasion evoked the presence of the leaders of the local medical school, and its orator was Signor Erminio Vitta, representing the Committee of Italian telegraphists now organising a similar commemoration of Alessandro Volta. The proceedings were highly successful.

ON Monday evening Prof. Ramsay delivered a lecture, by special invitation, to the members of the Berlin Chemical Society in the Chemisches Institut, on "The New Gases and their Relations to the Periodic Law." Prof. Liebermann presided, and in the crowded audience were Prof. Virchow, Prof. Liebreich, Prof. von Bezold, Prof. Warburg, Prof. Fischer, and many other eminent men of science. The German Emperor and Empress visited the Chemisches Institut on Tuesday afternoon, in order personally to listen to a private exposition by Prof. Ramsay of his discoveries and methods.

IT has already been announced that the Geological Society has decided to undertake the publication of the manuscript in its possession of a portion of the third volume of Hutton's "Theory of the Earth," and to accept the generous offer of Sir Archibald Geikie to edit and prepare it for the press. The third volume will be printed in the style of the first and second volumes of the same work, and will contain about 300 pages. The manuscript is now ready to go to the printers, and, as only a limited number will be issued, the Secretary of the Society would be glad to receive the names of intending purchasers.

THE Rome correspondent of the *Daily Mail* reports as follows:—Some very important discoveries have recently been made in the Vatican library. While examining some State documents of the sixteenth century, the Abbé Cozza Luzzi, assistant librarian, had the good fortune to find the original manuscript treatise by Galileo Galilei on the tides. The manuscript, which was hitherto only known as N 8193, is all in Galileo's own handwriting, and ends with the words:—"Written in Rome in the Medici Gardens, on January 8, 1616." The great astronomer had dedicated the book to Cardinal Orsino, his admirer, and Mœcenas. Leo XIII. has taken the greatest interest in the discovery, and has ordered the manuscript to be published in an elegant edition at the expense of the Vatican. The discovery of this treatise, the original of which was considered lost, is all the more important as it differs considerably from the text hitherto accepted as Galileo's, and now in course of publication, together with Galileo's complete works, by the Accademia della Crusca.

Science publishes some particulars in regard to the forthcoming meeting of the American Society of Naturalists, and of the Societies holding their meetings in New York City in conjunction with it. The first meeting of the Society of Naturalists will be in the American Museum of Natural History on December 28. After a welcome by the President of the Museum, Mr. Morris K. Jesup, Prof. Henry F. Osborn will give a lecture on "Collections of Fossil Mammals and their Care." The chief meeting of the Naturalists will be held on the afternoon of December 29 at Schermerhorn Hall, Columbia University. After the Societies have been welcomed by President Low, a series of short papers will be read on "Advances in Methods of Teaching," as follows:—Zoology, Prof. E. G. Conklin, University of Pennsylvania; anatomy, Prof. George S. Huntington, Columbia University; physiology, Prof. W. T. Porter, Harvard Medical School; psychology, Prof. Hugo Münsterberg, Harvard University; anthropology, Dr. Franz Boas, Columbia University; botany, Prof. W. F. Ganong, Smith College.

AT the end of last year the Council of the German Chemical Society appointed a Commission, consisting of Profs. Landolt, Ostwald and Seubert, to draw up a table of atomic weights for use in calculations incident to the practice of analytical chemistry. The report of the Commission is to be found in the last number of the *Berichte*. It is decided to take oxygen as 16·000, and to select atomic weights for other elements in direct or indirect comparison with this value. It is noteworthy that Prof. Seubert, who has hitherto stood out for hydrogen (1·000) as the proper basis for atomic weights, now concedes that for practical purposes oxygen as 16·000 is the more suitable standard. Hydrogen thus becomes 1·01. In the table as printed the atomic weights are not given beyond the last trustworthy figure, and in no case beyond the second decimal place. Nickel is given at 58·7, cobalt as 59; but these numbers are marked as open to some doubt. It is proposed to print the table annually in the *Berichte*, with any revision that may be found necessary. The wish is expressed by the Commission that there should be some international understanding on the subject of the atomic weights used in analytical chemistry; and it is remarked that the achievement of this would not be difficult, since the German table is practically the same as that issued in America by Prof. F. W. Clarke on behalf of the Atomic Weight Commission of the United States. The Council of the Society have requested the Commission to open international negotiations.

THE two following items of news give support to the case for the adoption of the metric system in this country:—The Board of Trade have received information that a large amount of ironwork for bridges in Norway has been ordered from Antwerp. The contractors state that they would gladly have placed the order in England, but have lately gone over to order all their iron from the continent, because they cannot get English makers to supply the work according to the metric system, and it is too complicated for them to work it all out into English measurement, feet and inches.—At a recent meeting of the Bristol Chamber of Commerce it was unanimously resolved: "That the Council of this Chamber, in view of the repeated warnings of H.M. Consuls, and deeply sensible itself of the injury done to British trade by the delay in the adoption of the metric system of weights and measures by this country, strongly urges the Government and all public bodies to aid in making the system familiar to the public, by making use of it in their various contracts, returns, and reports."

UPON the subject of mosquitoes and malaria, the *British Medical Journal* publishes the following note:—We learn on trustworthy authority that the Italian investigators have once again succeeded in conveying to man malarial infection by means of mosquito bites. The parasite in this instance was the benign tertian; the mosquito employed was the same as that which has already proved an efficient transmitter of the malignant tertian

parasite—namely, *Anopheles claviger*. In this second successful experiment the mosquitoes were brought from a distance from a notoriously malarial spot, and liberated on the subject of the experiment in Rome. The investigators referred to have not yet discovered Ross's "germinal rods" in mosquitoes purposely fed on crescent-containing blood. We hear, however, that they have found these rods in mosquitoes brought from a distance from houses in which there had been malarial fever cases.

MR. W. GARSTANG'S paper on the variation, races, and migrations of the mackerel (*Scomber scomber*), published in the latest number of the *Journal* of the Marine Biological Association, is a valuable contribution to a subject of economic as well as of scientific importance. The investigation was undertaken at the invitation of H.M. Treasury, and its chief object was to discover the relation to one another of the spring and autumn schools of mackerel which regularly visit the Irish coasts. In the spring a multitude of large fish approach the south and west coasts of Ireland to breed. In the autumn, schools of immature, but usually well-grown, mackerel come around the island. These differences are explained by the facts collected by Mr. Garstang; for it appears that the Irish race of mackerel may be subdivided into two distinct stocks.

THE paramount conclusion of the inquiry of Mr. Garstang into the life-history of the mackerel is thus expressed: "The mackerel which frequent British waters are not exactly alike in all localities, but possess certain average peculiarities which distinguish one local race from another. These peculiarities are greatest between the races of localities which are geographically remote, and least between those which occupy areas that are geographically contiguous. Between the mackerel of the North Sea and English Channel there are no differences at all; but the Irish race is distinctly divisible into two stocks, one of which is restricted to the west coast, the other to the south. A considerable amount of mixture takes place between the southern Irish stock and the fish which frequent the mouth of the English Channel. The western Irish stock represents more closely than any other race the primitive type of mackerel, from which all, whether British or American, have been derived." It is pointed out that the establishment of geographical or local races of the mackerel involves the rejection of the theory of long migrations.

AN abstract of a study of the more stable differences of a physical nature which exist between white and negro children of the same sexes and the same ages, is given by Dr. A. Hrdlicka in the *American Anthropologist* (November). It appears that, in a general way, white children present more diversity, negro children more uniformity, in all their normal physical characters. This becomes gradually more marked as age increases. As to physical abnormalities, those of congenital origin are much less frequent in the negro child than in the white one. With acquired abnormalities, principally the result of rachitic conditions, the case is almost the reverse, those characters being less frequent in the white children.

A RECENT number of the *Arbeiten aus dem Kaiserlichen gesundheitsamt* contains a series of reports drawn up by medical officers resident in different parts of German East Africa. These reports are furnished in response to a circular issued by the Colonial Medical Department, containing a list of various subjects upon which it was desired to collect information. Amongst these we find vaccination, the surgical treatment of various wounds, &c., the treatment of mental diseases; whilst special attention is directed to the collection and identification, where possible, of herbs and roots employed for medicinal purposes by the natives. As a result of this circular an immense amount of most valuable and instructive information has been collected, which not only should prove of use, but is also of great interest from an historical point of view, throwing as it does considerable light on the social conditions of these natives. Some curious medical superstitions are recorded, such as the treatment of stings from scorpions by burning the sting of the insect and placing its ashes on the wound; whilst, in the absence of this remedy, salt and snuff are to be rubbed in! The mentally afflicted suffer most from the effect of superstition, however, and have to submit to what can only be described as the most cruel torture to procure the ejection of the evil spirit with which the patient is believed to be possessed. The perpetuation of the race does not seem to be regarded as of much importance, and in the case of one tribe when twins are born, one is always destroyed, usually the last born, except where both sexes are represented, under which circumstance the female is invariably sacrificed. Nothing but praise can be accorded to the enterprising spirit of the German Colonial Department, which is not alone ambitious to extend its dominions, but is equally concerned in obtaining all the information it can about the possessions which it has already acquired.

