THURSDAY, JUNE 23, 1887.

THE AGRICULTURAL PESTS OF INDIA.

The Agricultural Pests of India and of Eastern and Southern Asia, Vegetable and Animal, Injurious to Man and his Products. By Surgeon-General Edward Balfour, Author of "The Cyclopædia of India," &c. (London: Bernard Quaritch, 1887.)

CONSIDERABLE attention has been directed lately to agricultural pests of all kinds, and especially to insect pests, in various countries, because the injuries occasioned to crops by their agency have greatly increased, and in some instances altogether new disorders and diseases attributable to them have appeared. The universal international exchange of agricultural produce and other commodities has tended and must tend to distribute insects, fungi, and other sources of evil to mankind, animals, and plants, throughout the world. Thus the terrible scourge of the vine, the *Phylloxera vastatrix*, was first introduced into the French vineyards with plants, or cuttings, of vines imported from the United States. Very many insects most noxious to agricultural, fruit, and garden crops, in the United States were brought there with plants, cuttings, fruits, and seeds. The elm-leaf beetle, *Galeruca xanthomelæma*, which is now seriously damaging elm-trees, was not known in the United States until 1837, and came probably from France, or Germany, where it had been a troublesome pest long before that date. The hop fly, *Aphis humuli*, called the "barometer of poverty" by a Kentish historian of hop culture, has only recently visited the hop plantations of America; yet it caused almost a total blight last year in those of the Eastern States, upon an area of nearly 40,000 acres. Without any doubt this insect was conveyed from England in "hop-sets." The Hessian fly has been conveyed to Great Britain by some means or other not yet discovered, during the last year, and bids fair to be a dangerous and permanent scourge to the wheat and oat crops of this country.

It is the same with moulds, or mildews, or "blights," occasioned by fungi. The vine mildew, *Oidium tuckerii*, was not dreamed of in France until 1845. The potato mould, *Peronospora infestans*, had shown no important sign in Great Britain until 1844. The coffee mildew, *Hemileia vastatrix*, did no serious harm in the coffee plantations of Ceylon until after 1870; but during the last ten years it has enormously decreased their yield.

Diseases of animals have also been greatly intensified during the past thirty years in Great Britain and in other countries. In India, as we gather from this little book of Surgeon-General Balfour, anthrax, pleuropneumonia, rinderpest, foot-and-mouth disease, are so rampant that the Madras Government has recently appointed an inspector of cattle diseases with a sufficient staff under him.

There is no doubt that the attacks of certain insects and parasitic fungi are more frequent and more fatal than formerly. Hop blights from aphides and mildew, *Spœrotheca castagnei*, are far more common and destructive in England than they were fifty years back; and the orange-growers of Florida, California, and other places where oranges are cultivated, are at their wits' end to combat the ravages of scale insects, Coccidæ, which have greatly increased since 1870.

It is a moot point as to whether this is due, or not, to modern and more artificial systems of cultivation, which may be more favourable to the spread of insects and parasitic fungi. Or it may be that these new systems interfere with the balance of Nature by decreasing parasitic and other insects, and birds and other animals, which are the natural foes of injurious insects. It has been discovered by Prof. Forbes, of Illinois, that several species of the Carabidæ and Coccinellidæ eat the spores of fungi; therefore an unusual increase in the number of birds, or other foes of these insects, might occasion a serious spread of mildews.

The importance of the subject of agricultural pests cannot be overrated. It is now fully recognized by the Government of the United States, who have a distinguished entomologist upon the staff of the National Agricultural Department. Besides this, many of the States have their own entomologists, who furnish frequent and valuable reports and advice as to methods of treatment. In England the Agricultural Department of the Privy Council have lately issued a series of reports upon insects injurious to crops, written by Mr. Charles Whitehead; and Miss Ormerod, the entomologist of the Royal Agricultural Society, has published annual reports for upwards of ten years, which have been of the utmost value and practical benefit to agriculturists. And in India, as Surgeon-General Balfour tells us in this work, the serious injuries caused by insects and other animals, fungi, and bacilli, to mankind, animals, and plants, have at last attracted the attention of the Government of India, and it is proposed to invite communications from those engaged in agriculture, forestry, and horticulture in that country, to furnish matter for periodical reports like those issued from time to time by Miss Ormerod. These would of course be published in the vernacular, and should be illustrated by woodcuts, as Miss Ormerod suggests in her comprehensive letter in the preface of "Agricultural Pests of India." It is much to be hoped that a competent entomologist may be appointed in India to direct this work.

Surgeon-General Balfour, so far back as 1880, recommended the Secretary of State for India to obtain reports on the diseases of cattle and plants, and on creatures noxious to mankind and vegetation. In his admirable "Cyclopædia of India and of Eastern and Southern Asia," published in 1885, he gave a general view of the entomology of these regions, and described the losses sustained by agriculturists from these and similar causes. He has followed this up with the work now under review.

Though a small book, the "Agricultural Pests of India" is very ambitious in design, as it treats not only of insects and fungi and animals injuriou to mankind and agricultural crops, but of all manner of birds, beasts, and fishes. Several of these cannot, even by the greatest stretch of the imagination, be classified as pests to agriculture, and seem to be altogether out of place in this category. Under the heading "Fish," sharks and siluroids are described, though it is not by any means clear in what way they are agricultural pests, except, perhaps, that they might bite off the limbs of unwary agriculturists disporting in the sea. The book should have been styled the "Natural History of India," or "A Manual of the Natural History of India," rather than the "Agricultural Pests of India." But the fact that rather too many subjects are dealt with cannot be held to be a very serious fault in a compilation containing an immense amount of serviceable information arranged alphabetically, together with a good index, so that any head can be quickly found. The author had great opportunities of acquiring knowledge of the branches of natural history he has here discussed while he was engaged in forming the Government Central Museum at Madras, and other museums in various parts of India, as well as in the preparation of "The Cyclopædia of India" and his work on "The Timber Trees of India." He was therefore very well qualified to prepare this manual or dictionary of natural history, which will serve to show Indian agriculturists what are the principal foes of their crops and herds. No remedies or methods of prevention are given in detail. Some general instructions appear in the introductory chapters, such as to farm cleanly, and to use certain washes and powders in case of the attack of some insects. These, however, have evidently been taken from lists of remedies prescribed by American and English practical entomologists, and have not been actually tried in India. Now that Surgeon-General Balfour has demonstrated the dangers, and indicated general remedies which have been found advantageous in other climes, the farmers, the foresters, and fruit-growers of India should at once make experiments, and prove for themselves whether these are as efficacious in the fiery heat of the East as in the temperate climates of Great Britain and America.

This notice cannot be concluded without an allusion to some of the errors which have been carelessly allowed to remain in the book, having evidently escaped the notice of the eminent scientific man who "revised nearly the whole in manuscript, and the proofs as they passed through the press." It is not to be expected that Surgeon-General Balfour should be a skilled entomologist, but it is very unfortunate for him that those on whom he relied for assistance should have so signally failed him. He says that the *Cecidomyia tritici* is the Hessian fly of Europe and America. In reality the Hessian fly of Europe and America is *Cecidomyia destructor*, named so by Say long ago, and is completely and specifically distinct from *Cecidomyia tritici*, which is the true wheat midge of Great Britain. This is a mistake which appears unpardonable in a scientific reviser. On p. 45 it is stated that "the species of Necrophorus and Silpha are useful; they feed on carrion, and by scratching the ground from under dead animals they partially bury them." As a fact the *Silpha opaca*, and another species, the *Silpha atrata*, eat and seriously injure plants of beet and mangelwurzel, as has been shown by Curtis and Miss Ormerod in England, by Guérin Méneville in France, and Taschenberg in Germany. It need hardly be said that correct information as to the habits of insects is as necessary as accurate nomenclature—at least to agriculturists.

Again, under the heading Buprestidæ and Elateridæ (click beetles) it is remarked that the larvæ feed on living wood, and are more or less injurious. The wire-worm, the larva of *Elater lineatus*, is fearfully destructive to the roots of crops of all kinds. In the description of Elateridæ, further on, this kind of mischief is attributed to their larvæ; so that there are two utterly conflicting accounts of the habits of these insects, calculated to puzzle the inquiring Indian farmers.

A sweeping statement that "all the weevil family insert their eggs in the stigma of the flower" cannot be supported, and is utterly opposed to the experience of observers. A few species do this, but others deposit their eggs in a variety of places. Of weevils it is also said that they "attack principally in their larval stage every part of vegetable tissues." As a fact, many weevils do incredible harm to vegetation in their perfect or weevil form, and it would be difficult for the larvæ—mere maggots—to hold on to leaves.

Sitonas, described as attacking stored grain and seed, have been evidently mistaken for species of Bruchi.

These and other mistakes ought to be corrected before the work is put into the hands of the agriculturists of India as a text-book for their guidance.

CELL-DIVISION IN ANIMALS.

La Cytodiérèse chez les Animaux: Étude comparée du Noyau et du Protoplasme. Par T. B. Carnoy, Professor of Biology in the University of Louvain. (Louvain: A. Peeters, 1886.)

IN this work the learned biologist of Louvain has ably resumed and discussed the latest researches made concerning the phenomena of cell-division in arthropods and worms. It is, of course, impossible in a short article to do justice to the great labour and admirable patience here displayed by the distinguished author; nor can we discuss as fully as the subject deserves the several points on which Dr. Carnoy appears to differ essentially from other workers in the same field, as, for instance, from Prof. E. Van Beneden and from Mr. Nussbaum. But the questions raised by the Louvain Professor are of such importance that even a summary of his present views cannot fail to be of interest.

First, as regards cell-division in arthropods, Prof. Carnoy maintains that in them the direct mode of division may be observed in various tissues, young and adult, and must be admitted to have all the characters of what he terms "un processus normal."

This direct mode occurs either by "étranglement" or by the help of a partition, just as in vegetable cells, and this is verified for the protoplasm itself as well as for the nucleus.

Then, contrasting the direct with the indirect or karyokinetic mode of cell-division, he remarks that those two processes have in reality the same morphological significance and physiological value; that the characters of karyokinesis are inconstant, and that they may often be seen passing through many intermediate stages into the characters proper to the akinetic mode. Nevertheless, our author admits that karyokinesis is of considerable importance to cell-life, inasmuch as it affords an easier and surer method for making the cell dicentric; it also leads to the division of the nuclear element into two equal parts; it enriches the protoplasm with plastine; and, lastly, it renders possible the total regeneration of the nucleus. In the present state of our knowledge, however, there is obviously much that is hypothetical in the respective importance of these consequences.

It is chiefly in his researches on the embryology of Nematoda that Prof. Carnoy has reached conclusions which are totally at variance with those already arrived at on the same subject by Messrs. Nussbaum and E. Van Beneden. We allude especially to the mode of formation of the polar bodies in the egg of *Ascaris megalocephala*. For the Louvain Professor, the two successive divisions which take place in the germinal vesicle assume the following characters:—

(1) The nuclear element ("élément nucléinien typique") of the egg of *Ascaris megalocephala* becomes at an early stage broken up into eight nearly equal rod-like portions; these at once separate into two groups of four rods ("bâtonnets"), thus constituting the Wagnerian spots.

(2) When a spermatozoid has made its way into the egg, sometimes very soon afterwards, occasionally later, an alteration of the germinal vesicle becomes visible; its membrane dissolves away, and subsequently, by a process of true karyokinetic division accompanied by the formation of asters of remarkable variety and complexity, the first polar body is expelled. This he finds to consist of four nuclear rods and a portion of the protoplasm of the egg. At this stage, therefore, according to Dr. Carnoy, four rods only remain within the egg.

(3) Now the same process begins again, in all essential respects resembling that which has just been described; finally, the second polar body is expelled in its turn. It consists of two nuclear rods, so that only two rods remain now in the egg for the formation of the female pronucleus. We are thus in a position to calculate accurately the amount of nuclein lost by the germinal vesicle during the expulsion of the polar bodies. According to Prof. Carnoy, the loss, for *Ascaris megalocephala*, would amount exactly to three-fourths of the nuclein originally present in the egg.

We are not sure whether Prof. E. Van Beneden's views on this delicate question may not be to a certain extent reconciled with those of the eminent biologist of Louvain, especially as regards the number of nuclear portions contained in the first polar body. But respecting the constitution of the second polar body the views of the two Belgian observers are certainly difficult, if not impossible, to reconcile.

Prof. Carnoy's book reads easily, and his statements are always clear and definite. The text is illustrated by a large number of figures, beautifully executed, which greatly enhance the value of this most interesting and important work.

L. MARTIAL KLEIN.

OUR BOOK SHELF.

The Climatic Treatment of Consumption: a Contribution to Medical Climatology. By J. A. Lindsay, M.A., M.D. (London: Macmillan and Co., 1887.)

DR. LINDSAY does not profess to have written a systematic and exhaustive treatise upon the climatic treatment of consumption. He holds that we are only on the threshold of climatological investigation: and "for its exhaustive discussion," he says, "prolonged inquiry will be necessary, and more exact methods than those hitherto generally employed." He has made, however, an important contribution to the study of a very difficult subject, and his book ought to be of much service not only to physicians but to many sufferers who may still hope to find in climatic treatment a powerful adjunct to hygienic and medical measures. Having discussed the causes of consumption and the general principles of climatic treatment, Dr. Lindsay presents a general view of the chief sanatoria for consumption. He then describes mountain sanatoria and the ocean voyage, and gives a full and trustworthy account of sanatoria he himself has visited, including Australia, Tasmania, New Zealand, California, the Cape, Algeria, Southern France, and the home sanatoria. The value of the book is, of course, greatly increased by the fact that he has relied for his information mainly on personal observation.

Illustrations of the British Flora. Drawn by W. H. Fitch, F.L.S., and W. G. Smith, F.L.S. Second Edition. (London: L. Reeve and Co., 1887.)

WHEN the illustrated edition of Bentham's "Hand-book of the British Flora" was exhausted, the wood engravings of that work were reproduced in a volume intended to serve as a companion to the "Hand-book" and other British Floras. The volume has been so popular that the publishers have found it necessary to issue a second edition; and they have taken pains to secure that it shall be more useful than ever to students of botany, and especially to beginners. Five cuts have been added, and the arrangement of all the illustrations has been brought into accordance with Bentham's "Hand-book" as it has been revised by Sir J. D. Hooker. To facilitate reference from other Floras, the index has been greatly enlarged, and there is a new index of English and popular names.

Sketches of Life in Japan. By Major Henry Knollys, R.A. With Illustrations. (London: Chapman and Hall, 1887.)

IN this book Major Knollys undertakes to tell us something of "the minor lights and shades" of the social life of Japan. He is a careful observer, and writes brightly and pleasantly; and no doubt the lively record of his impressions will interest a good many readers who would not have cared to study a more elaborate and systematic account of the Japanese people. The substance of the book was written "on the spot," but all statements with regard to matters of fact have been carefully revised.

LETTERS TO THE EDITOR.

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

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Thought without Words.

THERE appears to be some ambiguity about this matter as discussed in the correspondence which has recently taken place in your columns. In the first instance Mr. Galton understood Prof. Max Müller to have argued that in no individual human mind can any process of thought be ever conducted without the mental rehearsal of words, or the *verbum mentale* of the Schoolmen. Now, although this is the view which certainly appears to pervade the Professor's work on "The Science of Thought," there is one passage in that work, and several passages in his subsequent correspondence with Mr. Galton, which express quite a different view—namely, that when a definite structure of conceptual ideation has been built up by the aid of words, it may afterwards persist independently of such aid; the scaffolding was required for the original construction of the edifice, but not for its subsequent stability. That these two views are widely different may be shown by taking any one of the illustrations from the NATURE correspondence. In answer to Mr. Galton, Prof. Max Müller says, "It is quite possible that you may *teach* deaf-and-dumb people dominoes; but deaf-and-dumb people, left to themselves, do not *invent* dominoes, and that makes a great difference. Even so simple a game as dominoes would be impossible without names and their underlying concepts." Now, assuredly it does "make a great difference" whether we are supporting the view that dominoes could not be *played* without names underlying concepts, or the view that without such means dominoes could not have been *invented.* That there cannot be concepts without names is a well-recognized doctrine of psychology, and that dominoes could not have been invented in the absence of certain simple concepts relating to number no one could well dispute. But when the game has been invented, there is no need to fall back upon names and concepts as a preliminary to each move, or for the player to predicate to himself before each move that the number he lays down corresponds with the number to which he joins it. The late Dr. Carpenter assured me that he had personally investigated the case of a performing dog which was exhibited many years ago as a domino-player, and had fully satisfied himself that the animal's skill in this respect was genuine—*i.e.* not dependent on any code of signals from the showman. This, therefore, is a better case than that of the deaf-mute, in order to show that dominoes can be played by means of sensuous association alone. But my point now is that two distinct questions have been raised in your columns, and that the ambiguity to which I have referred appears to have arisen from a failure to distinguish between them. Every living psychologist will doubtless agree with Prof. Max Müller where he appears to say nothing more than that if there had never been any names there could never have been any concepts; but this is a widely different thing from saying what he elsewhere appears to say, *i.e.* that without the mental rehearsal of words there cannot be performed in any case a process of distinctively human thought. The first of these two widely different questions may be dismissed, as one concerning which no difference of opinion is likely to arise. Touching the second, if the Professor does not mean what I have said he appears in some places to say, it is a pity that he should attempt to defend such a position as that chess, for instance, cannot be played unless the player "deals all the time with thought-words and word-thoughts." For the original learning of the game it was necessary that the powers of the various pieces should have been explained to him by means of words; but when this knowledge was thus gained, it was no longer needful that before making any particular move he should mentally state the powers of all the pieces concerned, or predicate to himself the various possibilities which the move might involve. All these things he does by his specially-formed associations alone, just as does a draught-player, who is concerned with a much simpler order of relations: in neither case is any demand made upon the *verbum mentale.*

Again, if the Professor does not mean to uphold the view that in no case can there be distinctively human thought without the immediate and direct assistance of words, it is a mistake in him to represent "the dependence of thought on language" as absolute.[1] The full powers of conceptual ideation which belong to any individual man may or may not all have been due to words as used by his ancestors, his contemporaries, and himself. But, however this may be, that these powers, when once attained, may afterwards continue operative without the use of words is not a matter of mere opinion based on one's own personal introspection, which no opponent can verify: it is a matter of objectively demonstrable fact, which no opponent can gainsay. For when a man is suddenly afflicted with aphasia he does not forthwith become as the thoughtless brute: he has lost all trace of words, but his reason may remain unimpaired.

June 4. GEORGE J. ROMANES.

[1] *e.g.* "I hope I have thus answered everything that has been or that can possibly be adduced against what I call the fundamental tenet that the science of language, and what ought to become the fundamental tenet of the science of thought, namely that language and thought, though distinguishable, are inseparable, that no one truly thinks who does not speak, and that no one truly speaks who does not think."—"Science of Thought," pp. 63–64.

I HAVE postponed offering you any remarks on Prof. Max Müller's "Science of Thought," until I had read the book through.

I think Prof. Müller is on the whole right, that language is necessary to thought, and is related to thought very much as organization to life. The question discussed by some of your correspondents, whether it is possible in particular cases to think without language, appears to me of little importance. I can believe that it is possible to think without words when the subjects of thought are visible things and their combinations, as in inventing machinery; but the intellectual power that invents machinery has been matured by the use of language.

But Prof. Müller has not answered, nor has he asked, the question, on what property or power of thought the production of language depends. He has shown most clearly the important truth that all names are abstract—that to invent a name which denotes an indefinite number of objects is a result of abstraction. But on what does the power of abstraction depend? I believe it depends on the power of directing thought at will. Prof. Müller lays stress on the distinction between percepts and concepts, though he thinks they are inseparable. I am inclined to differ from him, and to think that animals perceive as vividly as we do, but have only a rudimentary power of conception and thought. I think the power of directing thought at will is the distinctively human power, on which the power of forming concepts and language depends. JOSEPH JOHN MURPHY.

Belfast, June 19.

AFTER reading the correspondence published in NATURE (vol. xxxvi. pp. 28, 52, and 100) on this subject, it has occurred to me that the difficulties anthropologists find in Prof. Max Müller's theory are connected chiefly with his peculiar definitions.

In his letters to Mr. Galton, Prof. Müller narrows the domain of his theory to a considerable extent. By defining thought as the faculty of "addition and subtraction," and by taking language as composed of "word-thoughts" or "thought-words," Prof. Müller excludes from his theory all those processes which are preliminary to the formation of concepts. Thus narrowed, I do not see that his doctrine in any way touches the wider question, whether reasoning, as generally understood, is independent of language. If we keep to the terms of this theory, thoughts and words are undoubtedly inseparable. But this does not in the least imply that all thought is impossible without words.

When we enlarge the scope of our terms, it is at once evident that thoughts and words are not inseparable. It is all very well to join together "thought-word" and "word-thought." Yet the thought is something quite distinct from the mere sound which stands as a word for it. A concept is formed from sensations. Our thoughts are occupied with what we see, and feel, and hear, and this primarily. Thus it is that, in the wider sense of thinking, we can think in pictures. This is the mental experience which Prof. Tyndall so highly prizes. He likes to picture an imaginary process, not in words, not even by keeping words in the background, but in a mental presentation of the things themselves as they would affect his senses. Surely, then, if the mind can attend to its own reproduction of former sensations, and even form new arrangements of sensations for itself quite irrespective of word-signs, as Mr. Galton and most other thinkers have experienced, it is evident that thought and language are not inseparable.

All this is, of course, somewhat apart from Prof. Müller's restricted theory. But the question follows, how from these wider thoughts do we become possessed of the faculty of abstraction. Does not the one shade imperceptibly into the other? Prof. Müller answers no, and here I think he is at fault. It is at this point that anthropologists part company with him. If he be right, how do people learn? According to his theory, new thoughts when they arise, start into being under some general concept. I do not deny that they are placed under some general concept, but it seems to me that something entirely independent of the general concept has, for convenience, been placed under it, and this something must be called a thought. No doubt the thought is at first vague and indefinite, and only when it becomes definite does it require a name. But here one can plainly trace the genesis of a thought, and the adapation of a word as a symbol for it. The new concept and its sign do not arise simultaneously. There are two distinct growths, not one only, as Prof. Müller's theory presupposes. The connexion may be subtle and close, but the two elements can be easily separated. It avails nothing to say that until the thought is placed under a concept, it is not a thought. This is a mere question of definition, not of actual fact.

I would point out one other consideration. If Prof. Müller's theory were true for all kinds of thinking, development would be impossible. If man could not think without language, and could not have language without thinking, he would never have had either, except by a miracle. And scientific men will not accept the alternative. We can conceive shadowy thoughts gradually shaping to themselves a language for expression, and we can understand how each would improve the other, until by constant interaction, a higher process of thought was introduced. But we cannot conceive the sudden appearance of the faculty of abstraction together with its ready-made signs or words.

I have often wished that Prof. Müller would state distinctly how his theory accounts for the very first beginnings of language. I have not been able to discover any explanation of this point in his "Lectures on the Science of Language."

Clapham, June 6. ARTHUR EBBELS.

As poets have extraordinary inklings and *aperçus* on the most abstruse scientific questions, Wordsworth's opinion on this matter (quoted by De Quincy) is worth considering: Language is not the "*dress*" of thought, it is the "*incarnation.*" This is Shelley's *aperçu* of Darwinism. Man exists "but in the future and the past; being, not what he is, but what he has been and shall be."

How to "distil working ideas from the obscurest poems"—to use Lord Acton's words—is one of the secrets of genius.

A. GRENFELL.

THE interesting discussion between Mr. Francis Galton and Prof. Max Müller on this subject will doubtless raise many questions in the minds of those who have paid some attention to the habits of animals. I have been asking myself whether, if Prof. Max Müller is right in his conclusion—"Of course we all admit that without a name we cannot really know anything" (an *utterable* name, I presume), and "one fact remains, animals have no language"—animals must not, therefore, be held by him incapable of knowing anything. This would bring us to the question whether animals *know* in the same manner as men, or in some other manner which men do not understand. Now, I think—at least it is as strong a conviction as I am capable of entertaining—that animals not only know, but deal with the materials of knowledge—facts—in a manner quite indistinguishable from the manner in which I mentally handle them myself. Thus, I place an animal in circumstances which are quite unfamiliar to it, and from which it is urgently pressed to escape. There are two, or perhaps three, courses open to it; one being, to my mind, patently the most advantageous. It tries all of them, and selects that which I should have chosen myself, though it is much longer in coming to its conclusion. Here the animal has the same facts as the man to deal with, and, after consideration and examination, its judgment precisely corresponds with the man's. I cannot, then, find it possible to deny that the mental operations are identical in *kind*; but that they are not so in *degree* can be demonstrated by my importing into the situation an element foreign to the experience of the animal, when its failure is certain. It makes no difference whether the animal is under stress, or acting voluntarily. It may frequently be found to choose the method which most recommends itself to the man's judgment. Every student of animals is familiar with numbers of such cases. Indeed they are constantly being recorded in the columns of NATURE, and abound in all accepted works on animal intelligence. I am quite prepared to admit that where there are two or more courses open to it the animal will occasionally select that which presents the greatest difficulties, and labour most assiduously to overcome them, sometimes trying the remaining courses and returning to that which it first chose. Darwin gives a good example of the honey-bee ("Origin of Species," p. 225, edition 1872). But no one will be surprised at imperfect judgment or vacillation of will in an animal, when such are common among men.

Prof. Max Müller lays down the very distinct proposition that "animals have no language." I suppose *utterable* language is meant. Is this so? That their sign-language is both extensive and exact (and even understood to some extent as between widely different species) most naturalists, I apprehend, will entertain no doubt. But has any species an utterable language? What is to be the test of this? First there is the whole gamut of vocal expressions—which even we understand—conveying the ideas of pain, pleasure, anger, warning. What sportsman who has stalked extremely shy animals does not know the moment a bird or animal utters a certain note that he is discovered? If Prof. Max Müller will not admit this to be language, I, for one, must ask him what it is. It conveys to others a distinct idea, in general if not in special terms, and seems to me quite equivalent to "Oh, dear!" "This is nice" (expressed, I believe, in some African language by the reduplicated form *ñum-ñum*, the letter *n* having the same value as in the Spanish *mañana*), "Leave off," "Look out," "Come here," &c. Those who have heard animals calling to one another, particularly at night, and have carefully noted the modulations of their voices (why should there be modulations unless they have a definite value), will find it very hard to accept Prof. Max Müller's conclusion that "animals have no language." Every female mammal endowed with any kind of voice has the power of saying "Come here, my child," and it is an interesting fact beyond question that the knowledge of this call is feebly or not at all inherited, but must be impressed upon the young individual by experience. Further, the young brought up by an alien foster-mother pay no attention to the "Come here, my child," of the alien species. The clucking of the hen meets with no response from the ducklings she has reared, even when she paces frantically by the side of the pond imploring them not to commit suicide. But let us creep up under the banks of a sedgy pool at about this time of year. There swims a wild duck surrounded by her brood, dashing here and there at the rising *Phryganidæ*. Now let the frightful face of man peer through the sedges. A sharp "quack" from the duck, and her brood dive like stones, or plunge into the reeds. She, at least, knows what to say to them.

The already inordinate length of this letter precludes me from offering any instances of the communication of *specific* intelligence by means of the vocal organs of animals. I think it probable that we far under-rate the vocabulary of animals from deficient attention—and, I speak for myself, stupidity. Possibly Prof. Max Müller has not yet examined "Sally," the black chimpanzee. If not, he would surely be much interested. She is by no means garrulous, but, in spite of her poor vocal capacity, if he should still consider that she "cannot really know anything" on that account, I must have completely misinterpreted his letter to Mr. Galton. ARTHUR NICOLS.

Watford, June 3.

Two Friends.

THE remarks on the reasoning powers of animals (dogs in particular) given in your issue of June 9 (p. 124) induce me to relate an experience of my own. We possess a dog and a cat, both males, the former called Griffon here, much like a Skye terrier, the latter a splendid animal (a cross of the Angora). These two animals are bound to each other by the closest friendship, which began thus:—The dog came to us two years ago, quite a pup—about three months old. Soon after a small, wretched, half-starved kitten arrived at our door asking hospitality. The dog at once adopted it, let it eat out of the same dish, let it sleep on the same mat (and continues to do so still), in fact took entire charge of it. A black cat, a very vicious creature, and seemingly wild, haunted our garden, to the great destruction of birds' nests and to the excessive terror of the kitten. As the dog grew, it became the kitten's protector against the black cat, and has been so now for two years. If it was indoors and heard a cry of distress from our cat, you could not hold it from flying wildly to its rescue, forcing someone to open the door, or darting through a window. It has done this so long, and with such effect, that the black cat scarcely dares show its face in the garden, as the dog invariably attacks it with fury and drives it away, following it along the road to see if it is quite gone. I do not know if you will think this worthy of insertion, but I think it curious, and I can vouch for its truth. M. C.

La Tour de Peily, June 13.

The Use of Flowers by Birds.

As a curious incident enacted by sparrows has just come under my notice, which possesses some added interest in connexion with the two occurrences recorded by your correspondent

J. M. H.—viz. the employment by some finches of flowers in the formation of their nests (NATURE, vol. xvi. p. 83, and vol. xxxvi. pp. 101–2)—it may be worth while to submit a detailed consideration of the case.

The front of the house of a friend living at No. 47 Highbury Hill is covered by an extensive growth of white jasmine which reaches beyond the first-floor windows. For several years house-sparrows have used the bushy branches of this shrub without causing special attention. This year, however, they have taken a new departure in nest-building. Not satisfied, apparently, with the hay, straw, and other ordinary materials of sparrow architecture, they have suddenly aspired to appropriating to their use the bright yellow flowers of laburnum, two trees of which are in full bloom a few yards from the first-floor window-sills below which they are carrying on their operations. Three nests were discovered twelve days ago, built close together in the jasmine, all of which had laburnum flowers strewn upon the top of ordinary nests; one nest contained two young birds just hatched, and the other two had each a couple of eggs. As they rather disturbed the lady occupant of the house, she had all three nests destroyed, the litter from them entirely filling a large foot-bath. But the three pairs of birds, as might be expected, only set to work rebuilding their nests in the same place, furnishing them with more laburnum than before. They were however again disturbed, and an ob tacle (which in a previous year had proved effectual in stopping the building in another part of the house front) was set in the place of the nests, but still they did not desist; two pairs continued to add their materials on the top of it, with more laburnum than ever, replenishing the nest as constantly as it was removed, while the third pair rebuilt their nest under the sill of the next window, using laburnum also. Even entire sprays of the flowers were used, and the ground beneath the trees was so much strewn with fragments that my friend at first thought that boys had been pulling the trees. All the birds are now allowed to remain unmolested, and the yellow decoration is withered, without fresh being provided.

This unaccustomed action of the sparrows is apparently somewhat different from the operations described by your correspondent J. M. H., for the bright golden flowers enveloping the nests are so strangely conspicuous as to attract the attention of passers-by, and therefore cannot answer the protective purpose evident both in the case of the goldfinches with forget-me-nots and of the sparrows that used Alyssum. The only explanation I can suggest is that the birds have elevated their æsthetic taste to this "quite too too" extent of art cultus. It is highly interesting to note also that—in opposition to the notions of the obsolete school of naturalists, who believed only in blind instinct—the rage for collecting their favourite "yellow" is infectious with these little yearners for the intense, just as is the desire for "blue" that now and then breaks out (like a disease) amongst larger householders. The three pairs of birds seemed to vie with one another in their revelry of the chosen colour. It will be instructive to learn whether the fashion will last for many seasons: perhaps it will languish of satiety, and some other attraction of a less absorbing kind arise.

The fondness of birds (in this country at least), for the colour yellow is perhaps worth considering in this connexion. A large number of wild or cultivated plants might be enumerated that produce yellow flowers, which are either used as food or have their petals mauled by birds. There need be no doubt, I think, that the mutilation of such flowers is due to a playful fondness rather than to a dislike of the flowers. That birds evidently exercise the selective faculty in the choice of flowers is well illustrated by the fact, twice observed by my brother, that sparrows pull to pieces the yellow flowers only in mixed beds of pansies, and of crocuses, without injuring a single purple, mauve, or white flower of either kind. I have myself also witnessed the same selective operation performed by a sparrow on various crocuses growing in pots upon my window-sill, and I find many correspondents gave similar testimony to this fact in a series of letters which appeared in these pages in the year 1877 (vols. xvi. and xvii.). It may be questioned whether the education of their preference for the colour yellow is in any way connected with the fact that it is proper to the yolk of their eggs, and which they must be aware of; but since all good eggs contain that colour, while probably some birds do not like it and greatly prefer other colours, this suggestion may be no more valid as a theory than would be the argument that some people's taste for claret-colour is due to the analogous physiological accident of arterial coloration. The rich yellow colour, again, of the beaks, entire mouths, and "open sepulchres" of the newly-hatched nestlings affords their parents ample opportunities for the contemplation of colour, and there may be an unconscious mental absorption of the colour in consequence of this course of training. At any rate, canary yellow is very highly developed in many species of the *Fringillidæ*, and there is a strong tendency towards the development of the yellowish colour in the plumage of the males of several British finches, apparently through a greenish-brown tinge. It is also well developed amongst the weavers and the orioles, to which they are so nearly allied. That sparrows should thus use sprays of flowers is perhaps not so remarkable when we recall the close affinity they bear to *Ploceus* and other weaver-birds.

Doubtless the colour-sense in birds, as well as in insects, is a real factor in the evolution of the floral beauty that surrounds them, although the *modus operandi* is not always one that can be so readily traced. WILLIAM WHITE.

55 Highbury Hill, London, June 9.

Names for Electric Units of Self-Induction and Conductivity.

A NAME seems to be wanted for the practical unit of self-induction, viz. an ohm multiplied by a second; in other words, for a length approximately equal to an earth-quadrant. Profs. Ayrton and Perry call it a "secohm." Why not call it a "quad"? It would be a handy great length for many other purposes. For instance, the velocity of light in air would be 30 quads per second, in common glass 20 quads per second.

To avoid misunderstanding, it would have to be understood that the actual earth-quadrant passing through any given place is only approximately a quad, its real value having to be determined geodetically. A quad is to be understood as ten million metres *precisely*.

Another unit requiring a name is the unit of conductivity. Sir William Thomson has suggested the word "mho," but it has not been greedily assimilated. I make the small suggestion of omitting the *h*. True, the expressions 12 mo and 16 mo would at first excite only bookbinding ideas, but they would soon carry a fresh meaning to electricians. OLIVER J. LODGE.

June 13.

Units of Weight, Mass, and Force.

THE necessity for *names* for the units of velocity and acceleration is very clearly illustrated by a criticism of my "Dynamics for Beginners," which appears in the *Practical Engineer* of June 3. After objecting to the introduction of new names, and explaining that *a velo* stands for *a foot per second*, the writer proceeds:—"The second new name is 'celo,' and is meant for an acceleration of *one foot per second*, or unit acceleration; so that if a body is moving with a velocity which is being accelerated *at the rate of one foot per second*, it is said in the new language to possess one celo. In other words, a celo means *an acceleration of one foot per second*, or *of one velo*." The italics are mine. I cannot resist quoting also the following sentence, which occurs a little lower down in the same criticism:—"We think there is something ridiculous about the adoption of these names, which, while possessing the very questionable advantage of shortening the language of the subject by some two or three words, *serve to muddle the mind of the student, and to obscure the sense by wrapping it up in meaningless words.*"

Why is not the *Practical Engineer* consistent? He ought to state that just as a celo is unnecessary, for he considers it the same as a velo, in like manner a velo is unnecessary, for by the same line of argument it must be the same as a *foot*. The fact is that the names velo and celo are not *necessary* for scientific men, although I expect they will be found to be convenient. It is, I believe, generally admitted that some such words are greatly needed by teachers; for it is the clear mental differentiation of the ideas expressed by velo and celo, or the want of it, which often marks the distinction between a sound physicist and a muddler. JOHN B. LOCK.

Gonville and Caius College, June 4.

I AGREE with your correspondent, Mr. R. B. Hayward (NATURE, vol. xxxv. p. 604), in holding that names for the dynamical units are of less importance than a convenient notation for them. To invent names for the pound-foot-second units may be helpful to beginners; but it is a small matter compared with a notation which completely specifies the mode of dependence of each unit upon the pound, foot, and second; and it is still more so when compared with a general notation which will serve for any system of units.