AMONG the subjects of papers read at the recent conference of the Society for the Protection of Birds, was the decrease in the numbers of swallows and martins coming to this country, by Mr. J. H. Allchin. One of the causes of this decrease is that swallows are netted by the thousand as they came to the shores of Italy in their northward migration, and are eaten as food; they are also caught in great numbers with artificial flies and fish-hooks; all this being contrary to the Italian law and to treaty with the European Powers, which binds Italy not to permit the netting of birds on her shores. As regards destruction of swallows on the southern coast of France, records in official publications testify to the massacre of millions, while on their passage, by means of the net, the fish-hook, and the electric wire. The chief disturbing element in England is the common house sparrow, which persecutes the house martin, ejecting it from its nest, and destroying eggs and young. Mr. Allchin proposed that the Society should present a strong protest to the Governments of Italy and France against the destruction of birds in the course of their annual migrations, and should also petition the Board of Agriculture to send a protest to the aforesaid Governments, on the ground that the destruction of the Hirundinidae and other insectivorous birds was diminishing their numbers to such an extent as to lead to a serious increase of insects injurious to our crops. He further suggested that means should be taken to destroy the eggs (but not the nests) of house sparrows, and that County Councils be petitioned to place all swallows and martins and their eggs on the protected list, and to extend the close season to the full extent of the birds' stay in this country.

DR. TOLLENAAR, writing from Batavia with reference to the alleged momentary increase of temperature in one end of a bar of metal suddenly cooled at the opposite end, calls attention to the fact that the matter was investigated sixty years ago by Schröder in a paper entitled "Kaun die plötzliche Abkühlung eines Theiles einer erwärmten metallische Masse eine plötzliche Temperatursteigung eines anderen Theiles zur Folge haben?" (*Pogg. Ann.*, 46, p. 135.) In our correspondence columns will be found a letter (p. 174), in which it is stated that there is no increase of temperature in the bar when one end is cooled.

DR. G. ERCOLINI contributes to the *Atti dei Lincei* (vii. 8) a note on the variations produced in the dielectric constant of glass by mechanical traction. The experiments, which agree with those of Quincke, serve to verify Lipmann's theory that the dielectric constant of glass increases with traction. The greater the tension the more closely is the increase in the constant proportional to it; at first it falls short of proportionality.

UNDER the somewhat ambitious and comprehensive title, 'On kathodic rays, on Röntgen rays, and on the size and density of atoms," Signor G. Guglielmo discusses in the *Atti dei Lincei*, vii. 8, that much debatable point, the nature of Röntgen rays. The author favours the hypothesis that these rays are due to non-periodic disturbances of the ether; and seeing that the impact of kathodic rays produces in bodies a regular vibration which is fluorescence, Röntgen rays may be due to the ether entrained by the particles of the kathodic rays, and set free when these particles are brought to rest.

In the *Journal* of the Royal Statistical Society (lxi. iii.) Prof. F. Y. Edgeworth is endeavouring to show that the higher theory of probabilities is not restricted to organic nature; but the law of error is fulfilled in social life also, whenever a great number of independent causes act. Remarking that the multifarious motives which sway voters at a contested election may be expected to produce results dispersed about an average according to that normal law, Prof. Edgeworth has obtained tables of the ratio of Unionists to Gladstonians, and Unionists combined in each English constituency for the three last general elections. The grouping of these ratios shows a certain approximation to the normal form. Prof. Edgeworth also discusses the reasons for selecting the above-named ratio as the attribute to be tabulated, and shows that the values of this ratio lie more symmetrically between the mean and the extremes than those of other ratios which might be suggested.

THE report on the Administration of the Meteorological Department of the Government of India in 1897-8 shows that the observatories, 174 in number, remain practically the same as in the previous year. In order to give early information of the advent and progress of the south-west monsoon, a daily telegram was received from the Seychelles Islands from May to July. Actinometric observations have been continued as in the eight previous years, and have been sent to the Solar Physics' Committee in London. The day of the total solar eclipse (January 22 last) was remarkably fine nearly all over India, and 158 observers took part in the observations. These have been tabulated and reduced, and it is proposed to publish them in detail during the ensuing year. A large number of reports of earthquake shocks have been received during past years, and copies have been sent to the Geological Survey Department; in future a brief statement of the earthquakes of each month will be published in the *Monthly Reviews*. The results of the cloud observations taken at various stations, in accordance with the scheme proposed by the International Meteorological Committee, are said to be very interesting and encouraging, and will probably throw much light on the meteorology and more massive air currents in India. The extraction of observations made in ships' logs has been continued at several ports; these are used chiefly in the preparation of daily weather charts of the Indian monsoon area. The collection of accurate information relating to the snowfall in the Himalayan and Afghan mountain areas has been continued, and enabled its probable effect in modifying the distribution of the south-west monsoon rainfall to be determined. The work of issuing storm warnings to the various ports appears to have been carried out very satisfactorily; ample notice was given of all the more important storms which visited the Indian coasts during the year in question. The selection of weather types, to aid in the issue of daily forecasts, has been under consideration, and the preparation of an atlas and handbook, with that object in view, will probably be taken up in due course, as it is considered that there are now sufficient materials in the possession of the Department for the adequate treatment of the subject.

PROF. R. H. THURSTON calls attention in *Science* to some points of scientific interest in the report of the Chief of the Bureau of Steam Engineering upon the engineering work of the navy in the war with Spain. Some work was performed with marvellous despatch. Thus, the old and worn-out "shell-boilers" of the monitors *Manhattan*, *Mahopac* and *Canonicus*, at League Island, were replaced by new constructions in thirty days. The new water-tube boilers were passed in parts through the hatches, and the old boilers were cut in pieces below and passed up in small sections. Water-tube boilers are unqualifiedly approved for naval purposes, and experience with those of the *Marietta*, while accompanying the *Oregon* on the long 14,000-mile voyage around Cape Horn, proves that such boilers are trustworthy when properly made and handled. The steam turbine is referred to, but with the statement that it is not yet certain that it will find permanent place in the naval service. The use of oil-fuels is pronounced promising in some naval work where costs of fuel are not of prime importance. Success is met with in the use of an oil of specific gravity, 0·85 to 0·87, a flash-point of 315° F., and a burning point of 350° F.

THE new volume of "Who's Who" (A. and C. Black) contains several additional features, and more than fifteen hundred new biographies, some of which refer to men of distinction in the scientific world.

A BULKY volume of "Anales de la Oficina Meteorológica Argentina" has just been received from the Director, Señor G. G. Davis. The volume is full of statistics referring to the climates of Asuncion in Paraguay, and Rosario in the Province of Santa Fé.

A NEW part of Prof. G. O. Sars' monograph on the Crustacea of Norway has just been published by the Bergen Museum. The family Oniscidae is concluded, and members of the families Bopyridae and Dajidae are described.

IN a pamphlet entitled "A Record of Study of Aboriginal American Languages," Dr. D. G. Brinton surveys his writings in this branch of linguistics, extending over a period of forty years. The papers are arranged geographically, and sufficient reference to their contents is given to indicate their aims and conclusions.

THE November (supplementary) number of the *Oesterreichische Monatsschrift für den Orient* includes an important report from Shanghai, dealing with sericiculture in China, to which we particularly call the attention of persons commercially interested in the silk trade.

THE last number received of the *Kew Bulletin of Miscellaneous Information* (designated Appendix I, 1899), is entirely occupied by the annual list of seeds of hardy herbaceous plants and of trees and shrubs, which the Department offers in exchange with Colonial, Indian, and foreign botanic gardens, as well as with regular correspondents of Kew.

THE United States National Museum has just published a large paper of nearly two hundred pages, with twenty-two plates, by the indefatigable entomologists, Drs. John B. Smith and Harrison G. Dyar, including a revision of the species of *Acronycta* (Ochsenheimer) and of certain allied genera. With this paper is issued a set of seven coloured plates of moths and larvæ belonging to the same group, which were prepared to illustrate an unfinished paper intended to be issued by the Department of Agriculture.

PART I. of the *Proceedings* of the South London Entomological and Natural History Society for 1898 is chiefly devoted to *Lepidoptera*. The most important paper is one by Mr. J. W. Tutt, on the British *Lasiocampidae*, containing a hypothetical phylogenetic tree of the genera, and another exhibiting the phylogeny of super-families of the Sphingo-Micropterygid

stirps. There are also notes by Mr. R. South, on British *Lepidoptera* occurring in Japan; and by Mr. A. H. Jones, on some South European *Lepidoptera*, with remarks on the genera *Thais* and *Euchloe*. The only paper relating to a different order is by Mr. E. Saunders, on collecting British *Hemiptera*.

THE Royal Society for the Prevention of Cruelty to Animals has sent us the twenty-ninth annual volume of "The Animal World," and a new volume of the "Band of Mercy." Both volumes are profusely illustrated with pictures of animals, and they will assist the educational work of the Society. Children interested in animals or natural history—and what children are not?—would regard either of the volumes as an acceptable present for Christmas or the New Year.

THE twenty-first volume of *Knowledge*, containing the monthly parts published during the current year, has been received. The articles in the volume deal with many scientific subjects, but the most prominent features are astronomy and natural history. The chief contributors are Mr. R. Lydekker, who writes on various zoological matters; Prof. Grenville Cole, who deals with a number of geological structures and problems; Mr. A. Vaughan Jennings, who contributes a series of botanical studies; and Mr. E. W. Maunder, who writes on interesting astronomical objects and events. Numerous illustrations, many of them full-page plates, and including reproductions of several of Dr. Roberts's marvellous photographs, adorn the pages of the volume.

MR. WILLIAM MARRIOTT informs us that on January 2, 1899, the offices of the Royal Meteorological Society will be removed to Princes Mansions, 70 Victoria Street, Westminster, S.W., to which address all communications, on and after that date, should be forwarded.

THE Tidal Survey branch of the Department of Marine and Fisheries of the Dominion of Canada has issued a collection of tide-tables for Halifax, Quebec, and St. John, for the year 1899, with tidal differences for the Atlantic coast of Nova Scotia, and for the St. Lawrence River, from Three Rivers to Gaspe.

PSYCHOLOGISTS and students of the philosophy of science will be interested in the announcement that, under the title of "Truth and Error, or the Science of Intellection," Messrs. Kegan Paul, Trench, Trübner, and Co., Ltd.. will shortly publish a new book by Mr. J. W. Powell, the Director of the United States Bureau of American Ethnology, and sometime Director of the United States Geological Survey.

THE Tuesday evening penny science lectures will be resumed at the Royal Victoria Hall, Waterloo Bridge Road, on January 3, when the Rev. R. H. Whitcombe will discourse on "Science Jottings in Switzerland." On January 10, Mr. R. A. Gregory will lecture on "Astronomy before Telescopes"; and on January 17, Prof. Farmer will lecture on "Plants as Engineers." On January 24, Mr. C. W. Andrews will give an account of his work on "Christmas Island"; and on January 31, Prof. Frank Clowes will lecture on "Old Father Thames."

A NUMBER of forthcoming works on scientific subjects appear in the *Book Circular* (No. 69, Scientific Series), just issued by Messrs. Williams and Norgate. Among the volumes announced we notice the following:—The second volume of Dr. F. Dannemann's "Grundriss einer Geschichte der Naturwissenschaften," entitled "Geschichte der Naturwissenschaften aller Völker und Zeiten."—Prof. Ernest Haeckel's lecture to the Fourth International Zoological Congress at Cambridge will be issued, with notes and tables, under the title "Unsere gegenwärtige Kenntniss vom Ursprung des Menschen."—Another work by Prof. Haeckel, which is announced for publication in January, is "Kunstformen der Natur."—A work by Prof. O. Bütschli, Professor of Zoology at Heidelberg, being a continuation of the same author's "Untersuchungen über microskopische Schäume," of which an English translation has been issued.—The second part of the second volume of Dr. Paul Knuth's "Handbuch der Blüten biologie," containing Lobeliaceæ to Coniferæ.—M. Riban, of the University of Paris, has prepared a "Traité d'analyse chimique quantitative par l'Electrolyse."—"La photographie animée," by E. Trutat, Director of the Natural History Museum of Toulouse.—A work by Prof. Lebon, of the Lycée Charlemagne, Paris, entitled "L'Histoire abrégée de l'Astronomie."—A volume by M. E. Bouty, Professeur de la Faculté des Sciences, on "Electricité à ondes Herziennes. Rayons X."

THE additions to the Zoological Society's Gardens during the past week include two Red-bellied Squirrels (*Sciurus variegatus*) from Trinidad, presented by Master Lawrence; a Palm Squirrel (*Sciurus palmarum*) from India, presented by Dr. G. Lindsay Johnson; a Pluto Monkey (*Cercopithecus leucampyx*, ♂) from Congoland, deposited; a Nutcracker (*Nucifraga caryocatactes*), a Common Sheldrake (*Tadorna cornuta*) European, purchased.

OUR ASTRONOMICAL COLUMN.

A TOTAL ECLIPSE OF THE MOON.—On Tuesday next (December 27) the moon will pass entirely into the shadow of the earth, and be totally eclipsed. The following are some of the particulars which may be useful to those who wish to observe this phenomenon, but fuller information, together with a list of stars to be occulted, will be found in the *Nautical Almanac* and the *Companion to the Observatory*.

	h.	m.	
First contact with the penumbra, Dec. 27,	8	26·5	G.M.T.
,, ,, shadow ...	9	39·4	
Beginning of total phase ...	10	49·0	
Middle of the eclipse	11	33·7	
End of total phase	12	18·4	
Last contact with the shadow ...	13	28·0	
,, ,, penumbra	14	40·9	

The moon meets the shadow at a point on her limb which is 112° from her north point towards the eastern side, and passes out at a point 95° towards the west.

The magnitude of the eclipse is represented as 1·383, the unit representing the case when conditions are such that the moon is only just able to be totally immersed for an instant.

COMET CHASE.—This comet, which is gradually brightening, is situated in the constellation of Leo Minor, and lies slightly to the north of the 6th magnitude star 50 in Leo Minor. The following is the ephemeris to the end of the present month.

1898.	R.A. (app.)	Decl. (app.)	Br.
	h. m. s.	° ′	
Dec. 22 ...	10 55 11 ...	+26 59·8 ...	1·39
24 ...	56 44 ...	27 19·0 ...	,,
26 ...	58 11 ...	27 38·8 ...	,,
28 ...	10 59 31 ...	27 59·0 ...	,,
30 ...	11 0 43 ...	+28 19·7 ...	1·39

COMETS *i* 1898 AND 1881 IV.—Writing in the *Astronomical Journal* (Nos. 448–450), Dr. Perrine, of the Lick Observatory, points out a distinct relationship between the comet *i* 1898 and 1881 IV. The similarity of the orbits is strikingly seen from the following comparison of the orbits:—

Comet.	ω	Ω	*q*
	° ′	° ′	
i 1898 ...	... 122 8 ...	97 17 ...	140 14 ... 0·6335
1881 IV....	... 123 22 ...	96 10 ...	140 19 ... 0·7564

Dr. Perrine states that although it is not possible for Brooks's comet to be a return of Schaeberle's, yet the resemblance is so close that a strong family connection is indicated. If we may be permitted to make a suggestion, might not there be two comets pursuing the same path? Just as comets are thinned out by their component parts lagging behind and following, so

to speak, in their wake, may not the first comet have undergone considerable perturbations and internal action, causing the original assembly of particles to separate into two or, perhaps, more portions? We should thus have two comets pursuing the same path, but passing perihelion at different times.

EPHEMERIS OF PLANET 1898 DQ.—We give below an ephemeris for Witt's planet for the remainder of this month. The planet is of the 12th magnitude, and will be found in the constellation of Aquarius, a little to the north of the stars η and ζ Aquarii.

1898.	R.A. (app.) h. m. s.	Dec. (App.) ° ′
Dec. 21 ...	22 26 11 ...	+1 31·8
23 ...	30 35 ...	1 54·2
25 ...	35 2 ...	2 17·0
27 ...	39 32 ...	2 40·3
29 ...	44 5 ...	3 4·0
31 ...	22 48 40 ...	+3 28·2

THE COMPANION TO THE OBSERVATORY FOR 1899.—This handy little *vade-mecum*, which contains in a condensed form the more useful data that are of more general interest in observational astronomy, has just been issued. As the introduction states, "the present 'Companion' closely resembles that of last year," and a brief perusal of its contents does not lead us to state otherwise. Mr. Denning, as usual, is responsible for the meteor notes, and Mr. Maw has supplied numerous observations of double stars. The variable-star ephemerides have been obtained from M. Loewy's "advance-proofs," and Mr. Crommelin has communicated the list of stars which will be occulted by the moon during the lunar eclipse of December 16.

THE SOLAR DISC DURING 1897.—The solar observatories at Dehra Dun, Mauritius, and Greenwich, give us between them pictures of the disc of the sun 364 days out of the 365 in the year. We have thus practically a daily record of the spots that appear on the solar disc that is absolutely unique in astronomical photography. As we are approaching, as far as we know, a period of minimum sunspots, which, in other words, means a more quiescent state of the solar atmosphere, spots are getting less numerous, and their latitudes are becoming lower. A general summary of an examination of such photographs, as mentioned above, for the year 1897 (*Monthly Notices*, *R.A.S.*, vol. lix. No. 1), shows that there has been a slight decrease in the daily spotted area as compared with the preceding year, the rapidity of the decline which set in after 1893 having now received a check; the decrease in faculæ has been quite considerable. The most noticeable feature has been the reduction of the mean distance of the spots from the equator. For the four preceding years the distance was 14°, but for 1897 it was not quite 8°. In both hemispheres the decline in latitude has been irregular. In the northern hemisphere the decline was very great for the first six months of the year, and was accompanied with a great decrease in spots. A secondary revival and subsequent decline and revival terminated during the year. A similar but less pronounced movement occurred in the southern hemisphere. The observations of the sun during the current year have shown that the spotted area has begun somewhat to increase again; but whether this is an indication that the minimum is now passed, or that only a temporary revival is taking place, cannot be definitely stated.