The difference between names and notation is well seen in the case of chemistry. The notation for a substance expresses the manner in which the substance is made up of the elementary substances; while its name, however derived, serves merely as a distinguishing mark: and just as the chemical notation for a substance may be used as a name for the substance, so the notation for a physical unit may serve as a name for that unit.

In my work on "Physical Arithmetic," published by Macmillan and Co. in 1885, and reviewed in NATURE, vol. xxxi. p. 551, I have devised a notation which is the natural and legitimate extension of existing conventions both in language and in the mathematics; and I have made that notation the basis of a method for solving problems in applied arithmetic. If the Committee of the Association for the Improvement of Geometrical Teaching are considering the subject, I ask them to consider whether any notation more in harmony with existing conventions can be devised than the notation of that work.

As a specimen I append the general notation for the chief geometrical, kinematical, and dynamical units. The word *by* corresponds to ×, and the word *per* to ÷, or / as now frequently used by physicists. The same method of notation applies to the thermal and electrical units. The notation for any special system is obtained by substituting the special names of the fundamental units **L**, **M**, **T**. The test of the value of a notation is the amount of facility it offers in reasoning; by referring to "Physical Arithmetic," anyone may see how this notation stands the test.

NOTATION FOR GENERAL UNITS.

Quantity.	Notation.	Dimensions.
	I. *Geometrical.*	
Length	**L**	l
Surface	**L** by **L** = **S**	l^2
Volume	**L** by **L** by **L** = **V**	l^3
Angle	**L** arc per **L** radius	l^0
Sine	**L** opposite per **L** along	l^0
Curvature	Radian per **L** arc	l^{-1}
	II. *Kinematical.*	
Time	**T**	t
Velocity	**L** per **T**	lt^{-1}
Acceleration	**L** per **T** per **T**	lt^{-2}
Angular velocity	**L** arc per **L** radius per **T**	t^{-1}
	III. *Dynamical.*	
Mass	**M**	m
Density	**M** per **V**	ml^{-3}
Mass-vector	**M** by **L**	ml
Momentum	**M** by **L** per **T**	mlt^{-1}
Force	**M** by **L** per **T** per **T** = **F**	mlt^{-2}
Pressure	**F** per **S**	$ml^{-1}t^{-2}$
Work	**F** by **L** = **W**	ml^2t^{-2}
Activity	**W** per **T**	ml^2t^{-3}

ALEXANDER MACFARLANE.

Austin, Texas, May 28.

The New Degrees at Cambridge.

A FEW years ago it pleased the dominant body in the University of Cambridge to institute a Doctorate of Science and of Letters. Candidates for these new degrees were required to be of a certain academical standing, and to submit the proofs of their qualifications to the respective Special Boards of Studies, who, after certain formalities, were empowered to forward their claims to the General Board of Studies for approval. By many well-meaning persons this step was thought to be a great encouragement to both letters and science. It was at the same time understood that the qualification for the Doctorate in Science was to be rather less than was required for admission to the Royal Society—a standard which all will admit is not too high. Whether any similar understanding was agreed upon as regards the Doctorate in Literature is uncertain. At first there was no particular desire shown among the best men of science and literature to aspire to the new distinction, and it is rumoured that a considerable amount of persuasion and friendly pressure had to be used to induce such men to submit to the infliction. But in time a few leading lights underwent the ordeal and were duly invested. The way being cleared, a good many others have followed, and as the Boards have not been too severe in judging the claims of candidates, the outbreak of "scarletina" has become rather general. However, no particular harm has ensued, and the coffers of the University have reaped the benefit—for the fee is not small.

But now there is another aspect to this business. The new Doctorate is inferior in rank to that of the old Faculties. The senior Doctor in Science or Letters must always yield precedence to the youngest Doctor in Divinity, Law, or Physics. So far, those who have sought the new degrees have known what their position would be; but of late the Council of Senate has taken upon itself to determine that when an honorary degree should be given to any distinguished man of science or letters he is not to have the higher degree of LL.D., but to be content with the lower rank. As a rule honorary degrees are almost invariably given to strangers—foreigners or colonists. They are not aware of this fine though real distinction; and thus this very day the Senate House at Cambridge has witnessed the time honoured and highly valued distinction of LL.D. being conferred on a number of excellent gentlemen, beginning with the Lord Mayor of London, while the new and inferior rank of Sc.D. is bestowed on one of the most distinguished biologists of the United States, whom the sister University is this week to recognize as a D.C.L.

It may be urged that proceedings like this are necessary to reflect the proper amount of dignity on the new "honour," and that in time it will be regarded as highly as the old one has been. But I submit that this is not fair to the innocent recipients, and, moreover, that the University should recognize the fact that its highest honours are not to be bestowed upon successful merchants, politicians, and persons of eminent social standing, while the greatest men of letters and science have to take up with the lower grade. OUTIS.

June 20.

"After-Glows" at Helensburgh.

I BEG to inclose a letter from Mr. L. P. Muirhead, with reference to the "after-glows" recently seen at Helensburgh, which you may think worthy of a place in NATURE.

ROBERT H. SCOTT.

Meteorological Office, 116 Victoria Street, London, S.W., June 8.

Rosemount, Helensburgh, June 4, 1887, 21*h.*

DEAR SIR,—I do not notice any remarks in any of the weather reports or in the press concerning the after-glows, and as they may be local only, I drop you a line. All have lasted about 45m.; the first of any note, on the 17th, commencing well down on the eastern, and finally fading away on the western, horizon, all through of a deep rosy red reflected from the under and western side of cirro-stratus. Again, on May 21, 23, 29, 30, 31, and June 1. The last was peculiar, not only as being the most lurid, the cloudscape being marvellously fantastic, but, dying away at 21h., it revived faintly at 21h. 18m. to 21h. 30m., and again from 22h. to 22h. 20m., of a decided rose-colour on western side of roll-cumulus coming up from east-north-east. Thursday, Friday, and to-night there is no glow; overcast and oppressive just now; a little rain fell in forenoon. The glow reminds me, on a more intense scale, of that previous to January 26, 1884, and again on December 8 last year.

From May 21, until to-day, the weather has been genial and fine.

Faithfully yours,

LEWIS P. MUIRHEAD.

R. H. Scott, Esq., Meteorological Office, London.

Zirconia.

SOMEHOW I overlooked for a few days the letter of Messrs. Hopkin and Williams, which necessitates a brief reply, since they have confused (I am sure from mere haste) two samples, one of which I never had, and a correspondence most of which took place after what I had recorded.

Briefly, these are the facts. I was informed by Mr. T. Bolas that I could obtain "pure zirconia" of Messrs. Hopkin and

Williams at a certain price. This seemed to me so low that I asked them about it, when they did inform me that the reason was its occurring as a by-product. Nothing whatever was then said, however, about being "impure"; on the contrary, they inclosed two small fragments, one of which they said they sold as "pure," and the other (at half price) as "impure." The last was a light yellow-brown colour, and I never meddled with it; of the other I purchased an ounce for trial. On finding so much silica and soda I wrote them reporting, and asking if the sample was reduced by the hyposulphite process, as Dr. Draper had mentioned the difficulty of getting a pure product in that way. They replied that hyposulphite was used, and that the "pure" sample might possibly contain soda, but they thought not silica; the other sample might contain soda, silica, and probably iron. I wrote again pointing out that oxyhydrogen illumination was the most likely use for the product, and asking if they could not purify it further at an enhanced price, when they declined, as they state.

The difference is, that all this took place *after* I had purchased and tested the sample, and reported to them upon it. I inclose you copy of their price list of 1886, still later, in which you will see that "zirconium oxide" still appears without qualification; and I also forward the original bottle and label which I received from them—the latter you will perceive is "pure zirconia." The correspondence, if sent you in full, will bear out all the details above.

At the same time I would say that I had not the least idea of impugning in any way Messrs. Hopkin and Williams. I simply pointed out, as reference will show, the *generally* unsatisfactory character of samples considered commercially "pure" (one never expects ordinary purchased articles "pure" in any other sense) for one special purpose, and I much regret that their letter necessitates this correction. LEWIS WRIGHT.

P.S.—I am sorry to add that my previous letter has not elicited any very satisfactory information, or real aid towards the desired object. I learn from Mr. Cottrell that Du Motay's cylinders were unquestionably more durable than any prepared since, even with the aid of Prof. Maskelyne. But I am as unable as ever to come across one, or to find exactly how the material was prepared, or what light it gave in comparison with limes.

THE JUBILEE.

II.

WE have already referred to some aspects of the Jubilee which have a special relation to science, and we shall soon have occasion to return to the subject. In the meantime we reprint from the *Times* an admirable passage which presents a striking confirmation of the opinions we have expressed as to the true place of science in the history of the past fifty years. The passage is from the "Jubilee Retrospect" which appeared in the *Times* on Tuesday last:—

"The keynote of the Victorian era is the development of scientific research, the concomitant growth of practical invention, and the expansion of industry which these have brought about. Other ages have been fruitful of profound scientific conceptions, or have been illustrated by great inventions and discoveries, but it would be difficult to point to any half-century in the history of the world in which equal progress in speculative science has been combined with anything approaching to the magnitude, variety, and importance of the applications of science to practical ends which distinguish the present reign. It is as true to-day as at any former period that nothing great can be done in pure science save by men who make the discovery of truth the sole aim of their efforts, and who prize no other reward. But it is no less true that abstract and applied science go hand in hand as they never did before, and that each owns enormous obligations to the other. For if the triumphs of the workshop have been achieved by means of the discoveries made in the laboratory, on the other hand the laboratory depends for every step of its advance upon the technical skill and hitherto unrivalled precision of the workshop. Physical science has reached a stage at which the verification of its hypotheses and the supply of new data for its speculations demand appliances of extraordinary excellence, and in many cases a collation of experience and experiment which nothing but the practical inventions of the age could render possible. It is doubtless to the co-ordination of the two forms of intellectual activity that we owe the rapidity of recent advance. An unprecedentedly large army of inquirers has simultaneously pushed the interrogation of nature in a thousand directions, and has attained unprecedented results. But beside them has been working an army larger, and equally keen, of men eagerly seeking to utilize for practical ends every crumb of available information, and giving to scientific ideas a concrete application which often forms the starting-point for new processes of scientific induction.

"The fundamental conceptions of the material universe entertained by educated men have been revolutionized during the last fifty years. The simple atomic theory of the older chemistry has given place to a molecular theory, which itself has undergone considerable development. The outlines of the elements which the older chemistry accepted as an ultimate analysis are melting under the gaze of the spectroscopist, who across the haze of their wavering figures catches glimpses of a simple primal matter. The evolution of matter is, however, like the evolution of living forms, a philosophical conception which must always rest rather upon the general necessities of thought than upon actual experiment. The immutability of certain forms of matter in all the conditions that we can devise or have any experience of is as absolute as the persistence of specific types in the animal or vegetable kingdom. The most refractory substances have been vaporized in the electric arc, and the most attenuated gases have assumed the solid form under the combined influence of intense cold and enormous pressure. But we have made no nearer approach to actual evidence either of material evolution or of the complexity of the so-called elements than may be inferred from certain spectroscopic observations of the sun and some experiments tending to show that in some cases we have confounded two or more very similar elements under one name. Apart, however, from these abstruse speculations, the whole tendency of physical and chemical investigation has been to bridge the gulf formerly fixed between molar and molecular motion and between chemical and mechanical force. There is an obvious interdependence between this scientific movement and the doctrine of the conservation of energy, which is one of the main philosophical achievements of the epoch under discussion. According to that doctrine, the total energy of any body or system of bodies is a quantity as absolutely fixed and as incapable of suffering either increase or diminution as the matter of which these bodies are composed. Energy, like matter, may assume an endless variety of forms; but the force put forth by the locomotive is as indestructible as the particles which compose its framework or its fuel. But to balance our account we have to take cognizance not only of the forces of impact or pressure of which we have direct experience, and conceive ourselves to have tolerably full understanding, but also of the forces of attraction and repulsion in their various forms, concerning which we as yet know absolutely nothing beyond the fact of their existence as inferred from their effects. To refer the whole complex sum of these energies to a general law, and to deal with them on fundamental physical and mathematical principles, is the aim of the physical science of to-day. Notwithstanding all superficial resemblances, it stands differentiated from the science of all past ages by the clearness with which it apprehends the nature of this quest and the unrivalled range of the analytical methods it has brought to bear. In the domain of biology the theory of evolution, first placed upon a scientific basis by the genius of Darwin, is a product of the same great movement of philosophic thought which brought forth the molecular theory of matter and the doctrine of the conservation of energy. The idea of evolution itself was not new, but what was new was the proof that in the vast geological changes established by the labours of Lyell and other workers in the same field, in the visible tendency to variation in existing plants and animals, and in the evidence collected by Darwin's industry and observation of the power of the struggle for existence to exercise, in given conditions, a selective and protective influence upon occasional variations, we have all the data required for the construction of a coherent theory. Evolution has now definitely taken its place as a working scientific hypothesis, not, indeed, capable of explaining all the facts of biology, but consistent with these facts and furnishing—the most that a scientific hypothesis can ever do—the means of systematizing our knowledge in preparation for a further advance. The study of embryology is already modifying profoundly the interpretation put upon the evolutionary theory, and is probably paving the way for some new generalization. Mr. Herbert Spencer's application of the theory of evolution to the facts of social order is the expression, in the sphere of human thought and action, of the intellectual movement of which Darwin made himself the exponent in the field of biology.

"But striking as is the enlargement of the intellectual horizon during the last fifty years, the imagination is more powerfully impressed by the enormous extension of the applied knowledge which vivifies and transforms old industries, invents new ones, abridges the whole mass of social labour, annihilates the obstacles of time and space, destroys the enemies of the general well-being, and endows the whole population with conveniences, comforts, and luxuries which a century ago were beyond the reach of kings. It seems as if the tree of national effort, after long putting forth scanty leaves and rare blossoms, had suddenly borne a load of fruit. Knowledge, which had long lain dormant or had led only to slow and trivial change, seems suddenly to have acquired a new significance in the minds of men, and to have taken on a new and unprecedentedly rapid development. Physical science had made great advances between the age of Elizabeth and the close of the last century; but relays of swift horses represented at one period as at the other the most rapid attainable mode of travelling or of transmitting news. The power of steam had been practically utilized by Watt a hundred years ago, and the investigation of electrical phenomena had made great progress before the accession of Victoria, but the whole of the vast improvements in locomotion and the transmission of news which we now enjoy have been effected since that event. With the exception of one or two short lines, the whole railway system of the country is the creation of the last half-century, and its effect upon the fortunes of the nation can hardly be over-estimated. The England of to-day has, in fact, been rendered possible only by the railway system, which in turn has been fed by the industries it fostered, and depends for its very existence in the form we know upon the modern development of telegraphy and engineering. It is easy, but not particularly useful, to give statistics showing the growth of railway enterprise since George Stephenson began his task of developing steam communication. No figures can add to the impressiveness of the consideration that, whereas railways are now everywhere, fifty years ago they were practically nowhere. Our whole modern system of commerce has grown up around this efficient system of intercommunication, and depends absolutely upon rapid transit for its very existence. But the direct results of the application of steam to locomotion are probably trivial in comparison with its profound influence upon the social life and even the moral character of the nation. The population of the country, formerly attached to the soil on which it was born by necessities stronger than feudal custom, has been endowed with the power of easy, rapid, and comparatively cheap locomotion. For good and for evil the habits of mind belonging to an age characterized upon the whole by permanence of local relationships have given place to the habits proper to a time in which labour is nomadic, and all the relations of life in the remotest districts are profoundly affected by the attraction of distant centres of population. The immense increase of these centres, and the corresponding depopulation of rural districts, is one of the most obvious results, not, indeed, of railways alone, but of that industrial revolution in which they have played a central and indispensable part. That revolution may be defined as a great and sustained movement in the direction of economizing and organizing labour. Railways have powerfully promoted economy by reducing to a fraction of its former amount the time spent in the transport of goods and workmen, and they have no less powerfully promoted organization by equalizing conditions and combining a thousand isolated stores of industrial energy into one central reservoir. Nor must we leave out of sight the enormous effect they have produced by facilitating the transmission of correspondence and news. While the railways were yet in their cradle they were utilized for the carriage of the mails, but the whole postal system was so chaotic and inefficient that the public could have reaped but little advantage save for the drastic reforms advocated by Rowland Hill in 1837, and carried into effect, in spite of the opposition of the Post Office officials, in 1840. The establishment of the penny post, together with the novel rapidity and regularity of the service rendered possible by railway extension, is in itself a reform which in earlier ages would have sufficed to render a reign illustrious. It has been supplemented by a telegraph system which as far transcends the penny post as that surpasses the clumsy and costly system of the last century; and the telegraph is in turn yielding the palm to the telephone, in the use of which, however, this country, owing to the obstructiveness of the Post Office, is far behind America and some Continental States.

"The maritime supremacy of this country was fully established long before the accession of Victoria, and the marine steam-engine was familiar long before the locomotive. Patents for screw propellers were even taken out a century ago, although they were not successfully applied until 1837, when Ericsson attained a speed of ten miles an hour. In the following year the *Great Western* performed what was then the extraordinary feat of making the passage from Bristol to New York in eighteen days. Considerable success had thus been attained before the present reign in the application of steam to marine transport, but the advance that has since been made is not less remarkable than the improvement in land transport. The voyage to New York is now performed in six days, and ships are actually sailing between Liverpool and the Isle of Man at a speed equivalent to doing the New York passage in five. But the real measure of the revolution that has taken place must be sought in the supersession of sailing vessels by steamers for all the purposes of commerce, and the consequent multiplication of the resources of industry. At the beginning of the reign the tonnage of British steam-ships was considerably under 100,000 tons. It is now about 4,000,000. But just as the immense growth of railways has not prevented a large increase in the traffic of the canals, so has the increase of steam-shipping left room for an addition of 50 per cent. to the tonnage of British sailing-vessels. The increase of steam-tonnage taken alone gives but an imperfect idea of the progress that has been made. For by continual improvements in marine engines each ton of shipping is moved at a greatly increased rate and a greatly diminished cost; while, as regards a very large and important portion of our trade, the opening of the Suez Canal, to which we supply four-fifths of its traffic, has still further economized time and labour. In this connexion by far the most important achievement of recent years is the opening of the Canadian Pacific Railway, and the establishment of a line of steamers connecting its western terminus with India, China, and Japan. We thus gain a shortened route to the East, passing entirely over great ocean highways and British territory instead of through a land-locked sea and a narrow gut which accident or design may at any moment render impassable. In view of the expansion of commerce during the last half-century, and of the immense undeveloped resources of Canada, it would be rash to set any limits to the future possibilities of this great Imperial highway.