THE MELBOURNE OBSERVATORY.—The thirty-second report of the Board of Visitors to the observatory, together with the report of the Government astronomer, Mr. P. Baracchi, for the period included between July 1, 1897, and June 30 of the present year, show that the observatory is in good working order. With regard to the position of Mr. Baracchi, the Board says: "We regret to find that the Acting Astronomer still occupies the anomalous position he has occupied since he has had charge of the Observatory; his salary being that which he enjoyed prior to the retirement of Mr Ellery, and we venture to hope that the Government will soon be able to appoint Mr. Baracchi to the full position of Government Astronomer, with the emolument fixed thereto under the Public Service Act." Mr. Baracchi's report shows that the observatory has been very busy during the past year. The appointment of a new assistant has led to a slight change in the distribution of the work, which has proved advantageous. The meridian work and reduction has been extensive, and the usual time and meteorological service continued. Considerable progress has been made with the astro-photographic work, the catalogue plates being now complete and the chart plates numbering 278. By an arrangement with Mr. H. C. Russell, the Government Astronomer of New South Wales, Mr. Baracchi has decided to have all the work of measuring and reducing the plates of the photographic catalogue of the two zones done at the Melbourne Observatory, the two Colonies sharing the expense. The proposal that four young assistants, directed by one of the officers of the Melbourne Observatory, should be employed on this work, has already been sanctioned, and the work will be commenced as soon as the appointments have been made. The Victorian Government has placed on the estimates for the current financial year a sum of money for dealing with the observations in terrestrial magnetism at the Melbourne Observatory for the past thirty years. A discussion of such a fine series of observations should be of great value.

THE RELATION OF THE TOXIN AND ANTI-TOXIN OF SNAKE VENOM.

EARLY in the present year a paper on this subject, by Drs. C. J Martin and Cherry, appeared in the *Proceedings* of the Royal Society (vol. lxiii. p. 420). A short summary of their experiments and conclusions was given in these columns. A supplementary paper has just been published by Dr. Martin (*Proc. Roy. Soc.*, vol. lxiv. 88), in which further experiments on this most important subject are detailed. They confirm the conclusions previously arrived at, that the antagonism between the toxins and anti-toxins is a directly chemical one, and is not, as Calmette and others state, due to an interaction solely produced by the agency of the cells of the organism into which these substances enter.

The present experiments were performed with the snake venom derived from the Australian tiger-snake (*Hoplocephalus curtus*); the anti-venene employed was prepared by Dr. Calmette; and rabbits were selected as the subjects of the experiments. The results obtained are not only of practical importance in the treatment of snake-poisoning, but are of special interest, as they bear on the relations of toxins and anti-toxins in general. In snake venom and its antidote we possess substances of which the chemical nature is fairly well understood. A knowledge of their action (which must be regarded as typical of the whole class of toxins and anti-toxins) furnishes the key to the unlocking of the problem in diphtheria and other diseases, where the chemical investigation of the actual agents is a much more difficult matter, since they are diluted and obscured by the other constituents of the blood and body juices.

Dr. Martin finds that about the same quantity of anti-venene necessary to neutralise the venom *in vitro*, is capable of doing so also when the former is injected into the blood-stream, and the latter subcutaneously. Solutions of the two substances can be titrated against each other just like standard solutions with the life of a rabbit as an indicator. If anti-venene is introduced into the blood-stream, it is there ready to neutralise the toxin as it is absorbed from the subcutaneous tissues, and the amount found necessary by titration outside the body is just about adequate to neutralise the toxin as it makes its appearance in the blood. To be quite exact, a slighter proportion of anti-toxin is necessary under these circumstances, and this result is no doubt due to delayed chemical action owing to the dilution of the anti-toxin in the blood.

When, however, both venom and anti-venene are introduced into the body subcutaneously, Martin finds, as Fraser originally stated, that at least ten to twenty times the quantity of anti-venene must be used to neutralise the toxin. This apparent contradiction of the results first given is really a confirmation of the views of Martin and Cherry. In the first place, it necessitates the inference that anti-toxin is comparatively slowly absorbed from the subcutaneous tissues. Calmette has stated that the exact contrary is the case, but adduces no experimental proofs of his statement. Brodie's (*Journ. of Pathol.*, 1897) work with the toxin and anti-toxin of diphtheria entirely confirms Martin's experiments with tiger-snake venom.

Our chemical knowledge of toxins and anti-toxins, together with what is known of the physiological mechanism of absorption, is quite in accordance with the view that anti-toxin is only capable of slowly penetrating the capillary wall, whereas the toxin passes through fairly rapidly. The toxins, both in the case of snake poison and diphtheria, are albumoses; they dialyse

slowly in dialysers constructed of vegetable parchment; they can be filtered through a gelatin film under pressure; but experiments show they are rapidly absorbed by the blood-vessels. In other words, though their molecules are large, they are not so large as those of the native proteids.

The walls of the capillaries are membranes possessed of permeabilities approximating those of a film of gelatin, and are relatively, although not absolutely, impermeable to proteids (Starling, *Journ. of Physiol.*, vol. xix. p. 311). If molecular size is the obstacle to proteid absorption from subcutaneous spaces, the same would apply to anti-toxins, for these are substances of great molecular size comparable to proteids.

The practical indication of this in the treatment of snake-bite is to inject the anti-venene intravenously, until the potency of the anti-venomous serum which is at the disposal of the public is greatly enhanced. W. D. H.

REMARKABLE EFFECT OF THE INDIAN EARTHQUAKE OF JUNE 12, 1897.

A REMARKABLE example of the effect of the Indian earthquake of June 12, 1897, upon railway lines is illustrated by a brilliant photo-etching in the general report of the operations of the Survey of India during the years 1896-97, prepared under the general direction of Major-General C. Strahan, R.E., and recently distributed. The picture (Fig. 1), which represents the Manshai Bridge, Cooch Behar State Railway, after the earthquake referred to, is here reproduced in a reduced form.

This earthquake continues to be the theme of discussion by seismologists. One of the most important papers yet published is that by Dr. Agamennone in the last *Bollettino* (vol. iv., No. 3) of the Italian Seismological Society, of which the following is a summary. At Rome, the early short-period vibrations were first recorded at 11.17 a.m. (G.M.T.), and these lasted until about 11.40, when the long-period pulsations commenced, reaching a maximum at about 11.47½. During the first interval there were five distinct maxima, all of which can be identified with those on the records from other observatories. After 11.47½ these records fail to show marked features in common, and the movement dies away more or less slowly according to the sensitiveness of the instrument employed. At Calcutta, the duration of the earthquake is variously estimated at from four to ten minutes, and at Shillong, which is close to the epicentre, at two minutes. In Europe, the duration of the disturbance, according to magnetograph records, was about half an hour at St. Petersburg, 1¼ hours at Wilhelmshaven, and 2¼ hours at Utrecht; and, according to those of different Italian seismometrographs, 1½ hours at Verona, 1¾ hours at Rome, 3 hours at Catania, and 3¼ hours at Padua. At Rome, the period of the earliest vibrations was half a second, but this gradually increased to 3·3 seconds after about 15 minutes. The pulsations which followed had a period of 11 and 10 seconds, in the records of pendulums 16 and 8 metres long, respectively, decreasing to about 8 seconds in both; and it is interesting to notice how closely the different instruments at other observatories agree in this respect. The measures of the maximum tilt of the ground during the passage of the pulsations are less concordant, but the mean of eight good observations in Italy is 12″·4, a value which agrees fairly well with that of 10″ obtained by means of the bifilar pendulum at Edinburgh. Unfortunately, for the calculations of the velocity, the recorded times at Calcutta differ by 2½ minutes, being 11.4½ (La Touche) and 11.7 (Oldham). Dr. Agamennone quotes nineteen European records of the time of the first disturbance, and the five best give a mean velocity of 9 or 11 km. per second, according to the time adopted for Calcutta. For the long-period pulsations, the corresponding estimates are 2·6 and 2·8 km. per second, *i.e.* about one-quarter of the above. Lastly, taking the period of the pulsations at 10 seconds, the velocity at 2·7 km. per second, and the maximum tilt of the ground at 12″, Dr. Agamennone finds the length of a complete pulsation, as it traversed Italy, to be 54 km., and the height of its crest (or amplitude) about half a metre.

FIG. 1.

BRITISH ASSOCIATION.

CONFERENCE OF THE DELEGATES OF THE CORRESPONDING SOCIETIES.

THE first meeting of the Conference was held at University College, Bristol, on Thursday, September 8, at 3 p.m. The Corresponding Societies' Committee were represented by Mr. W. Whitaker (Chairman), Dr. Garson, Mr. Hopkinson, Prof. Meldola, Mr. G. J. Symons, and Mr. T. V. Holmes (Secretary).

A short report, which was in the hands of every delegate present, contained the following paragraph:—

The Committee observe with satisfaction that the corresponding societies steadily increase in number, and that the total number of the members composing them also increases. For example, in the British Association Report of the Bath meeting in 1888 there is a list of fifty-five corresponding societies, having a total of 18,950 members. The Toronto Report of last year shows sixty-nine corresponding societies, having a total of 22,395 members. On the other hand, the average number of members in each society appears to have slightly decreased, having been between 344 and 345 in 1888, and between 324 and 325 in 1897. But this is accounted for by the collapse of the two federations—the Midland Union and the Cumberland and Westmoreland Association—and the withdrawal of the Royal Scottish Geographical Society between the two periods. For in 1888 these three associations numbered among them 4006 members, as many as would be found in eleven or twelve average societies.

The Committee, while regretting the absence of certain societies whose headquarters are not in London from the list of corresponding societies, add:—Fortunately, in most cases,

information as to the titles and authors of papers read before local societies not corresponding societies of the British Association may be obtained from the "Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland" (C. Griffin and Co., London). The "Year-book" appears every spring, and contains lists of papers read in the previous year. It will be found that the "Year-book" and the British Association "Index" combined leave little to be desired by the inquirer after papers on any locality in the British Isles.

The following societies have been added to the list of the corresponding societies:—The Hull Geological Society, the South-Eastern Union of Naturalists' Societies, and the Astronomical and Physical Society of Toronto.

Mr. Whitaker opened the proceedings by introducing the subject of coast erosion. He remarked on the much greater ease and accuracy with which measurements of the amount of loss could be made now that maps on the scale of 6 inches to the mile were obtainable for all parts of the country. He instanced Sheppey as a good example of a place at which loss by coast erosion had been unusually rapid. On the first visit of the Geologists' Association there, the church and churchyard of Warden were untouched; on a later occasion the churchyard was found to have been injured, and coffins were sticking out from the edge of the cliff. That year they had found neither churchyard nor church. They had also seen, during the visit last Whitsuntide of the Geologists' Association to Aldeburgh in Suffolk, an example of another kind of marine encroachment. There they found cottages, sheds and gardens more or less injured or destroyed by the heaping-up of masses of shingle in or against them, the result of a storm in November 1897. The driving inland of blown sand also caused much injury to land on the coast in certain localities. As to the economical aspect of the question, there were certainly many places from which the removal of shingle from the shore should never be allowed. Indeed it should nowhere be allowed without careful consideration as to the probable result. And the quarrying of stone on the face of a sea-cliff should seldom, if ever, be permitted.

Mr. W. H. Wheeler thought that the movement of shingle along our shores was due to the action of the tides, not of the winds. Mr. A. T. Walmisley had always advocated the protection of the shore by groynes. Sea walls should be placed a short distance in front of the cliff to be protected. Mr. Vaughan Cornish said that the protection of one part of the shore was a bad thing for the rest of the district. He thought that no local shore protection should be allowed unless sanctioned by a Government Board. In any study of the effects of coast erosion the coast-guard, if the Admiralty gave their consent, would be able to render most valuable assistance. Mr. Wheeler thought the retention of a mass of shingle in front of a place a better protection than a sea wall. He would greatly approve of an attempt to obtain the services of the coast-guard in noting coast erosion, as at present he had found it very difficult to get trustworthy evidence. Prof. Meldola moved the following resolution:—"That the Council of the British Association be requested to bring under the notice of the Admiralty the importance of securing systematic observations upon the erosion of the sea coasts of the United Kingdom, and that the co-operation of the coast-guard might be profitably secured for this purpose." After some discussion the resolution was seconded by Mr. Gray, and carried.

Prof. Meldola read a letter from Prof. W. W. Watts, stating that the Geological Photographs Committee had formed a collection of duplicate photographs and lantern slides, consisting of about 250 prints and 100 lantern slides, which could be sent during the winter to any local scientific society wishing to make use of them.

SECOND MEETING OF THE CONFERENCE, SEPTEMBER 13.

The Corresponding Societies Committee were represented by Mr. Whitaker, Dr. Garson, Rev. J. O. Bevan, Mr. Hopkinson, Mr. Symons, and Mr. T. V. Holmes (Secretary).

The Chairman (Mr. Whitaker) announced that the resolution on coast erosion, passed at their last meeting, had been submitted to the Geological and Geographieal Sections, both of which had unanimously supported the recommendations contained in it. It would now be forwarded to the Council.

Prof. Silvanus Thompson had been asked to bring before the Conference the importance of adopting one or two uniform standard sizes for the pages of scientific publications. All engaged in scientific investigation were greatly indebted to their fellow workers for reprinted papers, and all recognised the advantage given by uniformity of size in allowing these papers to be bound together. The great advantages of uniformity in size had caused the formation of a British Association Committee some four years ago, whose object was to prescribe the adoption of certain standard octavo and quarto sizes. The report of this Committee would be found in the Ipswich Report (1895), p. 77. The standard octavo size there recommended was—

Paper demy, pages measuring when uncut $5\frac{5}{8}$ inches by $8\frac{3}{4}$ inches. The width, measured from the stitching to the edge of the printed matter, to be $4\frac{5}{8}$ inches, and the height of the printed portion, including the running head-line, to be 7 inches.

The standard quarto size. Paper demy, the pages measuring when uncut $8\frac{3}{4}$ inches wide by 11 inches high. Letterpress not to exceed the measurements of $7\frac{1}{2}$ inches by 9 inches. It was also desirable that each article should begin a page, and, if practicable, the right-hand page. It can then be bound with other articles without the last page of a preceding article being bound up with it. Many other details would be found in the Report of the Committee, with illustrations.

Prof. Meldola said that a glance at the shelves at Burlington House, on which the publications of the corresponding societies were collected, showed a considerable amount of diversity in size. Some societies also did themselves injustice as regards paper and printing. Mr. Hopkinson thought that the chief offenders were societies which, from want of sufficient funds, published reprints from local newspapers.

Section A.

Mr. G. J. Symons said that Prof. Milne was making important observations on earthquake tremors in an unsatisfactory house in the Isle of Wight. It had been suggested that there were houses in Richmond Park suitable for the purpose, and that it might be well to approach the Government and try to obtain one for him. Or perhaps some rich man might lend Prof. Milne a house for a few years.

Section C.

Mr. Beeby Thompson said that a fine specimen of a Dinosaur had recently been discovered near Northampton. It would, however, be a very expensive work to uncover it carefully, and he wished either to obtain a grant from the British Association for that purpose, or to induce any rich people who might hear of the case to assist in providing funds.

The Chairman thought that the matter should be brought before the scientific societies of Northampton.

Section H.

The Chairman directed the attention of the Conference to the Ethnographical Survey, an investigation in which few local societies were co-operating.

Mr. Hartland, Secretary of the Ethnographical Survey Committee, said that it would greatly help his Committee if each of the corresponding societies would take up one or more branches of the inquiry. He had explained at previous Conferences that it was by no means necessary that all branches should be taken up everywhere. He would be happy to send to all the corresponding societies all the information they might require for the purpose of carrying on the work.

The Chairman hoped that the delegates would give some account to their respective societies of the discussions which had taken place at the Conference.

The proceedings then terminated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. RÖNTGEN has decided not to accept the call to the University of Leipzig as the successor of Prof. Wiedermann, who has retired, at the age of seventy-two.

IT is announced that the Queen has conferred a knighthood on Mr. W. C. McDonald, who provided the funds for the chemistry wing to the McGill University, Montreal, which was opened on Tuesday, and has made other generous gifts to the University.

THE appointment of the Rev. T. W. Sharpe, C.B., to the Principalship of Queen's College, London, should have a decided influence upon the work of the College. Mr. Sharpe has just retired from the post of senior chief inspector and head of the administrative division of the Education Department, so he takes with him to Queen's College a wide knowledge of the principles and practice of teaching.

A USEFUL list of the current scientific serials received in Manchester, with an indication of the various libraries in which they are to be found, has been compiled, under the direction of Dr. W. E. Hoyle, by Mr. C. W. E. Leigh, and published by the Manchester Literary and Philosophical Society. The periodicals are arranged geographically, according to their place of publication. The list will doubtless prove of great service to workers in Manchester and the neighbourhood, and thus assist in the progress of science. It is believed to be the first of the kind published in England; but it is to be hoped that similar lists will be published for the use of students of science in other great cities.

SIR PHILIP MAGNUS distributed the prizes at Sexey's Trade School, Bruton, Somerset, on December 17. Alluding to prospective legislation in the direction of secondary education, he said that the County Education authorities had done their work well, and trusted there would be no rivalry between them and School Board authorities, as it would involve a risk of setting back the educational clock for many years. He pointed out the advantage of teaching a boy the manipulation of a balance and the use of tools, and attached great importance to the study of English literature. He was glad to find the school providing satisfactory scientific education in a rural district, thus embodying ideas which he had been advocating for twenty years.

IN the course of an address to the members of the Yorkshire Naturalist Union at Scarborough, on Saturday, Prof. Michael Foster, the retiring President of the Union, urged upon his hearers the great necessity of co-operation in science. All the earlier naturalists, he said, sought to solve the problems which every form of life possessed. Nature was the naturalist's teacher, and the field his laboratory. It was useless to try to stop the tide of differentiation that seemed to be creeping over the scientific world. That must go on. Still, they must look for help to go forward, not backward. Prof. Foster criticised the method of teaching science in the schools, and condemned the examinations often held as prejudicial to the development of science. The minds of students were very often pushed on by compulsion and drawn on by rewards, and no encouragement was given to them to look at nature in the fields and receive from her lips the catholic teaching which she alone could give. Such naturalists as they hoped to rear must be reared apart from the schools.