"The universal acceleration of locomotion and transit is the most extended and general application of science to the great modern purpose of economizing labour and time. Every department of industry can, however, show special applications for effecting the same result."

ATLANTIC WEATHER CHARTS.

THE Meteorological Council has recently issued the second part of the Synchronous Weather Charts for the North Atlantic and the adjacent continents, the folio just published embracing two charts for each day from November 8, 1882, to February 14, 1883. The first part was noticed in NATURE, vol. xxxv. p. 469, when we gave a somewhat detailed explanation of the charts and the observations upon which they were based. The second part embraces a very large portion of an English winter, and the conditions pictured over the Atlantic show that the weather over that ocean in winter is far more disturbed than it is during the summer months. The barometer in the winter ranges both higher and lower, and the changes of pressure are much more rapid and considerable. The movements of the travelling disturbances are also accelerated, and keep in a much lower latitude, the British Islands coming frequently under their full influence after they have passed over the warm and moist air of the North Atlantic. In the summer the barometer is above 30 inches over the greater part of the ocean, but the highest readings seldom exceed 30·3 inches, whilst the areas of low pressure, the readings at the centre of which are seldom especially low, ranging for the most part from 29·2 to 29·5, skirt to the north of the high-pressure area, and pass as a rule well to the northward of the United Kingdom. At times these low-pressure areas scarcely influence our weather. At other times, when from some cause the high-pressure area is situated in rather a lower latitude than usual, the low centres will have a more southerly route in their passage from west to east, and will occasion disturbed weather over our islands, but for want of sufficient difference of barometric pressure will but very seldom materially augment the strength of the wind. If, however, this southerly track of the disturbances is maintained for any length of time in the summer, it will have a very marked effect upon our weather, occasioning frequent and heavy rains; it was this which caused the entire failure of real summer weather in 1879. The winter charts show that the barometer often ranges as high as 30·5, 30·6, and 30·7 in Mid-Atlantic, whilst on the adjacent continents such readings are common, and in North America much higher readings occur—on February 1 the mercury reached 31·1 inches. The charts do not extend to Siberia, but it is notorious that excessively high readings are commonly experienced there during the winter months. The low-pressure areas which are principally limited to the ocean, and almost solely to the northern latitudes, frequently have the barometer at the centre below 29 inches, and occasionally below 28 inches. With these differences of barometric pressure there is ample material for the development and maintenance of storm systems; and the most cursory examination of the charts shows to how great an extent storm after storm rages almost daily in one part or another of the Atlantic, and frequently several storm areas exist at one and the same time. This second series of charts illustrates in the most unmistakable manner the behaviour of storms over the Atlantic: many a disturbance can be traced in its progress for days together. On November 13 a storm area was passing over the north of France, and was occasioning strong easterly gales in the south of England and the English Channel. This disturbance can be traced back day by day until November 3, when it was in the vicinity of the West Indies, where it was apparently bred. The severe storm which was blowing over the British Islands on November 19 was apparently formed over central North America on November 9, and, after travelling slowly over the Lake District, left the Gulf of St. Lawrence on November 14, and followed a north-easterly track, but, after passing over the south of Greenland, it took a more southerly course, the centre subsequently passing between Iceland and Scotland. A fairly good specimen of storm development is shown on the charts of February 7 and 8: on the 7th, a bend is shown in the isobars of 29·0 and 29·1 at about 300 or 400 miles to the west of Ireland, and this on the following day becomes a closed area with its complete wind circulation; the disturbance, however, dies out again on the 9th. A feature of very special interest in the charts is the size of some of the disturbances: this stands out clearly from the graphic manner of representation. There are many instances of a gale blowing simultaneously in America and Europe, due to the same storm area, and in these cases the area of low-barometer readings usually occupies the whole of the northern part of the Atlantic, whilst over the land, both in Europe and America, the barometric pressure ranges very high. On January 23, as the result of a single low-pressure area, a gale was blowing in Hudson's Bay, Labrador, and Newfoundland, and completely across the Atlantic to the North Sea and the north of Norway, the diameter of the area over which the wind was blowing with gale force, being as much as 3800 miles (nautical); the centre of the storm was situated off the south-west coast of Greenland, where the barometer was reading 28·2 inches, whilst in America and Europe the barometer reached 30·8 inches. An almost equally large disturbance is shown on February 10, the gale force extending quite across the Atlantic from Labrador and the Gulf of St. Lawrence to the Gulf of Bothnia, the diameter of the gale area being fully 3000 miles.

The equatorial doldrum is shown to be of less extent than the general charts which have been deduced from averages would lead one to suppose, and very frequently the north-east and south-east trades almost meet. Between longitudes 20° and 30° W., the position at which the trades meet in November is about 5° N., in December about 3° N., whilst in January and the early part of February the south-east trade only just blows north of the equator, and the doldrum is probably at this time at its most southern limit. The north-east trade is far more regular on the eastern side of the Atlantic than in mid-ocean or on the western side, and this is fully accounted for by the fact that the wind blows round the Atlantic high-pressure area in agreement with the ordinary anticyclonic circulation, so that on the eastern side of this high pressure which is also, as a rule, the eastern side of the Atlantic, the wind is northerly, whereas to the westward of this area of high barometer readings the winds are frequently from the southward. The northern margin of the trade varies considerably, and is almost entirely dependent on the position of the area of high barometer situated over the Atlantic; when this area is well to the northward the northerly winds hold from the chops of the Channel down the coast of Africa to about 5° N., so that a vessel may leave England and keep a steady northerly and north-easterly wind until close to the equator.

The winter charts also show that the differences of temperature are much larger over the Atlantic than they were in the summer or autumn series, and the isotherms of both air and sea run much closer together. On November 25 there is a difference of 30° in the sea temperature in the distance of 340 miles to the south-east of Newfoundland, whilst on the eastern side of the Atlantic the same difference of temperature, 40° to 70°, spreads over 2360 miles. This disparity between the difference of temperature on the western and eastern sides of the Atlantic is quite common throughout the whole period of the charts, but not always to so large an extent. The charts of December 15 and 19 are other instances which show this difference, and on January 6 there is a difference of 30° (from 30° to 60° F.) in 120 miles off the south of Newfoundland, whilst on the eastern side there is only an equal difference of temperature (50° to 80°) in 3300 miles. The largest differences of temperature occur between latitude 40° and 45° N., and longitude 40° to 60° W., which is the area most affected by the meeting of the warm water of the Gulf Stream and the cold Polar current, and the weather which is given on each chart shows that there is almost constant rain in this position, and it is also the breeding-place of many a storm area, and storms when generated have a decided tendency to keep in the track of the Gulf Stream.

These synchronous charts will materially aid investigators in tracing the connexion between the weather in the British Islands and that over the Atlantic, and as it is not possible at present to know what is going on immediately to the westward of us, it is the more necessary to deduce, if possible, laws which regulate the changes from time to time. By the publication of these charts the Meteorological Council afford opportunity for testing many theories. Among these may be mentioned the theory of indraft of wind towards the centre of a cyclone, if this is not already pretty conclusively proved Light is also thrown upon the question as to the position of rain with regard to the position and development of the general storm area, and upon many other inquiries of a similar nature. We hope that after the two remaining parts of the work have been completed the Council will see their way to undertake a thorough discussion of the material which the charts contain.

A REVIEW OF LIGHTHOUSE WORK AND ECONOMY IN THE UNITED KINGDOM DURING THE PAST FIFTY YEARS.[1]

II.

THE fifty years of the present reign have been distinguished with regard to lighthouse illumination by the development in this country of the beautiful dioptric system of Augustin Fresnel. In 1837, this system had been established in France fifteen years, but had only just been introduced into Britain, where the catoptric system was in full operation. Parabolic reflectors formed of facets of silvered glass were used in the Mersey lighthouses so far back as 1763, and at Kinnaird Head, in Scotland, in 1787. In 1804, perfected reflectors of silver plate rolled upon copper were used at Inchkeith, and similar reflectors have been ever since employed. To Teulère must be attributed the honour of the invention of these parabolic mirrors, in 1783. The Inchkeith Lighthouse is also notable as the first in Britain to receive a Fresnel apparatus (1835), through the exertions of Alan Stevenson, who placed the next one at the Isle of May (1836), and the third at the Start (1836). These lights were all of the first order, Start and Inchkeith being revolving, and Isle of May fixed. They were constructed by Messrs. Cookson, of Newcastle, who subsequently constructed at least a dozen others, mainly as regards the refracting portion.

The lenticular system, as received from Augustin Fresnel by Alan and Robert Stevenson, comprised four principal optical agents of glass, viz. the cylindrical refractor, the totally-reflecting prism, the refracting vertical prism, and the annular lens. These have been continued in use, with few modifications, until the present day, while his auxiliary elements, such as the small inclined lenses, the silvered metallic zones, and the plane silvered glass mirrors, have been abandoned. The first-order fixed light of Fresnel came well-nigh complete from his hands, and has remained unchanged in size and character, save as relates to the number of prisms above and below the lenses, which has been increased from 19 in all to 26, and as to the joints of the lenses, which have been made inclined instead of vertical, the latter improvement being due to Alan Stevenson, who also introduced a refractor of more truly cylindric form. It is in the apparatus of revolving sections that the most striking ameliorations have been effected. The French engineers added little between 1822 and 1852 to Fresnel's original work, a few combinations or modifications of his elements to produce flashes alternately with fixed light being nearly all. But between 1849 and 1852 the great improvement known as the holophotal system was elaborated by Mr. Thomas Stevenson. It is difficult to describe without drawings the various applications to both catadioptric and dioptric instruments of this principle, by which the light of maximum intensity, or the best utilization of all the rays, was attained. The first *catadioptric* holophote was employed at the North Harbour, Peterhead, in 1849. Better forms were realized in 1864. The first use of holophotal metallic mirrors above and below the annular lenses of a large revolving light was at Little Ross. These mirrors, which needed no small auxiliary Fresnel lenses, were, instead of being plane, like Fresnel mirrors, generated by a parabolic profile passing round a horizontal axis. The typical *dioptric* holophote is a central refracting lens of usually three elements, with a series of concentric holophotal totally-reflecting rings, forming an instrument of varying diameter and focal distance, condensing into a parallel beam all the front arc of the diverging sphere of rays. The holophote is perfected by a glass spherical mirror of totally-reflecting prisms so shaped and set as to return all the back hemisphere of incident rays through the flame, to be parallelized and sent out with the front hemisphere of rays. This spherical mirror in its most effective form was the invention, in 1861, of Mr. James Chance, who generated the double-reflecting prisms or zones round a vertical instead of a horizontal axis, separated them, and divided them into segments or panels, thus making it practicable to increase the radius of the mirror and apply it to the largest apparatus as a most useful adjunct. In this instrument the image of the flame is not reversed, and the light sent back is at least three-fourths of that received.

But the most important application of the holophotal system was to the dioptric revolving sea-light. The totally-reflecting zones above and below the refracting lenses were generated round a horizontal instead of a vertical axis, and made to work in complete unison with the lenses, the light being parallelized in every plane from top to bottom. The first holophotal sea-light was the North Ronaldshay, in 1851. Since that date every revolving light with prisms has been holophotal. It has been estimated that the modern plan gives light five or six times more intense than the original plan.

Another material addition to the resources of the lighthouse engineer has been contributed by Mr. Thomas Stevenson in the azimuthal condensing system. This is, briefly, an arrangement of the optical agents before described, and of some others specially devised, by which either one arc of the horizon is illuminated by a beam of the greatest attainable intensity while the rest is dark, or else two or more sectors are lighted with equal or with unequal intensity while the others are dark ; these distinctions being governed by the nautical requirements as to range and direction of the sea-coast, channel, or harbour

[1] Continued from p. 105.

where the light is established. The beams thus sent out may be white or coloured, the differences in coloured media themselves, or, as compared with white light, being equalized approximately by the instruments used. The condensing method has been applied more freely to the smaller than to the larger orders of apparatus during the past twenty-five years; and among the most beautiful illustrations of the system, designed not alone by Mr. Stevenson, but by Mr. Chance, Mr. Alan Brebner, and Dr. Hopkinson, may be cited the Buddonness, the Isle Oronsay, the Lochindaal, the Dartmouth, the Hoylake, and many apparatus for certain narrow seas in Australia. But the large lights of Orme's Head, Dungeness, Bidston, Longships, St. Tudwal's, Dublin Bay, and McArthur's Head, may also be selected as good examples of the condensing plan.

A third and very valuable improvement is the group-flashing system of Dr. John Hopkinson, F.R.S., by which a new series of characteristics has been added to revolving lights. This invention dates from 1874, and consists in so shaping and combining on unequal axes the panels of an apparatus that a double, triple, or fourfold flash may be produced, each flash of the group being of such duration and divided from another flash by such an interval of time that compass-bearings may easily be taken from the ship; while each group is separated from another group by a longer interval, the whole period being one of the usual periods of revolving lights, such as half a minute. Thus, while adequate power is maintained for each flash, an unmistakable distinction is established. This plan became rapidly popular. The Trinity House were the first to apply it, in 1875, to the catoptric floating light on the Royal Sovereign Shoals, near Hastings. The next applications were to a dioptric light for Mexico, and to the Little Basses light, Ceylon. It is now used all over the world. At the Casquets, in 1876, it enabled the Trinity Corporation to dispense with two of the three lights hitherto employed, and show from one tower a half-minute light in triple flashes, each lasting two seconds, each interval between them three seconds, and the long interval between the groups eighteen seconds. The great lights of Bull Point, Hartland Point, and Eddystone are other examples of double and triple group-flashing by optical combinations.

The use of colour in lighthouse practice has been gradually diminishing since 1837, and is now almost restricted to harbour-lights and ship-lights, with a few cases of fixed sea-lights where a danger is to be marked over a narrow sector. The loss by absorption in red and green, the only two colours available, being from 60 to 80 per cent.—a loss slightly redeemed in the case of red by a certain relative superiority to white in thick weather—it is obvious that colour must sooner or later disappear from the list of effective lighthouse agents. Meanwhile the power of a coloured beam (without regard to the illuminant) has been optically enhanced by one of two methods, superficial amplitude and azimuthal condensation.

Where a revolving light is to show, in alternate or other series, red and white beams, the power may be approximately equalized by assigning to the red a certain greater angular breadth in the panels of prisms and lenses than to the white. The Wolf Rock light (1869), the Flamborough Head (1872), the Hartland Point (1874), were so treated by Mr. James Chance, though with different arrangements of panels, the average proportion being 73 for the red, and 27 for the white. The coloured glass plates used were of a selected tint of "copper ruby." The second method, condensation, is mainly applicable, as before mentioned, by means of vertical prisms and other agents to lighting sectors of the horizon, or to securing perfect definition between two coloured arcs or between a white and a coloured arc. The Kingswear fourth-order light, Dartmouth (1865), designed by Mr. Chance, is an excellent example. In a seaward arc of 45° there is a central white beam of 9½° between a red beam of 17¾° and a green beam of 17¾°. Ten vertical prisms were used, four condensing the lights on the border of the red and white, and four on the border of the green and white, while two augmented the central beam. The fairway channel to the harbour is indicated by the coloured light, and the bright beam constitutes a sea-light which is frequently observed at a distance of sixteen miles, though the lamp is inferior to the lamps of to-day.

The signal-lights of the port and starboard sides of a vessel are coloured in order that a marked contrast may be visible at a distance of at least two miles, and her course and evolutions plainly understood. But the great inferiority of green to red, and of both to white (the third signal carried by a steamer being a white light), combined with the imperfection of the optical apparatus and of the burner used, renders too many ship-lights lamentably untrustworthy at even this short range, and can only tend to multiply such terrible collisions as those with which we have become familiar during the past fifteen years. It might be impracticable, on account of weight or cost, to introduce condensing agents into side-lights generally, though Mr. Thomas Stevenson, ever foremost in the van of improvement, tried them on the small steamer *Pharos* in 1866; but there can be no sufficient reason for not adopting such lenses of true lighthouse types as are now made for the purpose in Birmingham and Paris, and in not fitting them with the incandescent electric light in two different degrees of power, so as to equalize nearly the red and green lights, and in not making them both equal in visibility to the white; thus securing an effective signal for the adequate protection of life and property at sea. The writer has long, but with small success, advocated this course. Public opinion, however, may yet be stimulated by some crowning disaster to insist on a reform so urgently needed, and so perfectly easy to realize.

In 1873 the first dioptric light established in England, Start Point, received its present apparatus in substitution for the old Fresnel lenses and concave mirrors. The new revolving light, the design of Mr. Chance, and which was repeated in 1874 at Cape Bon, Africa, and the South Stack Rock, Holyhead, was composed symmetrically of six sides of 60°, with the usual upper and lower prisms, the central lens having nine elements in circular settings. The panels are thus the widest in azimuth hitherto constructed, except some of those of Flamborough Head, which subtended 69½°, or the four holophotal quadrants constituting the South Stack Low Light (1879), designed by Dr. Hopkinson, and the only existing light of the kind. By a subsidiary arrangement of totally-reflecting prisms and a holophote, a fixed red beam at Start Point was projected to a lower chamber in the tower, and thence sent out to mark the position of certain rocks. The Watling Island (Bahamas) second-order double-flashing light of 1885, designed by Dr. Hopkinson, is a unique specimen of holophotal circular settings, with the most recent improvements.