THE following gifts to educational institutions in the United States are announced in *Science*:—The Lawrence Scientific School, Harvard University, has received 10,000 dollars from Mr. J. H. Jennings, for the establishment of a scholarship.—Mr. James Stillman, of New York, has given 50,000 dollars to Harvard College to cover the cost of land and buildings for a projected Harvard Infirmary, which will bear the name of the donor. In addition, Mr. Stillman will contribute 2500 dollars annually for four years.—The will of the late Charles P. Wilder, of Wellesley Hills, bequeaths 102,000 dollars to Mount Holyoke College, and the trustees of Wellesley College announce a gift of 50,000 dollars made by Mr. Wilder before his death. No conditions are attached to the gift.—The Catholic University of Washington has received the information that by the will of Daniel T. Leahy, of Brooklyn, it receives 10,000 dollars.—The University of Cincinnati has been presented by Mr. William A. Proctor with the library of Mr. Robert Clarke, containing 6704 volumes valued at over 50,000 dollars.—A fund of 100,000 dollars is being raised by the trustees and friends of Oberlin, the income from which is to be applied to the reduction of the term bills of needy students. About one-tenth of this amount has already been collected.

THE system of payment by results of examinations, which the Intermediate Education Board for Ireland still uses in distributing its annual income of about 80,000*l.*, is made the subject of criticism by Dr. Gerald Molloy in an article reprinted from the *Irish Ecclesiastical Review*, and suggestions are made as to a general policy of reform. The following statement of facts from the article points unmistakably to the need for the reform which must soon take place:—In a memorial addressed to the Lord Lieutenant of Ireland last June, the Council of the Royal Dublin Society called attention to the way in which the teaching of science, in the intermediate schools, has been "practically exterminated" by the operation of the present system. From this paper it appears that the total number of boys that presented themselves for the examinations of the Intermediate Education Board, in the years 1887 and 1888, and the numbers that presented themselves in the subjects of natural philosophy and chemistry were as follows:—

	Total number	Nat. Philosophy	Chemistry
1887 ...	4613	... 2611	... 1376
1888 ...	4551	... 2565	... 1357

But, after the lapse of ten years, it is found that while the total number of boys presented for examination had considerably increased, the number presented in these two subjects had dwindled down almost to insignificance. The figures are:—

	Total number	Nat. Philosophy	Chemistry
1896 ...	6503	... 618	... 359
1897 ...	6661	... 596	... 312

It would seem, therefore, that something has occurred in the working of the system, during the last ten years, which has practically killed the teaching of these two important subjects in the intermediate schools of Ireland. The teaching of natural philosophy has fallen from 56 per cent. of the total number of boys presented for examination to somewhere about 9·2 per cent., and the teaching of chemistry has fallen from 30 per cent. to 4·6 per cent.

SCIENTIFIC SERIALS.

American Journal of Science, November.—Irregular reflection, by C. C. Hutchins. A carefully prepared surface of plaster of Paris, and a deposit of magnesia upon zinc, approximate very closely to Lambert's law of diffused reflection. A plaster disc cut into fine vertical furrows shows a considerable departure from the cosine law. A sphere prepared by coating an ivory ball in the flame of burning magnesium follows Lambert's equation very closely. The reflection measured is that of the total energy, observed with a thermograph and galvanometer.—Separation of nickel and cobalt by hydrochloric acid, by F. S. Havens. Pinerua's process for separating nickel and cobalt, which is analogous to the author's method of separating aluminium and iron, will not give a complete precipitation of the nickel chloride. Nickel chloride is, however, practically insoluble in pure ether saturated with HCl gas, and can be separated from small quantities of the soluble cobalt salt in that medium.—The value of type specimens and the importance of their preservation, by O. C. Marsh. The origin of mammals, by the same author. These two papers were read before the Cambridge International Zoological Congress, in August last.—Causes of variation in the composition of igneous rocks, by T. L. Walker. The author reviews briefly the more common theories advanced to explain the phenomena of variation in the composition of igneous rocks from border to centre or from top to bottom, and calls attention to the part which gravitation seems to play in causing heterogeneity in eruptive rocks. Some homogeneous salt solutions, if allowed to remain at a constant temperature for a long time, become gradually more concentrated in the lower strata. It is very probable that similar concentration occurs in complex silicate magmas, particularly near the temperature of solidification. An eruptive magma would therefore tend to become acid above and basic below. In the upper horizons of the eruption there would be a gradual increase of acidity towards the centre, since the outer and more quickly cooling portion would have no time to become differentiated by gravitation. The lower portions would show an increased basicity towards the centre. This is all in accordance with observed facts.—The relation between structural and magneto-optic rotation, by A. W. Wright and D. A. Kreider. Experiments on the crystallisation of various substances in a magnetic field show no indisputable evidence of the influence of the field upon optically active structure. In the case of sodium chlorate, there seems to be a preponderance of optically active crystals when deposited in a magnetic field, but these are right-handed or left-handed in about equal proportions.

Wiedemann's Annalen der Physik und Chemie, No. 11.—Electric dispersion in organic acids, esters, and glass, by K. F. Löwe. Drude's rule, that anomalous electric dispersion is always

accompanied by anomalous absorption, receives a negative confirmation in the esters of the fatty acids and benzoic acid, which show neither. Other esters and alcohols show a rough approximation to Drude's formula. In the glasses, the relation between absorption and dispersion is undefined.—Limits of the solid state, by G. Tammann. Ostwald considers it possible that the transition from the liquid to the crystallised state takes place continuously along a Thomson-van-der-Waals isothermal. The author shows that this assumption implies the possibility of four volumes at the same pressure, and that the liquid isothermals may be followed up beyond the point of intersection with the crystal isothermals. This eliminates what Ostwald calls the meta-stable phase of crystallisation.—Contact electricity between metals and liquids, by A. Heydweiller. The author introduced minutely sub-divided metals into a narrow tube containing an electrolyte, and passed a current through the latter. Any contact electrification was then indicated by motion of the particles. He thus tested Coehn's rule, according to which bodies with a higher dielectric constant are positively charged by contact with bodies of a lower dielectric constant. Platinum, gold, tin, and other metals, immersed in various mixtures of water, chloroform, and acetone, show an agreement with Coehn's rule, but not when immersed in alcohol.—Use of a vacuum tube for thermal insulation, by A. Weinhold. In connection with d'Arsonval's claim of having employed the principle of Dewar's double bottle in 1887, the author mentions that he described the same apparatus as long ago as 1881, in the first edition of his "Physikalische Demonstrationen."

THE current number of the *Izvestia* of the East Siberian branch of the Russian Geographical Society contains several valuable papers.—M. Prein gives a list of 424 phanerogam plants collected in the west of the northern parts of Lake Baikal, and his list contains several species which are new for this interesting region.—A paper by S. V. Yastremski, on the ancient beliefs of the Yakutes (who belong to the Turkish stem), not only shows that their religion has a good deal in common with the religion of the Mongols, but also reveals traces of a worship of good-willing deities, which worship was practised by so-called "*white shamans*" (the *shaman* is the witch-priest). Traces of this worship, which has been intermingled in recent times with Christianity, are now found in epical poetry and popular songs only, but "white shamans" were known to exist not further than ten years ago. At the present time the "black shamans," or worshippers and conjurers of the bad-willing deities only, are retained.—M. S. Peretolchin gives an account of his ascent of the Munku-Sardyk peak in the Sayans, and describes a small glacier on its southern slope, surrounded by old moraines testifying to its former greater extension. Phanerogams were found up to an altitude of 10,230 feet.—N. A. Witaszewski gives interesting copies of inscriptions on the crags of the Olekma.—All papers are summed p in German.

IN the *Journal of Botany* for November and December, Col. H. W. Feilden continues and concludes his list of the "Flowering Plants of Novaya Zemlya," &c., 195 species in all, besides four Vascular Cryptogams.—Mr. E. S. Salmon describes and figures a moss new to the British flora, *Catharinea tenella*, lately found in Kent.—Messrs. H. and J. Groves describe and figure another very interesting addition to the British Cryptogamic flora, *Nitella hyalina*, discovered in Cornwall, one of the most beautiful of the Characeæ, distinguished from other species of the genus by the presence of secondary branchlets.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—"On the Condensation Nuclei produced in Gases by the Action of Röntgen Rays, Uranium Rays, Ultra-violet Light, and other Agents." By C. T. R. Wilson.

By means of expansion experiments the degree of supersaturation necessary to cause water to condense on nuclei from various sources was determined. The nuclei produced in air or hydrogen by Röntgen rays or Uranium rays, or by the discharge of electricity from a pointed platinum wire, or by the escape of negative electricity from a zinc plate exposed to ultra-violet light, all require the same expansion ($v_2/v_1 = 1{\cdot}25$, corresponding to a fourfold supersaturation) in order that water may condense on them. In moist air or oxygen exposed to ultra-violet light, nuclei are produced throughout the volume of the gas exposed to the rays; when the radiation is weak, these require as great a degree of supersaturation as the various nuclei above mentioned in order that water may condense on them; but with stronger radiation they appear to grow, and the expansion required to make water condense on them then depends on the intensity of the ultra-violet light, and on the time for which the gas has been exposed to the rays before expansion. With very strong ultra-violet light the growth of the nuclei continues even in unsaturated air till they become visible as a fog. Sunlight produces in air nuclei resembling those produced by weak ultra-violet light. Certain metals in contact with moist air produce nuclei always requiring great supersaturation in order that water may condense on them. This effect is most strongly exhibited by amalgamated zinc, with which comparatively dense fogs may be obtained on expansion.