A remarkable variation of the usual elements of a dioptric sea-light dates from 1879 or 1880. Lower prisms for sea-lights had, at the suggestion of the writer in 1874, been suppressed on several occasions; and for port-lights, Messrs. Chance had dispensed with all prisms, and raised the lenses to a vertical angle of 80°. But now it was determined to produce a first-order apparatus with refractors only, extending the vertical angle to 92° from 56° or 57°, the old normal height. This was attained by Messrs. Chance by means of dense flint glass in the superior and inferior limits. The power of the lenses, always counting for 75 per cent. of that of the complete light, was thus considerably augmented, while the cost and bulk were reduced, though doubtless at the expense of symmetry. The first-order lights, Anvil Point (Dorset), the Eddystone, and the Minicoy (Indian Sea), were constructed on this principle at Birmingham (1880–83). In the case of the Eddystone, two apparatus exactly alike were employed by the Trinity House—one superposed on the other, and each lighted by its own lamp, the whole height of optical glass exceeding 12 feet. The plan of superposed lenses was first suggested, in 1859, by Mr. J. W. D. Brown, of Lewisham, and first practically set forth, in 1872, by Mr. John R. Wigham, an engineer of conspicuous ability, in connexion with his large gas flames for Irish lighthouses; and it has been since fully approved and adopted by the Trinity House. The great lights of Galley Head, Howth Bailey, and Rockabill attest the excellence of this arrangement of lenses, and the Eddystone biform (1881) is not less successful.

The enhancement of illuminating power through the amplification, vertical and horizontal, of lenticular panels has been described. But a more emphatic change, associated with the name of Stevenson, has recently been consummated. The radius or focal distance of Fresnel's first-order light is 920 millimetres. The Fresnel of our time proposed a radius of 1330, and such a lens has been already constructed in France. The name "hyper-radiant," given to it by Mr. Stevenson, seems hardly so accurately formed as "hyper-radial," which was independently suggested by the writer in 1885, although the new lens will be excellently adapted to the large flames of the day, at once utilizing their volume and not suffering from their heat. In the lights for the Bishop Rock and Round Island (Scilly) now (1887) being prepared by Messrs. Chance for the Trinity House, the apparatus will be of the hyper-radial type, and it will have a vertical angle of 80°, with glass all of the usual refractive index. There will be for each lighthouse a biform structure 15 feet high, the Bishop having lenses for white double flashes arranged in a pentagon of five groups, each lens subtending 36° horizontally, with an eight-wick burner; and the Round Island having lenses for red single flashes, each lens subtending 60° horizontally, with a ten-wick burner. Petroleum will be used in both cases. The latter apparatus would seem to mark the maximum limit of dimension, with regard to optical agents and to illuminants, compatible with the present conditions of lanterns and towers. Hyper-radial apparatus is also being prepared in Paris for the Tory Island and Bull Rock lights in Ireland.

But the true maximum of power or intensity for lighthouses must ever be sought in the electric light. This application of the branch of physical science that has perhaps more than any other distinguished the Victorian epoch had its experimental beginnings, under the auspices of Faraday, at Dungeness and the South Foreland. The apparatus used at Dungeness was of 150 millimetres radius. In 1881 the apparatus for Macquarie was constructed of 920 millimetres radius. Six large electric lights have been established in Britain since 1862, all the work of Messrs. Chance, and all of their design except the Isle of May, which was planned by Mr. Thomas Stevenson. The Souter Point light, revolving, of second and third order elements, dates from 1871; the South Foreland, High and Low, fixed, of the third order, from 1872; the Lizard fixed lights, of the third order, from 1877; and the Isle of May, which gives a fourfold flash, and is of first and second order radii, from 1886 In addition, there have been designed by Dr. Hopkinson, and made at Birmingham, the Macquarie (Sydney), a first-order revolving, the most powerful light in the world, and the Tino (Spezia), a second-order triple group-flashing light. It is needless to give details of these apparatus, which are throughout distinguished by skilful optical combinations and the utmost precision of workmanship. They have all been, with the exception of the Isle of May, the subject of elaborate papers and exhaustive discussion before the Institution of Civil Engineers. An apparatus of the second order is being prepared at Birmingham for the new electric light of St. Catherine's (Isle of Wight). It is composed of refractors only, extended to 97° of vertical angle, and with certain special arrangements for divergence. The carbons will be of 50 millimetres diameter and of a novel and perfect form.

There has been during the past fifty years, but especially since 1861, with regard to lighthouse characteristics, a selective process in operation by which the fittest have survived. Not only has the optical apparatus been perfected in curvature, finish, and adjustment to nautical conditions, and the intensity of light increased threefold, but the weaker forms of distinction have been suppressed, and the better forms retained and multiplied. Fixed lights for the most part have been discontinued, and, in this country at least, lights composed of fixed and revolving portions. Long periods in revolving lights have been altered to short periods, the uncertain aid of colour largely abandoned, the varieties of the group-flashing system invoked, and the quick contrasts of light and dark resorted to in occulting or intermittent apparatus, although the very ingenious but too complicated plan of Babbage, with its rhythmical longs and shorts, has not prevailed. The enhanced speed of steam-vessels, the multiplication of all kinds of vessels, the improvement of shore-lights, and the spread of commercial enterprise, by which new ports are opened and new coasts explored, have naturally effected these changes. And, *pari passu*, striking improvements in the mechanism of revolving carriages and of clockwork both with weights and springs, in occulting-cylinders and gun-metal framing of apparatus, have resulted from the combined efforts of our best lighthouse engineers.

The early rivalry between the catoptric and the dioptric systems has wholly ceased, the latter having, by the weight of its general and well-tried superiority, displaced the old system in all directions save in one or two revolving sea-lights of exceptional merit, like Beachy Head or St. Agnes, and save in all light-vessels where the excellent 21-inch reflectors, with the two-wick Douglass burners, often send out beams of 20,000 candles over the shoal-beset waters.

There were in the United Kingdom, in 1886, 202 sea-lights, of which 147 were dioptric and 55 catoptric, and, in addition, about 450 small lights of all kinds, making, with the 74 light-vessels, a total of about 730. Surely this is a noble growth of lighthouse illumination, even in the long period under review. It compares not unfavourably with the United States, the first country to adopt the lenticular system on a bold and comprehensive scale, or even with the country of Fresnel himself and of his brother Léonor, where the elucidations and experiments of Allard and of Reynaud, and the practical work of Lepaute, Sautter, Barbier and Fenestre, have done much to promote science and benefit humanity.

J. KENWARD.

(*To be continued.*)

THE OBSERVATORIES AT OXFORD AND CAMBRIDGE.

THE following is the Annual Report of the Rev. Prof. Pritchard, the Savilian Professor of Astronomy at Oxford, to the Board of Visitors of the University Observatory; read June 8, 1887:—

I. *Lectures.*—The statutable lectures have been given, and the Observatory and its instruments have been freely accessible to the students during every day of Term time. For next Term I offer a course of elementary lectures expressed as far as possible in untechnical language. I desire to add also two public lectures on the development of astronomy during the last century.

II. *Instruments.*—As a matter of practical convenience, portions of both the equatorial instruments have been within the last day or two placed in the hands of the opticians, with a view to modifications or repairs which shall render them applicable to the entirely new departure which is now in progress in respect of the processes and methods of practical astronomy. The De la Rue equatorial, which has long possessed an historical value, has been rehabilitated mainly at the expense of Dr. De la Rue in certain of its more delicate working parts, and this has been so advantageously completed that Dr. De la Rue has been induced to introduce still further renovations, whereby that instrument will be placed in a condition probably equal to that in which it first left its designer's hands.

The mounting of the large equatorial refractor, originally supplied at the expense of the University, is now required for some experimental inquiries suggested by the Photographic Committee of the Royal Society. Dr. De la Rue has supplied two mirrors of 15 inches aperture of different focal length, and these are to be mounted alternately on the tube of the refractor, together with a camera as arranged by Mr. Grubb. The expense of these valuable additions is borne by the Royal Society and by Dr. De la Rue. The delicacy of the projected inquiries necessitates the electrical control of the driving-clock.

The transit-circle recently presented to the University by Mr. Barclay has realized my expectations of its excellence. I find it to be thoroughly stable, and sufficient for all the purposes required, whether for University instruction or for accurate meridional observations. In the latter respect it completes the Observatory equipment. The electrical illumination of the circles and other necessary parts has proved entirely successful, and the general aspect of the instrument as it stands on its massive piers is such as to suggest confidence.

III. *Buildings.*—The fabric of the building and its complicated roofs and domes are in excellent substantial repair, and will require no outlay that I can foresee during the present year.

IV. *Astronomical Work.*—The somewhat hazardous enterprise of attempting for the first time in the history of astronomy to obtain the distance of the fixed stars from our earth by the aid of photography has been attended with success. The final results of the investigation have been placed in my hands only during the writing of this Report. The first observation was obtained on May 26 of last year, and the last was effected on May 31 of the present year. The intermediate computations were systematically continued during the interval. They involved the reduction of no less than 30,000 bisections of star images, on 330 photographic plates, procured on 89 nights. Eight independent determinations of the parallax of the two components of 61 Cygni resulted from all this work, and these happily indicate a substantial agreement between themselves, and afford other necessary proof of reliability.

By a happy coincidence, on the very day when the final results of these investigations were evolved, I had the pleasure of a visit from Her Majesty's Astronomer at the Cape of Good Hope, a practical observer whose experience in parallactic investigations is probably unrivalled. His remarks, after critical examination of the entire work, have encouraged and gratified me. Astronomical photography is hereby placed on a secure basis as an efficient and exact exponent of the highest form of astronomical science.

Simultaneously with these observations, similar work has been in progress for the determination of the parallax of μ Cassiopeiæ and Polaris. These observations will now be treated on a less laborious scale. Photographic plates of the Pleiades have also been taken with the view of obtaining the accurate relative positions of about one hundred stars therein. The necessary triangulations have been commenced.

I should say that the experimental investigations required by the Photographic Committee of the Royal Society originated in the necessity of ascertaining what are the limits of accurate field obtainable from mirrors of different focal lengths: the inquiry had distinct reference to the questions which were open for discussion at the recent Paris International Conference. I deeply regret that I was unable to fulfil my intention of taking part (as invited by Admiral Mouchez) in that important meeting.

V. *Finance.*—The funds granted by the University have been sufficient, notwithstanding the continuous activity, which requires a corresponding continuity of outlay. This grant, hitherto triennial, expires on December 31 next. If the Board of Visitors see fit to request the University to continue this grant for five years, it would assist me in undertaking, for the University, a share in the production of a photographic map of the heavens, a valuable and extended class of work, which under other circumstances I should not be justified in contemplating.

The details given above testify without further words of mine to the unwearied perseverance and intelligence of my two able assistants, Mr. Plummer and Mr. Jenkins.

Prof. J. C. Adams has just presented the Report of proceedings in the Cambridge Observatory, from May 27, 1886, to May 26, 1887. From this Report we take the following extracts:—

The total number of observations made with the transit-circle during this interval, for determinations of right ascension and north polar distance, is 2253.

These include 726 observations of clock stars made on 151 nights; 68 observations of Polaris at the upper transit involving 169 circle readings, and 61 observations at the lower transit involving 149 circle readings; 1331 observations of zone stars made on 88 nights; and 67 observations of stars compared with the minor planet Sappho.

For instrumental adjustment, the nadir point was observed 218 times, the bisections of the declination wires with their images being in every case made in two positions of the observer, on the north and south sides of the tube respectively; the level and collimation errors were each observed 217 times.

At the request of Mr. Bryant, F.R.A.S., the planet Sappho was compared with adjacent stars 70 times on 7 nights from January 12 to February 2, by means of the Northumberland equatorial and square bar micrometer for differences of right ascension and declination. Before the end of February all the compared stars were repeatedly observed with the meridian circle; and in addition to this 9 stars which had been compared elsewhere with Sappho.

State of the Reductions.—The true right ascensions are obtained up to February 17, 1887, and the true north polar distances to April 27, 1887.

The mean right ascensions and north polar distances for January 1, of the standard stars are calculated to the end of 1886, as are also nearly all the observations of stars made in the present year for comparison with Sappho. The mean R.A. and N.P.D. of the zone stars are similarly reduced up to the end of 1881. The right ascensions of zone stars are reduced to the epoch 1875 as far as March 16, 1878, and the north polar distances to March 1880.

The collection of the observations of the zone stars for the Catalogue has been commenced.

A fresh determination of the intervals of the right ascension wires from 73 observations of Polaris, from 1885 November 17 to 1886 July 6, was completed on July 12. As no change seems to have taken place in the wires, the results were combined with those previously obtained: so that the final determination rests on 145 observations of Polaris made from 1885 January 21 to 1886 July 6. These intervals were used till 1887 March 3, since which time another determination, from 78 observations of Polaris, from 1886 July 7 to 1887 April 27, has been used.

Sixty-five observed north polar distances of Polaris above the pole, deduced from observations made in 1886, with observed nadir point and assumed colatitude 37° 47′ 8″ 4, and corrected for flexure and errors of division, give a north polar distance less than that given in the *Berliner Jahrbuch* by 0″·557: 68 observations below the pole, treated in the same way, give a polar distance greater than the Berlin one by precisely the same quantity. Thus our polar distance of Polaris for 1886 is exactly equal to the Berlin one, and the correction of assumed colatitude is + 0″·557; results very similar to those of previous years.

The observations of Polaris above the pole, direct and reflected, made by Miss Walker on 1886, April 8, May 3, 4, and 6, when corrected for errors of division and for refraction, give for the colatitude 37° 47′ 8″·853. The mean for eight years, given in the last Report, is 37° 47′ 8″·854.

579 observations of clock stars made by Mr. Graham in 1886, Mr. Todd in nearly every case reading the circle, give, as a mean value for reduction to the Berlin N.P.D. + 0″·353; or, if we take the means for each separate night as of equal weight, + 0″·319. These have not been corrected for errors of division and flexure, which, for the limits of the zone, 60°-65° N.P.D., have probably a mean value of - 0″·26 or thereabouts; this would have to be applied with an opposite sign to the above means: but the results for intervals of 1° show that the errors of division ought to be determined for each star, as they have been for Polaris and for the nadir point.

Meteorological Observations.—The meteorological observations continue to be communicated daily by telegraph to the Meteorological Office.

The sunshine recorder has been regularly employed, and the records are sent at intervals to the Office.

NOTES.

IN the distribution of Jubilee honours the claims of science have not been forgotten. Among those who have been raised to the peerage we are glad to see the name of Sir William Armstrong, C.B., F.R.S. The honour of knighthood has been conferred upon Warington Smyth, Esq., F.R.S.; Dr. Garrod, F.R.S.; G. H. Macleod, Esq., Queen's Surgeon, Edinburgh; and J. Wright, Esq., C.B., late Civil Engineer to the Navy. Among the new Knights Commanders of the Bath are John Simon, Esq., M.D., C.B., F.R.S., late Medical Officer, Privy Council Office; and Capt. Douglas Galton, C.B., F.R.S.; Prof. W. H. Flower, F.R.S., British Museum, and Prof. Brown, Agricultural Department of the Privy Council, have been made Companions of the Bath.

THE names of the following gentlemen have been added to the list of the Tyndall Dinner Committee:—The Duke of Northumberland, President of the Royal Institution; Sir W. G. Armstrong, F.R.S., ex-President of the Society of Mechanical Engineers; Dr. Haughton, F.R.S., President of the Royal Irish Academy; E. H. Carbutt, Esq., President of the Society of Mechanical Engineers; and G. B. Bruce, President of the Institution of Civil Engineers.

MR. HARFORD J. MACKINDER, M.A., has been elected Reader in Geography at the University of Oxford.

IN the Report on the Oxford Observatory, which we print to-day, reference is made to important improvements effected, either wholly or in part, at the cost of Dr. De la Rue. We may add to what is there stated that Dr. De la Rue generously offers £500 to convert the Oxford 12¼-inch refractor into a Henry—photographic telescope—practically, to buy a new object-glass.

THE annual general meeting of the Marine Biological Association will be held to-morrow in the rooms of the Linnean Society. The Laboratory on the Citadel Hill, Plymouth, erected by the Assocsation at a cost of £9000, will be opened for wo rk in the summer, and the Council are anxious to co-operate in the foundation and management of laboratories on other parts of the British coast.

MISS OLDFIELD has presented to the Herbarium of the Royal Garden s, Kew, the botanical collections made in Australia by her late brother, Mr. Augustus Oldfield. This gentleman was, as stated by Mr. Bentham in the preface to "The Flora of Australia," an acute observer as well as "an intelligent collector." His series of *Eucalypti* are especially good, as he took great pains to obtain the various forms of foliage characteristic of each species, as well as the fruiting and flowering stages. Sir Joseph Hooker used his Tasmanian plants in his "Flora" of that colony. Mr. Oldfield "made large additions to the West Australian plants previously known." These collections were placed at Mr. Bentham's disposal for the purposes of his "Flora Australiensis."

THE biennial Exhibition of Agriculture and Entomology in Paris will take place from August 27 next to September 29, at the Orangerie, one of the terraces of the Tuileries Gardens. The French Minister of Public Works is the President of the Society which organizes the display.

THE Pilot Chart of the North Atlantic Ocean for June, issued by the Hydrographic Department of Washington, states that Capt. Lassan, of the Norwegian barque *Petty*, while in lat. 17° 38′ N., long. 46° 34′ W., on April 1, experienced three distinct shocks of earthquake, diminishing in force, and accompanied by strong eruption of air-bubbles, covering the surface during the continuance of the shocks. The ice-reports show large numbers of bergs north of lat. 42°, and between long. 47° and 53°.

ON June 1, M. Hervé Mangon, President of the Council of the French Central Meteorological Office, read the ninth Annual Report of the work of the Office (see NATURE, vol. xviii. p. 96). It shows satisfactory evidence of continued energy and progress in all departments of the service. No less than 154 telegraphic reports are received daily from Europe and Algeria, and 41 telegraphic summaries and weather forecasts are issued, including one to a London daily paper. The success claimed for the forecasts is 88 per cent., and for the warnings of storms 82 per cent., being a greater success than in any previous year. There are 153 climatological stations (including 12 observatories) taking not less than 3 observations daily, in addition to a large number of minor stations. The Office is also actively engaged in collecting observations made at sea, and received upwards of 500 log-books during the past year. This branch is encouraged by the presentation of medals, awarded by the Association Scientifique to the best observers. M. Hervé Mangon reviewed the work of the various observatories, and referred especially to the investigations of M. Renou, at St. Maur, who has just completed an inquiry into the rainfall for the last 200 years, and is finishing a work on the climate of Paris, on which he has been engaged for 40 years. Reference is also made to the reports now received daily from America and the Atlantic, of which our own Meteorological Office bears half the cost. The telegrams are regularly published in the French *Bulletin International*. The other half of the expense of these telegrams is borne by a lady whose name is not generally known. M. Hervé Mangon spoke at great length of the damage caused yearly by the inundations and mountain torrents, and of the advantage of planting the mountain declivities with trees or shrubs. One of the chief features of the past year is the completion of the Observatory of the Pic de l'Aigoual, in the department of Gard, which has been established in the interest of forest meteorology. A series of experiments is to be made on the influence of various kinds of soil and vegetation in storing the water caused by rainfall, and on the time necessary for its evaporation and percolation.

THE *Bollettino Mensuale* of the Italian Meteorological Society for May contains the report of the first annual meeting of the Council, held on April 14. The principal matters discussed were: the co-operation of the Italian Navigation Societies; the development of the service of medical meteorology at Naples and other towns; and the preparation of a map of the globe showing all the stations of the Society both at home and abroad. It was proposed to encourage observations of the temperature of the surface of the ground, and to publish the results of these and other observations already collected. The second annual meeting of the Council was fixed for the autumn.

THE Observatory at Batavia has just published vol. vii. of its series, containing the magnetic observations (only), from September 1883 to December 1885, together with the results from July 1882 to December 1885, prepared under the direction of Dr. van der Stok. The observations show a well-defined decrease of the declination in 1884–85, at the rate of nearly two minutes a year, and a decrease of the horizontal force at the rate of 0·00012 a year. The vertical force has continued to increase, and the dip shows a progressive value of about 7′·5 a year. It is intended in future to issue, yearly, a volume containing both the magnetic and the meteorological observations, but the publication of the meteorological observations for the years 1883–85, and the discussion of the results for the twenty years during which the observations have been made, are indefinitely delayed, owing to pressure of other work.

MR. CLEMENT L. WRAGGE, the newly-appointed Government Meteorologist of Queensland (see NATURE, vol. xxxv. p. 229), has published the meteorological synopsis of the Brisbane Observatory and rainfall reports for the colony for January to March 1887, and also his report of the inspection of the stations. The inspection disclosed the thorough disorganization of many of the stations. For instance, at Cooktown, a station of the first class, the spirit thermometer had the enormous error of 15°, owing to the volatilization of the alcohol. At Normanton, another first-class station, the shade thermometers were "exposed" in the sitting-room. It is unnecessary to multiply instances, and we merely quote Mr. Wragge's concluding remark that "the majority of the meteorological records and results already published are unreliable and valueless." We hope with him that the new system will gradually attain a position of excellence equalling that which obtains in this country.

WE have received a copy of the lecture delivered lately by Dr. Orme Masson, the Professor of Chemistry in the University of Melbourne, on the first occasion on which he addressed himself publicly to a Melbourne University audience. The subject is, "The Scope and Aims of Chemical Science, and its Place in the University." Dr. Masson has a clear, fresh, and vigorous style, and in this lecture he brings out with much force the part which chemistry has played in modern material progress, and its fitness to serve as an instrument of intellectual culture. He expresses a hope that there may always be at the University of Melbourne a small band of students devoting the bulk of their time for a few years to chemical research. The University, he says, will soon have "well-equipped laboratories, not only for the practical instruction of large classes of medical students and others, but for the accommodation of those specialists who go further in the work, requiring to be provided with the more elaborate paraphernalia of experimental science."

AT the opening meeting, on April 19, of the Royal Society of Tasmania for the session of 1887, Mr. R. M. Johnston read an interesting paper on the question, "How far can the general death-rate for all ages be relied upon as a comparative index of the health or sanitary condition of any community?" The object of the paper was to demonstrate that the general death-rate of any one place, although in itself due to a combination of many causes, may be taken as a fairly trustworthy local index to health and sanitary condition, but that it is a most faulty index as regards the comparative health and sanitary condition of different localities. The latter fact he attributed mainly to the extreme variability in the proportions of persons living in different places under the principal age groups.

MR. E. STANFORD, of Charing Cross, has just issued three volumes of his series of Tourists' Guides. They are Guides to Suffolk, Wiltshire, and the Wye and its neighbourhood; the first by Dr. J. E. Taylor, the second by Mr. R. N. Worth, and the third by Mr. G. Phillips Bevan. Each of the volumes has been carefully compiled, and is worthy of the useful and well-known series to which it belongs.

AN interesting collection of Indian antiquities is now being exhibited at the Albert Hall. It includes, among other objects, a large number of Palæolithic and Neolithic implements, remains from Indian grave-mounds of the prehistoric aborigines, copies of rude cave pictures and marks on rocks, and Buddhist sculptures and terra-cotta seals found among the ruins of Kusinagara. The objects exhibited form part of a collection made in India by Mr. A. C. Carlyle, late of the Archæological Survey of India.

THE remains of a cemetery belonging to the age of the Gauls have recently been discovered in Paris, in the old Faubourg St. Germain, at the corner of Rocroi and Bellechasse Streets. Fifty-two tombs have been found, with skeletons, most of which are skeletons of women and children. Only twelve are skeletons of men. Many weapons and implements have also been unearthed: swords, lances, shields, and bronze and iron instruments of all descriptions.

THE grasshopper plague is giving serious trouble in Algeria this year. The efforts made to destroy the eggs have proved useless. In one district 50,000 gallons have been collected and burned. This represents the destruction of 7,250,000,000 insects.

IT is observed in the French army that diseases of the heart are very common. In a recent study of this subject, certain military doctors show that they arise from the fatiguing duties imposed on recruits, at an age when, generally, the development of the body is not in harmony with that of the heart, being either in advance of it or behind it. In the latter case, there is hypertrophy of growth; in the former, insufficiency (the more common occurrence). An instance is given in which a regiment in garrison in the West, in 1880, had on an average twelve to fifteen men per thousand invalided annually (the normal figure for the French army), of which number two or three had hypertrophy of the heart. A colonel came to the regiment who had very faulty notions as to the amount of drill and fatigue the men could stand. By September 1883, the number of heart-invalids had risen steadily to twenty-two out of forty-five (*i.e.* about one in two).

A BRILLIANT discovery is announced in the current number of the *Berichte der Deut. Chem. Ges.* by Dr. Theodor Curtius, who has succeeded in preparing the long-sought-for hydride of nitrogen, $(NH_2)_2$, amidogen, diamide, or hydrazine, as it is variously termed. This remarkable body, which has hitherto baffled all attempts at isolation, is now shown to be a gas, perfectly stable up to a very high temperature, of a peculiar odour, differing from that of ammonia, exceedingly soluble in water, and of basic properties. In the course of his work upon the diazo-compounds of the fatty series, Dr. Curtius treated diazo acetic ether with hot, strong potash, and obtained the potassium salt of a new diazo-fatty acid, which on addition of mineral acids yielded yellow tabular crystals of the free diazo-acid. On digesting the yellow aqueous solution of this acid with very dilute sulphuric acid the colour disappeared without the usual evolution of nitrogen; and on cooling a magnificently crystalline substance separated out, which was shown by analysis to be no other than the sulphate of amidogen, $(NH_2)_2 . H_2SO_4$. These crystals remained unchanged at 250°, but on strongly heating over a flame melted with explosive evolution of gas and deposition of sulphur. On warming this salt with potash solution the free diamide, $(NH_2)_2$, was expelled as a gas which changed red litmus into blue, and rendered itself evident by its irritating odour. The gas fumed in contact with hydrochloric acid forming the hydrochloride, and on leading it into sulphuric acid re-formed the sulphate. It possessed energetic reducing properties, reducing Fehling's and ammoniacal silver solutions in the cold, gave a dense red precipitate with neutral copper sulphate, and formed crystalline compounds with aromatic aldehydes and ketones. It is very seldom that chemistry is enriched by the discovery of a new gas, and the intrinsic value of the isolation of amidogen to both organic and inorganic chemistry renders the communication of Dr. Curtius one of exceptional and of far more than passing interest.

MEASUREMENTS have lately been made by Messrs. A. von Ettingshausen and W. Nernst, upon the Hall effect manifested in different metals. They have found that tellurium far surpasses bismuth in its power, hence they think that the Hall effect is connected with the thermo-electric properties of the metals. The effect is least in tin. Taking this as unity, the effects in other metals are relatively as follows: platinum, 6; copper, 13; gold, 28; silver, 21; palladium, 29; cobalt, 115; iron, 285; nickel, 605; carbon, 4400; antimony, 4800; bismuth, 252,500: tellurium, 13,250,000. The sign of the effect is positive in the case of cobalt, iron, steel, antimony, and tellurium, also lead, zinc, and cadmium. It is negative in all the others.

THE mining engineer, M. Dahll, who has been examining the north of Norway on behalf of the Norwegian Government, states in his Report that all the rivers in the interior of Finnmarken, a district of fifty Norwegian square miles, carry gold. The metal is found in sand contained in little hollows, which by their shape prevent its being washed away by the water. The weight of the gold grains varies from 10 milligrammes to 1 gramme. Platinum is also found occasionally.

DURING the cutting of peat in a moss at Vevang, near the town of Christiansund, in the north-west of Norway, the workmen recently dug out a log of oak over 12 feet in length, and about 4 feet in diameter. It was found at a depth of 9 feet. The trunk and root of a great oak-tree were unearthed in the same moss some years ago, so we may conclude that there was once an oak forest in this spot. The remains of the oak were found below a layer in the bog in which remains of firs are often found.

IN the new number of the Proceedings of the Geologists' Association there is a paper by Dr. H. Hicks on the explorations which he, in conjunction with others, has carried on in the Ffynnon Beuno and Cae Gwyn Caverns in North Wales. He has no doubt whatever as to the accuracy of the conclusions presented by him in his previous papers on the subject. "I am," he says, "perfectly convinced by the evidence found during the exploration of these caverns that they must have been occupied by man and the animals before the climax of the Ice age; also that the thick stalagmite was formed some time during that age; that this was broken up by marine action during the submergence; and that the caverns were afterwards completely covered over by materials deposited from floating ice. There seems, therefore, to be every reason to suppose that man and the so-called Pleistocene animals arrived in this country in advance of the glacial conditions, and that their migrations were mainly from northern and north-western directions."

THE first number of the *Technology Quarterly* has been sent to us. This new American periodical is published by a Board of Editors chosen from the senior and junior classes of the Massachusetts Institute of Technology, representing, as far as possible, all the departments of the Institute. A large amount of original work is done in the Institute every year by advanced students, and it is thought by the editors that the *Quarterly* will be an acceptable journal if it contains nothing more than the results of the original investigations made in the chemical, physical, mining, mechanical, and biological laboratories, and also in the departments of civil engineering and architecture. But it is expected that the *alumni* of the Institute will be glad of this medium for recording their investigations and the results of their practical work. Among the contents of the present number are articles on "The Control of Rivers and the Prevention of Floods," "The Efficiency of Small Electromotors," "The Use of the Aneroid Barometer in Western Massachusetts by the U.S. Geological Survey," and "The Constitution of Benzol."

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Mrs. Slatter and Mrs. Beeston; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Miss Kate Wood; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Miss Dudding; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mrs. Dick; a Virginian Deer (*Cariacus virginianus*) from North America, presented by Mr. Tom Jay; three Kestrels (*Tinnunculus alaudarius*), British, presented by Dr. J. W. Trentler; two Blue Titmice (*Parus cæruleus*), British, presented by Mrs. Francis L. Barlow; a Blue-eyed Cockatoo (*Cacatua ophthalmica*) from New Britain, presented by Mr. W. H. Fellows; four Horned Vipers (*Vipera cornuta*), three Dwarf Chameleons (*Chamæleon pumilus*), a Many-spotted Snake (*Coronella multimaculata*), a Rufescent Snake (*Leptodira rufescens*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Crowned Horned Lizard (*Phrynosoma coronatum*) from California, presented by Mr. Duff Gordon; a Pig-tailed Monkey (*Macacus nemestrinus*) from India, four Herons (*Ardea cinerea*), six Night Herons (*Nycticorax griseus*), European, deposited; a West African Python (*Python sebæ*) from West Africa, purchased; a Mesopotamian Fallow Deer (*Dama mesopotamica*), two Japanese Deer (*Cervus sika*), two Collared Fruit Bats (*Cynonycteris collaris*) born in the Gardens; two Yellow-legged Herring Gulls (*Larus cachinnans*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE GREAT SOUTHERN COMET, 1887 *a*.—Mr. Chandler continuing his researches on the orbit of this comet (referred to in last week's NATURE), gives, in No. 157 of the *Astronomical Journal*, the following elements deduced from the Cape and Adelaide observations published in the *Monthly Notices* for March last:—

$$T = 1887 \text{ January } 11{\cdot}230 \text{ G.M.T.}$$

$$\left.\begin{aligned} \omega &= 63^\circ\ 36'{\cdot}0 \\ \Omega &= 337\ \ 42{\cdot}8 \\ \iota &= 137\ \ \ 0{\cdot}0 \end{aligned}\right\} \text{True Equinox.}$$

$$\log q = 7{\cdot}73892$$

The observations on which this orbit depends differ widely from the estimates of position at Cordoba and Windsor, which Mr. Chandler had used in his previous computations; and the elements now found are in fair agreement with those deduced by Mr. Finlay from the Cape observations of January 22, 25, and 28 alone, which are published in the above-mentioned number of the *Monthly Notices.*

THE COMPANION OF SIRIUS.—Prof. A. Hall gives, as the mean results of his observations during the present year (*Astronomical Journal,* No. 157): Epoch 1887·238; position-angle, 24°·18; and distance, 6″·508.

A SHORT METHOD OF COMPUTING REFRACTIONS FOR ALL ZENITH DISTANCES.—In continuation of his paper in *Astronomische Nachrichten,* No. 2768 (NATURE, vol. xxxv. p. 329), the application of which was limited to zenith distances less than 45°, Mr. Schaeberle, of Ann Arbor, U.S.A., in No. 2788 of the same publication, gives his method for the computation of refractions, with Bessel's constants, for 45° to 77° of zenith distance, and for zenith distances greater than 77°, with an accuracy sufficient for practical purposes. Starting from Bessel's expression $r = \alpha\beta^A\gamma^\lambda \tan z$, Mr. Schaeberle finds that Δr (the quantity to be added to the mean refraction r_0) can be represented only by $\Delta r = r_0 F + \epsilon \frac{\Delta\gamma}{\gamma}$, between the limits $z = 45°$ and $z = 77°$. In this expression $F = \frac{\Delta\beta}{\beta} + \frac{\Delta\gamma}{\gamma}$ and $\epsilon = r_0 (\lambda - 1)$. For zenith distances greater than 77°, the final equation becomes $\Delta r = r_0 F + \epsilon \left(F - \frac{\sigma}{\gamma}\right)$, where $\sigma = 0{\cdot}9\,\frac{\Delta\beta}{\beta}$. The requisite quantities can evidently be easily tabulated, and the computer is thus provided with a very convenient method for calculating refractions which will not materially differ from those deduced directly from Bessel's Tables.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 *JUNE* 26—*JULY* 2.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on June 26.

Sun rises, 3h. 46m.; souths, 12h. 2m. 29·7s.; sets, 20h. 18m.; decl. on meridian, 23° 22′ N.: Sidereal Time at Sunset, 14h. 36m.

Moon (at First Quarter on June 28) rises, 9h. 35m.; souths, 16h. 38m.; sets, 23h. 29m.; decl. on meridian, 8° 53′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Decl. on meridian. ° ′
Mercury ...	5 51	13 51	21 51	21 6 N.
Venus	7 39	15 11	22 43	16 40 N.
Mars	2 39	10 55	19 11	23 23 N.
Jupiter... ...	14 1	19 20	0 39*	8 51 S.
Saturn... ...	5 20	13 23	21 26	21 33 N.

* Indicates that the setting is that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

June.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
27	10 Virginis	6	23 36	near approach	199 —
July.					
1	ξ^1 Libræ	6	0 52	near approach	201 —
1	η Libræ	6	21 23	22 4	19 320

June. h.
29 ... 17 ... Jupiter in conjunction with and 3° 40′ south of the Moon.

July. h.
1 ... 10 ... Mercury at greatest elongation from the Sun, 26° east.
2 ... 9 ... Sun at greatest distance from the Earth.

Meteor-Showers.

	R.A. °	Decl. °	
Near σ Herculis	253	47 N.	Swift meteors.
δ Cygni	294	39 N.	Slow meteors.
ϵ Delphini	305	9 N.	
Between β and γ Cephei.	330	77 N.	

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·3	81 16 N.	June 27,	23 54	*m*
			July 2,	23 33	*m*
R Piscium	1 24·8	2 18 N.	June 26,		*M*
S Ursæ Majoris ...	12 39·0	61 43 N.	July 1,		*m*
W Virginis	13 20·2	2 48 S.	,, 2,	22 0	*m*
U Ophiuchi	17 10·8	1 20 N.	June 30,	23 25	*m*
U Sagittarii	18 25·2	19 12 S.	,, 28,	0 0	*M*
β Lyræ...	18 45·9	33 14 N.	,, 30,	0 0	*M*
R Lyræ	18 51·9	43 48 N.	July 1,		*m*
S Vulpeculæ ...	19 43·8	27 0 N.	June 26,		*m*
η Aquilæ	19 46·7	0 43 N.	July 2,	0 0	*m*
S Sagittæ	19 50·9	16 20 N.	June 27,	23 0	*M*
T Aquarii	20 44·0	5 34 S.	,, 26,		*M*
W Cygni	21 31·8	44 52 N.	,, 29,		*m*
δ Cephei	22 25·0	57 50 N.	,, 28,	23 0	*M*

M signifies maximum; *m* minimum.

THE ZOOLOGICAL SOCIETY OF LONDON.

A GENERAL meeting of the Zoological Society of London took place on the afternoon of Thursday, the 16th inst. In celebration of the fiftieth anniversary of Her Majesty's reign the meeting was held on the lawn of the Society's Gardens, which was reserved for the occasion. A very large number of the members and their friends were present.