It was found that the nuclei produced by X-rays or Uranium rays may readily be removed by applying an electric field, showing that the nuclei are identical with the ions to which the conducting power of the gas when exposed to the rays is due. Similar experiments with the nuclei produced by the action of ultra-violet light on moist air, and with those resulting from the presence of metals, showed that such nuclei do not move in an electric field. This is in agreement with the absence of conducting power.

Royal Microscopical Society, November 16.—Mr. E. M. Nelson, President, in the chair.—The President read a paper describing a very large and elaborate binocular microscope possessing many original features; it was designed and made some years ago by a friend. The description was illustrated by an excellent photograph of the instrument shown upon the screen.—Mr. Beck exhibited two slides of *Amphipleura pellucida*, mounted by Prof. Hamilton Smith in his high refractive medium; they were shown under $\frac{1}{12}$ achromatic oil immersion objectives of N.A. 1·0, and 1·25, the diatoms under the former showing re-solution very fairly, bur those under the latter were re-solved most satisfactorily.—Mr. Michael called attention to the slides of diatoms mounted in high refractive media, which Mr. Curties had brought for exhibition.—Dr. Hebb said there was a paper contributed by Mr. A. W. Waters, "on Bryozoa from Madeira," of which he gave a short *résumé*. Mr. Michael remarked that a systematic paper such as this would prove of considerable value to those who were studying the subject. Mr. Waters was at the present moment the best English authority on the Bryozoa, and their knowledge of these organisms had been systematised and made available largely by his contributions to the subject and by his skill as a draughtsman.

Mathematical Society, December 8.—Lieut.-Colonel Cunningham, R.E., Vice-President, in the chair.—Major Macmahon, R.A., F.R.S., communicated a discovery he had recently made in the theory of compound partitions.—Mr. J. E. Campbell read a paper on simultaneous partial differential equations.—The following papers were communicated in abstract: On hyperplane coordinates, by W. H. Young.—On a theorem allied to Laplace's, by Prof. W. H. Metzler.—Two problems of wave propagation at the surface of an elastic solid, by T. J. Bromwich. The two problems deal with the velocity of propagation of waves in hypothetical elastic solids. An attempt is made to find causes for the discrepancy between the observed velocities of earthquakes and those calculated by theory. The first case considered is that of a thin elastic shell (this case appears to have been solved by Lord Rayleigh, but it has not apparently been thought worthy of publication by him). The author finds that, with the elastic constants given by Prof. Milne as representing the nature of rocks at the surface of the earth, the deduced velocity has a value agreeing much more nearly with observed velocities than the velocity deduced from Lord Rayleigh's paper in the *Proceedings* (vol. xvii.). The second problem solves the hypothetical case of a thin skin fastened to the surface of a solid, the elastic constants of the two materials being supposed different. As might be expected the effect of the skin is not large, and the result only indicates that it is necessary to know the elastic constants at a depth comparable with a wave-length, before we can get a satisfactory comparison between theory and observation. Also by the same author, the influence of gravity on waves in an elastic solid, with especial

reference to the earth. The paper contains solutions of three problems which are concerned with the effect of gravity on the velocity of propagation of elastic waves in the earth. The first and second are based on a paper of Lord Rayleigh's (*Proceedings*, vol. xvii.). They show that when the wave-length is short enough for us to consider the earth as bounded by an infinite plane, the effect of gravity must be small. The third deals with the vibrations of an elastic sphere under its own gravity; here the modification appears to be considerable, when we consider the approximate elastic constants of the earth. This case is partly founded upon a paper by Prof. Lamb (*Proceedings*, vol. xiii.) on the vibrations of a sphere. The author finds that the effect of gravity is necessarily null when the order of the harmonic disturbance is zero or unity. For a sphere of the mass, size and gravity of the earth, but with rigidity about that of steel, he finds the gravest free period to be 55 minutes; without gravity the corresponding free period is 66 minutes. If the rigidity is about that of glass, the period is 78 minutes; without gravity, 120 minutes. The solids throughout are supposed to be incompressible in order to avoid the difficulties introduced by gravity. —Lieut.-Colonel Cunningham (Mr. Tucker, *pro tem.*, in the chair) drew attention to the three following exceptionally high numbers :—

$$N_1, N_2 = [2^{213}.(2^{209} \pm 1)^3 \mp (2^{211} \pm 1)^3] = (2^{210} \pm 1)(2^{210} \mp 1)^3$$

$$N_3 = [\{(2^{105} + 1)^4 - 2^{108}.(3.2^{104} + 1)\}^2 + \{(2^{105} + 1)^4 - 2^{212}.(2^{106} + 3)\}^2] = 2.(2^{210} + 1)^4.$$

The *complete factorisation* of the numbers $(2^{210} \pm 1)$ being known (see Lucas's memoir "Sur la Série récurrente de Fermat," Rome, 1879, pp. 9, 10), the three large numbers (N) are also *completely factorisable into their prime factors*. The two N_1, N_2 are of order 2^{840}, and therefore contain 253 figures; whilst N_3 is of order 2^{811}, and therefore contains 254 figures. The largest number hitherto *completely factorised* into its prime factors (so far as known to the author) is $(2^{210} + 1)$, which contains 64 figures.

Geological Society, December 7.—W. Whitaker, F.R.S., President, in the chair.—The geological structure of the Southern Malverns and of the adjacent district to the west, by Prof. T. T. Groom. The structure of the district is explained on the supposition that the rocks represent the western margin of an old mountain-chain overfolded towards the west; the eastern portion of this range lies faulted down and buried beneath the Permian and Mesozoic of the vale of Gloucester. All the characteristics of a folded chain are present, namely, the profound folds, overfolds, thrust-planes, and transverse faults; and a typical Austönungs-zone is seen to the west.—The Permian conglomerates of the Lower Severn basin, by W. Wickham King. The rocks thus described are the calcareous conglomerates included in the Middle Permian of the Shropshire type, and exposed north of the Abberley and Lickey Hills. Three calcareous horizons occur, interstratified in sandstones or marls, and surmounted by the Permian breccia. It was the opinion of Ramsay and others that the materials of the calcareous horizons and of the Permian breccia had been brought from the Welsh border; but Buckland and Jukes, among others, claimed a southern derivation for those of the Permian breccia, from local hill-ranges to the south. The latter view accords with the fact that the pebbles composing these calcareous horizons, and also the broken fragments constituting the Permian breccias north of the Abberley and Lickey Hills, are coarser in the south-easterly direction, and gradually become finer to the north-west. The fragments embedded in the Middle Permian calcareous bands near the Lickey are chiefly of Archæan rocks; but in all the other districts described there are very few rock-fragments older than Woolhope Limestone. On the other hand, pebbles of dolomitic Wenlock and Carboniferous Limestones are abundant, while Aymestry Limestone, Old Red, Carboniferous, and Lower Permian sandstones occur in greater or less abundance; and all these rocks, except the Carboniferous Limestone, may be seen *in situ* near at hand to the south.

Entomological Society, December 7.—Mr. R. Trimen, F.R.S., President, in the chair.—Mr. McLachlan exhibited a series of specimens of the neuropterous genus *Tetracanthagyna*, de Selys, including a pair of a new species from Borneo, which was the largest known of all recent dragon-flies, though it was slightly exceeded in wing-area by the much more slender *Megaloprepus caenulatus*, a common Central-American species. —Mr. A. H. Jones showed about sixty species of Lepidoptera, taken round electric lights at Zermatt in August.—Dr. Dixey exhibited a series of Pierid butterflies from the Neotropical region to show the existence among them of seasonal forms. The President observed that the exhibit was of special interest, as affording the first recorded evidence of the existence of seasonal dimorphism in Neotropical butterflies.—Mr. G. T. Porritt exhibited an extraordinary variety of *Bombyx quercus*, bred in June last by Mr. W. Tunstall, from a larva found near Huddersfield. The specimen was a female of deep chocolate colour, with the band very faintly traced in dark olive.—Dr. Chapman, Mr. Lloyd, and Mr. Nicholson exhibited butterflies taken by them in Norway from June 20 to July 22, during the past summer at latitudes 60° 12′ and 69° 50′.—Papers were contributed by Mr. R. McLachlan, entitled "Considerations on the genus *Tetracanthagyna*"; by Mr. M. Burr, entitled "A List of Rumanian Orthoptera"; and by Mr. J. H. Leech, on "Lepidoptera Heterocera from China, Japan and Corea."