After the meeting there was a garden party, the visitors being received by the President, Prof. Flower, F.R.S., and the Secretary, Dr. P. L. Sclater, F.R.S. Among those present during the afternoon were the following:—The Queen of Hawaii and Princess Liliuokalani, His Highness the Thakore Sahib of Limbdi, His Highness the Prince Devawongse, the Maharajah of Bhurtpore, the Earl of Buckinghamshire, the Earl of Cawdor, Lord Wantage, the Earl of Lauderdale, the Earl of Kilmorey, the Earl of Wharncliffe, Lord Coleridge, Lord Walsingham, the Dowager Marchioness of Tweeddale, Lord and Lady Thring, Sir James Paget, Sir Harry Lumsden, Sir Richard Pollock, Sir Joseph Hooker, Prof. Huxley, Capt. Gouglas Dalton, and the following members of the Council of the Zoological Society:—Lord Abinger, Mr. W. T. Blanford, F.R.S., Mr. H. E. Dresser, F.R.S., Mr. C. Drummond, F.R.S., Colonel J. A. Grant, F.R.S., Dr. A. C. L. Günther, F.R.S., Dr. E. Hamilton, F.R.S., Mr. E. W. H. Holdsworth, Dr. St. George Mivart, F.R.S., Prof. A. Newton, F.R.S., Mr. Henry Pollock, Mr. H. Saunders, F.L.S., Mr. J. Travers Smith, and Surgeon-General L. C. Stewart.

At the general meeting the President presented the silver medal of the Society to the Maharajah of Kuch-Behar. In doing so he said that His Highness had been good enough to present to the Society a fine specimen of an Indian rhinoceros.

The Maharajah of Kuch-Behar, in reply, said that he would be happy to supply specimens of such animals as the Society might desire to possess, so far as it was in his power to do so.

Prof. Flower then delivered the following address:—

Nowhere has the progress which the world has made during the fifty years of Her Majesty's reign, the completion of which we are now happily celebrating, been more strikingly manifested than in the advance of that so-called "natural knowledge" for the improvement of which our Royal Society was instituted more than two centuries ago. Although there have been, without doubt, immense strides in other directions—in morals, in art, in historical and literary criticism—I venture to say that none of these can be compared with the marvellous progress that has been made in scientific knowledge and scientific methods.

The tangible results that have followed the practical applications of mechanics, physics, and chemistry have so deeply affected the material interests of mankind, that the progress of these branches of knowledge may seem to put into the shade the wonderful changes that have taken place in the kindred sciences. Nevertheless, I think we may safely say that zoology, in a certain sense one of the oldest of human studies, has in these latter times undergone a new birth, which has not only changed the standpoint from which we view the special objects of our studies, but has also spread its influence far and wide, and profoundly modified our conceptions on many questions at first sight entirely remote from its sphere. The universal abandonment of the doctrine of fixity of species, which was an article of faith with almost every zoologist in 1837, has introduced new interests, as well, it must be confessed, as new difficulties, the extent of which we are only beginning to appreciate. The definite systems of classification and methods of nomenclature on which our fathers relied utterly fail before the wider field of vision which it is the privilege, as well as the embarrassment, of the present generation of zoologists to realize.

But it is no part of my intention, in the brief space of time for which I shall ask your patience, to attempt to give a history of the recent advances of zoological science in general, but only, as requested by your Council, to say a few words on the progress of the particular institution established for its cultivation in which we are personally interested, and the duration of which is so nearly cotemporaneous with that of Her Majesty's reign.

Before this Society was founded there was no distinct organization in the country devoted solely to collecting, recording, and discussing the facts upon which zoological science rests. The dignified parent of all our scientific Societies, the Royal, certainly undertook, as it does still, the discussion of many zoological subjects; but it could not be expected to treat them in any detail. The Linnean was a Society of great respectability, devoted solely to biological research, both zoological and botanical, already nearly forty years of age, and possessed of all the usual appurtenances of a scientific organization—meetings, library, and collections for reference. I cannot help thinking that if its leading Fellows had, at that time, displayed more energy, it might have kept in its hands the principal direction of the biological studies of the country, instead of allowing what has since proved so formidable a rival to spring up, and to absorb so large a portion of its useful functions. However, for reasons which it is perhaps not worth while to inquire into now, it did not supply all the needs of the lovers of zoology; and in the year 1826 an active and zealous band united together, and, as the Charter tells us, "subscribed and expended considerable sums of money for the purpose" of founding the Zoological Society of London.

The leading spirit of this band was Sir Stamford Raffles, then just returned from the administration of those Eastern islands of which the history, both natural and political, will ever be intimately associated with his name. He was chosen for the office of President, but his death, on July 4, 1826, deprived the Society, while yet in its infancy, of his valuable services even some years before it acquired its Charter of Incorporation. In this deed, dated March 27, 1829, Henry, Marquis of Lansdowne, is named as the first President of the chartered Society, Joseph Sabine as the first Treasurer, and Nicholas Aylward Vigors the first Secretary.

The Society appears to have acquired great popularity in a surprisingly short time. The first printed list of Members that I can discover (dated January 1, 1829) contains the names of 1294 ordinary Fellows and 40 honorary and corresponding Members. The list is an interesting one from the number of names it includes of persons eminent either in science, art, literature, politics, or social life: indeed, there were not many people of distinction in the country at that time who are not to be found in it.

A piece of ground in the Regent's Park having been obtained from the Government at little more than a nominal rent, the Gardens were laid out, and opened in 1828, during which year 98,605 visitors are recorded as having entered. In the following (the first complete) year there were as many as 189,913 visitors, and this number was increased in 1831 to 262,193.

While the menagerie of living animals was being formed in the Regent's Park, the Officers and Fellows of the Society were also engaged in establishing a Museum of preserved specimens, which soon assumed very considerable dimensions. A Catalogue printed as early as the year 1828 contains a classified list of 450 specimens of Mammalia alone; and it continued for many years to attract donations from travellers and collectors in all parts of the world, and became of great scientific importance, inasmuch as it contained very many types of species described for the first time in the publications of the Society. It was at first lodged in rooms in the Society's house in Bruton Street; but these becoming so crowded as to present the "confused air of a store rather than the appearance of an arranged museum," premises were taken in 1836 in Leicester Square; the same which were formerly occupied by the museum of John Hunter before its removal to the College of Surgeons. At this time the Museum is reported to have contained as many as 6720 specimens of vertebrated animals, and numerous additions were still being made both by donations and by purchase. The rooms in Leicester Square being found inconvenient for the purpose, it was finally resolved, after considerable discussion of various sites, to transfer the collection to the Gardens in the Regent's Park; and in 1843 the building which is now occupied as a lecture-room on the upper floor and a store-room below was constructed and fitted up for its reception.

Although the Museum was at one time looked upon as a very important part of the Society's operations, being spoken of as "the centre of the Society's scientific usefulness" (Report of Council, 1837), and one upon which considerable sums of money were spent, it was afterwards a cause of embarrassment from the difficulty and expense of keeping it up in a state of efficiency; and when the Zoological Department of the British Museum acquired such a development as to fulfil all the objects proposed by the Society's collection, the uselessness of endeavouring to maintain a second and inferior zoological museum in the same city became apparent, and in 1856 it was, as I think very wisely, determined to part with the collection, the whole of the types being transferred to the National Museum, and the remaining specimens to other institutions where it was thought their value would be most appreciated.

Another enterprise in which the Fellows of the Society were much interested in its early days was the Farm at Kingston, the special object of which was thus defined:—"It will be useful in receiving animals which may require a greater range and more quiet than the Gardens at the Regent's Park can afford. It is absolutely necessary for the purpose of breeding and rearing young animals, and giving facilities for observations on matters of physiological interest and research, and, above all, in making attempts to naturalize such species as are hitherto rare or unknown in this country." The Farm, however, apparently not fulfilling the objects expected of it, and being a source of expense which the Society could not then well afford, was gradually allowed to fall into neglect, and finally abandoned in 1834.

The mention of this establishment, however, causes me to allude to one of the objects on which the Society laid considerable stress at its foundation, and which is defined in the Charter as "the introduction of new and curious subjects of the animal kingdom," but which, as may be gathered from the Annual Reports of the Council and from other documents, meant not only the temporary introduction of individuals for the purpose of satisfying curiosity about their external characters and structure, but also the permanent domestication of foreign animals which might become of value to man, either for their utility in adding to our food-supplies or for the pleasure they afforded by their beauty.

Abundant illustrations of the vanity of human expectations are afforded by the details of the hopes and disappointments recorded in the Reports of the Society relating to this subject. It is mentioned in the Report of the year 1832 that "the armadillo has three times produced young, and hopes are entertained of this animal, so valuable as an article of food, being naturalized in this country." More than fifty years have passed, and British-grown armadillo has not yet appeared upon the menu-cards of our dinner-tables. At one time the South-American curassows and guans were confidently looked upon as future rivals to our barn-door fowls and turkeys. Various species of pheasants and other game-birds from Northern India, collected and imported at great expense, were to add zest and variety to the battue of the English sportsman. The great success which for many years attended the breeding of giraffes in the Gardens not unnaturally led to the expectation that these beautiful creatures might become denizens of our parks, or at all events a source of continued profit to the Society; and it is possible that some who are here now may have been present at the feast for which an eland was sacrificed, amid loudly-uttered prognostications that the ready acclimatization of these animals would result, if not in superseding, at least in providing a change from, our monotonous round of mutton, beef, and pork. Unfortunately for these anticipations, no giraffe has been born in the Gardens during the last twenty years, and elands are still far too scarce to be killed for food of man in England.

It is well that these experiments should have been tried; it may be well, perhaps, that some of them should be tried again when favourable opportunities occur; but it is also well that we should recognize the almost insuperable difficulties that must attend the attempt to introduce a new animal able to compete in useful qualities with those which, as is the case with all our limited number of domestic animals, have gradually acquired the peculiarities making them valuable to man, by the accumulation of slight improvements through countless generations of ancestors. While all our pressing wants are so well supplied by the animals we already possess, it can no longer pay to begin again at the beginning with a new species. This appears to be the solution of the singular fact, scarcely sufficiently appreciated, that no addition of any practical importance has been made to our stock of truly domestic animals since the commencement of the historic period of man's life upon the earth.

I now turn to the history of one of the most important features of the Society, the scientific meetings. In the early days of the Society there was only one class of general meetings for business of all kinds; and the exhibition of specimens and the communication of notices on subjects of zoological interest formed part of the ordinary proceedings at those meetings. The great extent, however, of the general business was soon found to interfere with such an arrangement. The number of the elections and of the recommendations of candidates, the reports on the progress of the Society in its several establishments during each month, and other business, were found to require so much time as to leave little for scientific communications, and the Council saw with regret that these were frequently and necessarily postponed to matters of more pressing but less permanent interest. To obviate this inconvenience and to afford opportunities for the reception and discussion of communications upon zoological subjects, the Council had recourse to the institution of a "Committee of Science and Correspondence," composed of such Members of the Society as had principally applied themselves to science; at the meetings of which communications upon zoological subjects might be received and discussed, and occasional selections made for the purpose of publication.

The first meeting of the Committee took place on the evening of Tuesday, November 9, 1830, at the Society's house in Bruton Street, when a communication was received upon the anatomy of the urang utan by a young, and then unknown, naturalist, Richard Owen by name, the first of that long series of memoirs, extending over a period of more than fifty years, the publication of which in our Transactions has done so much to advance the knowledge of comparative anatomy and to give an illustrious place to their author in the annals of science.

Among the names of others who are mentioned as having taken part in the business of the Committee during the first year of its existence, either by their actual presence or by forwarding communications, are N. A. Vigors, W. Yarrell, J. E. Gray, J. Gould, E. T. Bennett, Andrew Smith, T. Bell, W. Martin, Joshua Brookes, W. Kirby, W. H. Sykes, Marshall Hall, W. Ogilby, John Richardson, and B. H. Hodgson, who, I am happy to say, is with us at the meeting to day.

The Committee continued in existence for two years, having met for the last time on December 11, 1832. The success of its meetings was so great that it was thought desirable to make an alteration in the by-laws, by which the meetings of the Committee were replaced by the "General Meetings of the Society for Scientific Business." The first of these meetings took place on Tuesday, January 8, 1833, and they have continued to be held on two Tuesdays in each month during the season to the present time. As long as the Society retained its house in Bruton Street, the meetings were held there. In 1843 the Society took another house, which it occupied for forty-one years, No. 11 Hanover Square; but its needs having outgrown the accommodation afforded there, it removed in 1844 to the far more spacious and commodious premises, in No. 3 of the same square, which we at present occupy. These meetings of the Society, which are open to all the Fellows and to friends introduced by them, have exercised a considerable influence upon the progress of zoological knowledge, not only by the reading and discussing of communications formally brought before them, but also by the interchange of ideas at the informal social gatherings over the coffee-table in the library afterwards, which have great value as affording a common meeting-ground and bond of union for all the working zoologists of the country, as well as of many visitors from foreign lands.

The more important scientific communications to these meetings have from the commencement been published in the form of quarto Transactions and octavo Proceedings, which constitute a series of inestimable importance both for the value of the material contained in them and for the excellence of the illustrations of new or rare forms of animal life with which they are embellished. In later times they have also formed a vehicle for communicating to the world the important results obtained from the dissection of animals which have died at the Gardens, and which, since the establishment of the office of Prosector in 1865, have been systematically used for this purpose.

In connexion with the scientific meetings must be mentioned the Library, the first formation of which is described in the Report of the Council for the year 1837, and which has been steadily growing ever since by donations of books, by exchange of publications with other learned Societies, and by judicious annual expenditure of money, to be one of the best-selected, well-arranged, and most accessible collections of works of reference that it is possible for the zoological student to enjoy. Its value has been greatly increased by the publication within the past month of an excellent Catalogue, which contains the titles of about 6560 publications.

The most recent addition to the functions that the Society has undertaken with a view to carry out the purposes of its foundation is the publication of an Annual Record of Zoological Literature, containing a summary of the work done by British and foreign naturalists in the various branches of zoology in each year, a publication of the utmost value to the working zoologist. Such a Record has been carried on for some years past by a voluntary association of naturalists, but, owing to the difficulties met with in obtaining sufficient support, it was in danger of being abandoned, until the Council, after the full consideration which the importance of the subject deserved, resolved to take it in hand as part of the operations of the Society.

The Society has, however, not only been mindful of advancing scientific knowledge—it has also endeavoured to spread some of this knowledge in a popular manner by means of lectures. In former years these were only given in an occasional manner; but the liberal bequest of Mr. Alfred Davis to the Society in 1870 has enabled the Council to undertake a more regular and systematic method of instruction; and the Fellows and others have had every summer for several years past the opportunity of hearing many of our most eminent naturalists and able expositors upon subjects which they have made especially their own. I must, however, confess that the interest taken by the Society generally in these lectures has not quite equalled the expectations that were raised when the question of establishing them was first brought before the notice of the Council.

Although, as will be seen by a consideration of the various subjects which I have already referred to, the Society has a wide sphere of operations and many methods by which the objects of its founders are carried out, it is undoubtedly the maintenance of the menagerie of living animals in the Gardens where we are now assembled, by which it is most known both to the public as well as to a large number of our Fellows. It will be well, therefore, before concluding, to add a few words upon some points of interest connected with the past history and present condition of this branch of the Society's operations, the one which is at the same time the largest source of its revenue and cause of its expenditure.

The collection and exhibition of rare and little-known living animals has long been a subject of interest and instruction in civilized communities, and in many countries either the State or the Sovereign has considered it as part of their duty or privilege to maintain a more or less perfect establishment of the kind.

Before the Zoological Society was formed, the "lions" at the Tower had been for centuries a national institution; and it may be interesting to those who derive pleasure in tracing the links between the present and the past, to be reminded that our collection is in some measure a lineal continuation of that time-honoured institution, as it appears from the Reports of the Council that in the year 1831 His Majesty King William the Fourth "was graciously pleased to present to the Society all the animals belonging to the Crown lately maintained at the Tower." It is also recorded that in the previous year His Majesty had made a munificent donation of the whole of the animals belonging to the Royal Menagerie kept in Windsor Park. This may perhaps be the place to mention that, in the Report read April 1837, the Council "had the gratification to call the special attention of the members to a donation from Her

Royal Highness the Princess Victoria," consisting of a pair of those pretty and interesting little animals the Stanley Musk-deer. During the fifty years that have elapsed since this first-recorded mark of interest in the Society on the part of her present Majesty, the Queen and her family have never failed to show their regard for its welfare whenever any opportunity has arisen, of which the acceptance of the Presidency by the late Prince Consort, on the death of the Earl of Derby in 1851, was one of the most signal instances. The advantages which the Society has received from the numerous donations to the Menagerie, and the constant kindly interest shown in its general progress by H.R.H. the Prince of Wales, are so continually before the observation of the Fellows, that I need scarcely do more than allude to them here, beyond stating that in no year of the Society's existence has the number of visitors to the Gardens, or the Society's income, been so great as in 1876, when the large collection of animals brought from India by His Royal Highness formed the special object of attraction.

Except for the collection, necessarily of limited extent, exhibited in the Tower, and a few others having their origin in commercial enterprise (as Mr. Crosse's menagerie at Exeter Change, and the various itinerant wild-beast shows), there were, before the foundation of the Society's Gardens, little means in the country of gaining knowledge of the strange forms of exotic animal life with which the world abounds. An extensive, well-arranged, and well-kept collection, where the circumstances of exhibition were more favourable than in the institutions just referred to, seemed then to fulfil a national need, as the rapidly acquired popularity of the Society already alluded to testifies. Indeed, when we consider the amount of enjoyment and instruction which has been afforded to the 24,572,405 visitors who are registered as having entered our Gardens from their first opening in 1828 to the end of last year, it is easy to realize what a loss the country would have sustained if they had not existed. There was a period, it is true, in which they fell rather low in popular favour, the record of 1847 showing both the smallest number of visitors and the lowest income of any year in the Society's existence. A new era of activity in the management of the Society's affairs was then happily inaugurated, which resulted in a prosperity which has continued ever since, with only slight fluctuations, arising from causes easy to be understood—a prosperity to which the scientific knowledge, zeal, and devotion to the affairs of the Society of our present Secretary, ably seconded in all matters of detail by the Resident Superintendent, have greatly contributed.