Zoological Society, December 13.—Prof. G. B. Howes, F.R.S., Vice-Presldent, in the chair.—A communication was read from Mr. H. H. Brindley, on certain characters of the reproduced appendages in the Arthropoda, particularly in the Blattidæ. It was a continuation of a paper published in the *Proceedings* of the Society for 1897 (p. 903), and contained observations on the process of regeneration of the legs in the Blattidæ.—Mr. W. P. Pycraft read the second part of his contributions to the osteology of birds, which dealt with the Penguins (Impennes). The author found it necessary to divide this order into six genera. Of these *Eudyptula* appeared to represent the least specialised form of the whole group, and probably came nearest to the ancestral stock. The Impennes, as a whole, appeared to be most nearly related to the Tubinares. It did not seem possible to distinguish the skeleton of *Catarractes pachyrhynchus* from that of *C. chrysocome*.—One of the most important features of this paper related to the "secto-pterygoid," which the author described at some length. —Mr. W. L. H. Duckworth read a note, illustrated with lantern slides, on a specimen of a female anthropoid Ape which had been received from the Gaboon early in the present year, and as to which he was unable to decide whether it was a Gorilla or a Chimpanzee.—Mr. J. Stanley Gardiner read a report on the Turbinolid and Oculinoid Corals collected during his recent expedition to the South Pacific. Nine species were treated of in the paper, of which four were described as new. —Mr. L. A. Borradaile read the third instalment of a paper on Crustaceans from the South Pacific.—Dr. G. H. Fowler contributed the seventh of a series of papers on our knowledge of the Plankton of the Faeroe Channel. It dealt with the Station-data of depth, temperature, &c., of the hauls of H.M.S. *Research* in 1896 and 1897, with the chief Protozoa and Medusæ of the collections.

EDINBURGH.

Royal Society, December 5.—The Rev. Prof. Flint in the chair.—The Chairman gave a short opening statement, referring, amongst other things, to the Antarctic Expedition, to the survey of Christmas Island, to the new expedition to Socotra, and to Dr. Traquair's important memoir of the preceding session, and concluding with short biographical notices of recently deceased Fellows.—Prof. Kuenen, in a paper on the miscibility of liquids at different temperatures, pointed out the necessity of taking the vapour into account in the discussion of any case of equilibrium. The mixtures dealt with were chiefly mixtures of hydrocarbons and alcohols. In the case of ethane and ethyl alcohol, the solubility curve was shaped like a perverted ∂—the vapour and upper liquid line joining at the higher temperature, the two liquid lines joining at the lower temperature. A few degrees above the lower temperature at which the two liquids began to exist in equilibrium, it was possible, by moderate increase of pressure, to get the liquids to mix completely again. On the other hand, above the higher temperature at which phenol and water began to mix in all proportions, a large increase of pressure caused a separation of the liquids.—Prof. Ewart, in a paper on reversion in birds and mammals, discussed many instances of reversion either to a recent ancestor or to a remote ancestor. The influence of in-breeding as establishing prepotency in one or both of the parents was clearly shown, a prepotent parent or ancestor preventing reversion. Prof. Ewart illustrated his remarks by means of living specimens of pigeons and rabbits, and threw on the screen views of the zebra hybrids with which he had been experiment-

ing for some time. These hybrids showed markings much more like the markings of the Somali zebra than of their Burchell sire; they seemed to be a case of reversion to a very remote ancestor.

PARIS.

Academy of Sciences, December 12.—M. Wolf in the chair.—Physical study of the elasticity acquired by muscular tissue in a state of physiological work, by M. A. Chauveau. The experiments cited were all carried out upon the flexor muscles of the fore arm of man, and were so arranged as to eliminate the disturbing influence of the weight of the limb. The elongations in the length of the muscle produced by a given increase of load are compared with the elongations which would be produced in inert substances, and the conclusion is drawn that the law obeyed by the muscle is given by $e = p(1 + r)$, where e is the increase or decrease of the force of elasticity which is maintained in a muscle put in statical contraction, p is the charge sustained, and r the muscular contraction.—Influence of metallic armatures upon the properties of mortars, by M. Considère. The use of iron or steel for the interior armature of mortars, although opposed by military engineers, on account of the results of tests made by tension only, is justified by the results of the experiments given.—Observations of the Brooks Comet (October 1898), made at the Observatory of Algiers with the 31·8 cm. equatorial, by MM. Rambaud and Sy.—Observations of the planet DQ (Witt) and the Perrine-Chofardet and Chase comets, made at the Observatory of Toulouse with the Brunner equatorial, by M. Rossard.—Observations, made at Athens, of the Leonid and Bielid swarms, by M. D. Eginitis.—On the examination of the singularities of a function defined by a Taylor's series, by M. Émile Borel.—On systems of partial differential equations reducible to ordinary differential equations, by M. Jules Beudon.—On the determination of the group of numerical equations, by M. Edmond Maillet.—On lines composed of rectilinear parts, by M. D. Gravé.—On the practical synchronising of regulators, by M. L. Lecornu.—On the ratio of the wo specific heats of gases, by M. Louis Boltzmann. Remarks on a paper on the same subject by M. Leduc, with especial reference to the ratio found for the new atmospheric gases. The author arrives at the conclusions that the molecule of a perfect gas for which $k = 1\frac{2}{3}$ ought to behave in molecular concussions as a rigid sphere, a condition which is probably only possible for monatomic gases: in a gas for which $k = 1{\cdot}4$, over an extended range of temperature, the molecule behaves like two spheres rigidly joined together, a case probable for diatomic gases only. At high temperatures, even perfect gases ought to show a diminution of k. For polyatomic gases this would be evident at ordinary temperatures.—On a curious phenomenon of adherence of metallic filings under the action of the electric current, by M. Thomas Tommasina.—On the arc with alternating currents, by M. A. Blondel.—On the transformation of the carbonate of orthocresol into a homologue of the phthalein of orthocresol, by M. P. Cazeneuve. The phthalein is produced by the action of soda lime upon the carbonate.—On the mixed phenyl-ethyl phosphates, by M. Albert Morel.—Chlorination of benzene in presence of aluminium chloride, by MM. A. Mouneyrat and Ch. Pouret. If $AlCl_3$ is present in the proportion of 30 gr. to 1000 gr. of benzene, the latter absorbs a rapid current of chlorine completely at 50° C. Fractional distillation of the product gave 760 gr. of pure C_6H_5Cl, together with 450 gr. of dichlorbenzenes. The latter can be obtained readily in quantity by similarly chlorinating monochlorbenzene, the para compound predominating.—Action of oxidising agents upon some nitrogen compounds, by M. Œchsner de Coninck. A study of the reaction between chromic acid and potassium bichromate and numerous nitrogen compounds, including hydroxylamine, hydrazines, ureas, and amides.—Action of the bacillus *Coli communis* and the Eberth bacillus upon nitrates, by M. L. Grimbert. The nitrogen evolved by the action of these bacilli upon a nitrated medium, is always at least double that corresponding to the nitrate taken; hence the nitrogen evolved cannot arise exclusively from the nitrates, but must come in part from the amido-compounds always present in the culture.—The assimilation of nitric nitrogen and of ammoniacal nitrogen by the higher plants, by M. Mazé. Details of experiments are given which confirm the conclusions of M. Müntz, that ammonia, as such, can be absorbed and assimilated by plants.—On the natural dissemination of wine yeasts, by M. Léon Boutroux. Remarks on a paper by M. J. A. Cordier. In opposition to the latter, the author holds that the theory of dissemination by insects is more in accord with facts than the theory of air dissemination.—The juice of fungi as a vaccine against snake poison, by M. C. Phisalix.—The endomorphic modifications of the gabbro of Pallet (Loire-Inférieure), by M. A. Lacroix.—On the part played by subterranean deposition in the constitution of the soil of a portion of the department of Orne, by M. Stanislas Meunier.

BOOKS and SERIALS RECEIVED.

BOOKS.—The Gold-Fields of Australasia: K. Schmeisser and K. Vogelsang, translated by Prof. H. Louis (Macmillan).—The Micro-organism of Faulty Rum: V. H. and L. J. Veley (Frowde).—Twenty-seventh Annual Report of the Local Government Board: Supplement containing the Report of the Medical Officer for 1897-98 (London).—Annuaire de l'Observatoire Municipal de Paris, 1899 (Paris, Gauthier-Villars).—Les Recettes du Distillateur: E. Fierz (Paris, Gauthier-Villars).—Ostwald's Klassiker der Exakten Wissenschaften, Nr. 97 to 100 (Leipzig, Engelmann).—Congrès National d'Hygiène et de Climatologie Médicale de la Belgique et de Congo, première partie. Belgique (Bruxelles, Hayez).—Recent Advances in Astronomy: Dr. A. H. Fison (Blackie).—University College, London, Calendar for Session 1898-9 (Taylor).

SERIALS.—Engineering Magazine, December (222 Strand).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1898, Nos. 9 and 10 (Bruxelles).—Observatory, December, and Companion (Taylor).—National Geographic Magazine, November (Washington).—Notes from the Leyden Museum, April and January (Leiden).—Atlantic Monthly, December (Gay).—Journal of the Anthropological Institute, August and November (Paul).—Journal of the Marine Biological Association, November (Plymouth).—An Account of the Crustacea of Norway, Vol. 2, Parts xi., xii. (Bergen).—American Journal of Science December (New Haven).—Morphologisches Jahrbuch, 26 Band, 3 and 4 Heft (Leipzig).—Quarterly Journal of Microscopical Science, November (Churchill).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. 42, Part 5 (Manchester).

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