One of the greatest improvements which have been gradually effected in the Gardens in recent years is the erection of larger, more commodious, and more substantial buildings for the accommodation of the animals than those that existed before. A few examples will suffice to illustrate the successive steps that have been taken in this direction. The primary habitation of the lions and other large feline animals was the building on the north side of the canal, which many of us may remember as a Reptile-house, and which has been lately restored as a dwelling-place for the smaller Carnivora. The Council Reports of the period frequently speak of the bad accommodation it afforded to the inmates, the consequent injury to their health, and the disagreeable effects on visitors from the closeness of the atmosphere. In September 1843, the terrace, with its double row of cages beneath, was completed; and the Report of the following spring, speaking of this as "one of the most important works ever undertaken at the Gardens," congratulates the Society upon the fact that the anticipations of the increased health of this interesting portion of the collection, resulting from a free exposure to the external air, and total absence of artificial heat, have been fully realized. The effects of more air and greater exercise were indeed said to have become visible almost immediately. Animals which were emaciated and sickly before their removal became plump and sleek in a fortnight after, and the appetites of all were so materially increased that they began to kill and eat each other. This, however, led to an immediate increase in their allowance of food, since which time, it is stated, no further accidents of the kind have occurred. As this structure, looked upon at that period as so great an improvement upon its predecessors, still remains, though adapted for other inmates, we all have an opportunity of contrasting the size of its dens and the provision it affords generally for the health and comfort of the animals and the convenience of visitors, with those of the magnificent building which superseded it in 1876.

In the Report of the year 1840 it is stated that the only work of considerable magnitude undertaken since the last anniversary was the erection of the "New Monkey-house," and the Council speak with great satisfaction of the substantial nature of the structure and the superior accommodation which its internal arrangements are calculated to afford to its inmates.

Many of us may remember this building, which stood on the space now cleared in the centre of the Gardens. Twenty-four years after its erection, in their Report dated April 1864, we find the Council speaking of it as "what is at present perhaps the most defective portion of the Society's Garden establishment," and the erection of a second "New Monkey-house" was determined upon. This is the present light and comparatively airy and spacious building, the superiority of which over the old one in every respect is incontestable.

Up to the year 1848 the only attempt which had been made to familiarize the visitors with the structure and habits of animals of the class Reptilia was by the occasional display of a pair of pythons, which were kept closely covered in a box of limited dimensions in one of the smaller Carnivora-houses. In 1849 the building which had been rendered vacant by the removal of the lions to the new terrace was fitted up with cases with plate-glass fronts on a plan entirely novel in this country, and which for many years afforded an instructive exhibition of the forms, colours, and movements of many species of serpents, lizards, and crocodiles. This house was a vast improvement upon anything of the kind ever seen before; but the contrast between it and the present handsome and spacious building so recently erected in the south-eastern corner of the grounds affords another illustration of the great progress we are making.

If time allowed I might also refer to the Elephant-house, completed in 1870, to the Insect-house, opened in 1881, and to various others of less importance.

The erection of these houses has necessarily been a very costly undertaking; in fact, since what may be called the reconstruction of the permanent buildings of the Gardens, which commenced in the year 1860, more than £50,000 has been expended upon them. It is only in years of great prosperity, when the Society's income has considerably exceeded its necessarily large permanent expenditure, that works such as these can be undertaken.

Much as has been done in this direction, we must all admit that there is still more required. The buildings of to-day will, we may even hope, some day seem to our successors what the former ones appear to us. The old idea of keeping animals in small cramped cages and dens, inherited from the Tower and the travelling wild-beast shows, still lingers in many places. We have a responsibility to our captive animals, brought from their native wilds, to minister to our pleasure and instruction, beyond that of merely supplying them with food and shelter. The more their comfort can be studied, the roomier their place of captivity, the more they are surrounded by conditions reproducing those of their native haunts, the happier they will be, and the more enjoyment and instruction we shall obtain when looking at them. Many of our newest improvements are markedly in this direction. I may especially mention the new inclosure for wild sheep near the Lion-house in the South Garden, with its picturesque rock-work and fall of water, and the large aviary for herons and similar birds just completed on what used to be called the Water-Fowls' Lawn.

All such improvements can, however, only be carried out by the continued aid of the public, either by becoming permanently attached to the Society as Fellows or by visiting the Gardens. I trust that this brief record of the principal events of the Society's history will show that such support is not undeserved by those who have had the management of its affairs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In the Natural Sciences Tripos, Part I., the following women students were placed in the first class: E. E. Field, A. J. Flavell, and M. M. Smith, all of Newnham College.

In Part II. the following men were placed in the first class in alphabetical order, the subject for which they were so placed being named:—Adie, Trinity, and Couldridge, Emmanuel (Chemistry); Durham, Christ's, and Edgeworth, Caius (Physiology);

Lake, St. John's (Geology); Melsome, Queens' (Physiology); Rendle, St. John's (Botany); Turpin, St. John's (Chemistry). No women were placed in the first class.

Mr. Lake, of St. John's, whose name appears in the above list, has been elected to the first Harkness Scholarship for Geology and Palæontology.

Dr. William Hunter, M.D., F.R.S.Edin., has been elected the first John Lucas Walker Student in Pathology.

The degree of Doctor in Science has been conferred on Mr. James Ward, of Trinity College, and Prof. F. O. Bower, of Trinity College and Glasgow University.

In consideration of this year being the two hundredth anniversary of the publication of Newton's "Principia," the Chancellor's Medal is to be given for an English poem on Isaac Newton.

The botanical teachers in the University have made a pressing appeal for the erection of a class-room for practical microscopical botany.

The Examiners for the Mathematical Tripos, Part II., have issued the following class list:—

Class I. Division 1: C. W. C. Barlow, and Bryan, Peterhouse; Dixon, Trinity; Fletcher, St. John's; Platts, Trinity. Division 2: Coates, Queens'; F. W. Hill, St. John's. Division 3: Clark, Pembroke; H. G. Dawson, Christ's.

Class II. Division 1: Askwith, Trinity. Division 2: Johnston, Peterhouse; McAulay, Caius; Nicolls, Peterhouse. Division 3: Tate, St. John's.

Class III. Division 1: Dickinson, Trinity.

The appointment of a Demonstrator of Pathology has been approved.

The proposals regarding the teaching of geography and the appointment of a University Lecturer in Geography have been confirmed.

The modified proposals to build new plant-houses in the Botanic Garden have been approved. A small research laboratory is to be built in connexion with them.

At the annual election at St. John's College, on June 18, the following awards in Natural Science and Mathematics were made:—

Foundation Scholarships:—Science: Rendle, £50; d'Albuquerque, £60; Groom, £50—Mathematics: Norris, £40; Varley, £50; H. H. Harris, £50; Rudd, £40. Scholarships prolonged or increased in value:—Science: Rolleston, £80; Shore, £60; Seward, £40; Harris, W., £50; Lake, £80—Mathematics: Fletcher, £80; Hill, £60; Tate, £40; Orr, £80; Sampson, £80; Baker, £100; Flux, £100.

Exhibitions:—Science: Grabham, d'Albuquerque, Baily, Hankin, Shaw—Mathematics: Orr, Sampson, Carlisle, Millard, Cooke, Humphries, Shawcross, Palmer. Proper Sizarships:—Science: Kellett—Mathematics: Box, Brown, Lawrenson; Shawcross, Palmer. Hughes Prizes:—Science: Lake; Mathematics: Baker and Flux, equal. Wright Prizes:—Science: Turpin, d'Albuquerque; Mathematics: Orr, Cooke. Hockin Prize (for Physics, and in particular Electricity): Turpin. Herschel Prize (for Astronomy): Flux. Hutchinson Studentship (for Sanskrit): Strong.

Among the distinguished persons upon whom honorary degrees were conferred on June 20 was Prof. Asa Gray, Professor of Natural History and Keeper of the University Herbarium and Botanical Library, Harvard University, author of the "Elements of Botany" (1836), the "Botanical Text-Book" (1842, ed. 6, 1880), "Darwiniana" (1876), "Flora of North America" (1878), &c., &c. We append the text of the speech delivered by the Public Orator, Dr. Sandys, in presenting him for the degree:—

Iuvat tandem pervenire ad historiae naturalis professorem Harvardianum, botanicorum transmarinorum facile principem. Annorum quinquaginta intra spatium de scientia sua pulcherrima quot libros, eruditione quam ampla, genere scribendi quam admirabili composuit. Quotiens oceanum transiit ut Europae herbaria diligentius perscrutaretur, virosque in sua provincia primarios melius cognosceret. In aliorum laboribus examinandis, recensendis, nonnunquam leviter corrigendis, iudicem quam perspicacem, quam candidum, quam urbanum sese praebuit. Quanta alacritate olim inter populares suos occidentales Darwini nostri solem orientem primus omnium salutavit, arbitratus idem doctrinam illam de formarum variarum origine causam aliquam primam postulare, et fidei de numine quodam, quod omnia creaverit gubernetque, esse consentaneum. Viro tanto utinam contingat ut opus illud ingens quod Americae Borealis Florae accuratius describendae olim dedicavit, ad exitum felicem aliquando perducat. Illum interim, qui scientiam tam pulchram suis laboribus, sua vita, tam diu illustravit, usque canam ad senectutem, ut poeta noster ait, 'vitae innocentis candidum florem gerens,'—illum, inquam, his saltem laudis flosculis, hac saltem honoris corolla, libenter coronamus.

Plurimos in annos Academiae coronam illustriorem reddat Florae sacerdos venerabilis, ASA GRAY.

SCIENTIFIC SERIALS.

THE *Journal of Botany* for May contains the following articles:—Angolan Scitamineæ, by Mr. H. N. Ridley.—Forms and allies of *Ranunculus Flammula*, by Mr. Chas. Bailey.—Notes on British Characeæ for 1886, by Messrs. H. and J. Groves.—The progress of botany in Japan, by Mr. F. V. Dickins.—Conclusion of the Rev. Mr. Purchas's list of plants for South Derbyshire.

In the number for June Mr. E. M. Holmes describes and figures two species of seaweed new to Britain, *Ectocarpus simplex* and *E. insignis*.—There are also papers on Queensland ferns, by Baron von Müller and Mr. J. G. Baker; on the genus *Potamogeton*, by Mr. A. Fryer; on plants of Northern Scotland, by Mr. F. J. Hanbury and Rev. E. S. Marshall; on Chinese ferns, by Mr. J. G. Baker; and on Australian species of *Potamogeton*, by Mr. A. Bennett.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—"Abstract of Investigations upon Rabies." By G. F. Dowdeswell.

The first experiments made by inoculations with the saliva of rabid street dogs, during the outbreak of the disease in 1885, all failed to produce infection, thus confirming the reputed uncertainty of the result of the bite of a rabid animal.

Subsequently, adopting the methods recently described by M. Pasteur, it was found:—

(1) That the virus of rabies in the lower animals and of hydrophobia in man resides in the cerebro-spinal substance and in the peripheral nerves, and is not confined to the salivary secretion, as previously believed, nor is even as constantly present or as actively virulent in it as it is in the nervous tissues.

(2) That inoculation of a portion of the nervous tissue from a rabid animal upon the brain of another by trephining produces infective rabies or lyssa, much more certainly, and with a far shorter incubation period, than by subcutaneous inoculation of the same substance; but that the disease is identically the same in both cases.

(3) That the virulence of "street rabies" is usually increased and ultimately becomes remarkably constant by passing through a series of rabbits, in which animals the symptoms are somewhat different from those in others, and which are generally regarded as typical, being essentially paralytic, but that paresis to some extent is always present in this disease in dogs and others of the lower animals, and that there is no constant distinction between the so-termed "dumb" and "furious" rabies in the latter animal, the difference consisting in the preponderance of the paralytic or other symptoms.

(4) That the tissues of an infected animal do not themselves usually become infective till towards the close of the incubation period.

(5) That of a large number of drugs that were tried, both germicides and those which act specifically upon the cerebro-spinal system, including those most esteemed for the treatment of rabies and hydrophobia, none have any material effect in modifying the result of infection in the rabbit.

(6) Lastly, that with respect to the methods of protection against infection by a series of inoculations with modified virus, as advocated and practised by M. Pasteur, these are unsuccessful with the rabbit, and that his recent "rapid" or "intensive" method of inoculation is liable itself to produce infection; and that with the dog the natural refractoriness of this animal to infection with rabies by any method of inoculation, is so great, that it is exceedingly difficult to determine the effect of any remedial or prophylactic measures upon it; and that with man the statistics of the treatment must determine its effects.

Physical Society, June 11.—Mr. Shelford Bidwell, F.R.S., Vice-President, in the chair.—A number of Puluj and other vacuum-tubes were exhibited by Dr. Warren De la Rue. The Puluj tubes consisted of a phosphorescent lamp, and radiometers with phosphorescent vanes and mica disks painted with phosphorescent substances. The other tubes contained different phosphorescent minerals, such as magnesium carbonate, calcium silicate, and Iceland spar. When illumined by a large induction-coil, beautiful colour-effects were produced.—The following papers were then read:—Note on beams fixed at the ends, by Profs. Ayrton and Perry. This paper contains a simple method of solving problems relating to horizontal beams with vertical loads, and fixed at both ends. The curve of bending-moment for the given distribution of load is first plotted, supposing the beam "*supported*" at the ends, and the constant c, by which the ordinates of this curve exceed those of the true curve, is determined from the condition that the angle between the end sections must be nought. If M is the bending-moment at a section, I the amount of inertia of the section about its neutral line, and E Young's modulus of elasticity for the material, then $\frac{M}{EI}$ is the curvature of the beam at that section. If O O′ is a short length of the beam, the angle between the originally parallel sections at O and O′ is $\frac{M}{EI}$. O O′. Hence, if the beam be divided into a great number of parts, and the values of M and I determined at the middle of each, then

$$\Sigma \frac{M}{I} . OO' = 0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

since E is supposed constant. But $M = m - c$, where m is the bending-moment at the same section, supposing the ends "supported";

$$\therefore \Sigma \frac{m - c}{I} = 0,$$

or,

$$\Sigma \frac{m}{I} = \Sigma \frac{c}{I},$$

$$\therefore c = \frac{\Sigma \frac{n}{I}}{\Sigma \frac{1}{I}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The following rule results: Knowing m and I at every point, divide the beam into any number n of equal parts, find $\frac{m}{I}$ at the middle of each part, and take their sum; this gives the numerator of (2). Find $\frac{1}{I}$ at the middle of each part, their sum gives the denominator of (2). From this c is determined. Diminish all the ordinates of the m diagram by c, and we have the diagram of bending-moment for a beam fixed at both ends, with any assumed distribution of load and variation of cross-section. Particular cases are worked out in full. Numerous drawings made by students of Finsbury Technical College were exhibited, showing applications of the method to different distributions of loading.—Note on Messrs. Vaschy and Touanne's method of comparing mutual induction with capacity, by Prof. G. C. Foster. In November last the author described a method of comparing the mutual induction of two coils with the capacity of a condenser. Since then he has found that a very similar method was used by Messrs. Vaschy and Touanne in July 1886, and published in the *Electrician* the following month. The formulæ are identical, and the difference consists in interchanging the galvanometer and the variable resistance p. Messrs. Vaschy and Touanne's arrangement has the advantage that the resistance of the secondary coil need not be known. Prof. Foster's method had been used by one of his students (Mr. Draper) about two years ago, but priority in publication belongs to Messrs. Vaschy and Touanne.—Prof. Perry asked the meeting for suggestions to explain why a strip of steel twisted about its longitudinal axis at a red heat, and allowed to cool, tends to untwist when under tension, and for a formula to calculate the amount.—A note on magnetic resistance by Profs. Ayrton and Perry was postponed.

Geological Society, June 8.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—A revision of the Echinoidea from the Australian Tertiaries, by Prof. P. Martin Duncan, F.R.S. After calling attention to a previous paper by himself published in the Society's Journal for 1877, and to additions to the fauna made by Prof. R. Tate and Prof. McCoy, the author proceeded to give notes on the characters, relations, and nomenclature of 29 species of Echinoidea. A few notes were added on the relations between this fauna and that now inhabiting the Australian seas, also on the connexions with the Tertiary Echinoidea of New Zealand, Sind, &c.—On the lower part of the Upper Cretaceous series in West Suffolk and Norfolk, by Mr. A. J. Jukes-Brown, and Mr. W. Hill. The district described in this paper is that of West Suffolk and Norfolk, and is one which has never been thoroughly examined; for no one has yet attempted to trace the beds and zonal divisions which are found at Cambridge through the tract of country which lies between Newmarket and Hunstanton. Until this was done the Hunstanton section could not be correlated definitely with that of the neighbourhood of Cambridge. It was the authors' endeavour to accomplish this, and the following is an outline of the results obtained by them. The paper was divided into six parts: (1) stratigraphical, (2) palæontological, (3) microscopical, (4) chemical analyses, (5) faults and alteration of strike, (6) summary and inferences. In the four first parts separate lines of argument were followed, and each led to the same set of conclusions. The chief interest of the paper probably centres in the gault, and its relations to the chalk marl and the red chalk. Quite recently the very existence of gault in Norfolk has been disputed, but the authors think the facts they adduce and the fossils they have found will decide that point. The gault at Stoke Ferry is about 60 feet thick, and in the outlier at Muzzle Farm *Ammonites interruptus* occurs plentifully in the form of clay-casts with the inner whorls phosphatized. At Roydon a boring was made which showed the gault to be about 20 feet thick, the lower part being a dark blue clay, above which were two bands of limestone inclosing a layer of red marl, and the upper 10 feet were soft gray marl; the limestones contained *Amm. rostratus*, *Amm. lautus*, *Inoceramus sulcatus*, and *Inoc. concentricus* (?), while the marls above contained *Belemnites minimus* in abundance. At Dersingham another boring was made which proved the gray marl (2 feet) to overlie hard yellow marl, passing down into red marl which rests on Carstone. The gray marl thins out northward, and as the red marl occupies the position of the red chalk, the authors believe them to be on the same horizon, an inference confirmed by the presence of gault *Ammonites* in the red chalk. Another point of importance is the increasingly calcareous nature of the gault as it is followed northward through Norfolk. This was regarded as evidence of passing away from the land supplying inorganic matter, and approaching what was then a deeper part of the sea; this inference is borne out by the microscopical evidence. As regards the chalk marl, it also becomes more calcareous: at Stoke it is still over 70 feet thick, and its base is a glauconitic marl which can be traced to Shouldham and Marham, but beyond this the base is a hard chalk or limestone, which is conspicuous near Grimston and Roydon, and passes, as the authors believe, into the so-called "sponge bed" at Hunstanton. The Totternhoe stone is traced through Norfolk, but is thin at Hunstanton (2 feet); its existence, however, enables the limits of the chalk marl to be defined, with the result that some 13 feet of the hard chalk at Hunstanton must be referred to that subdivision. The gray chalk also thins northward, and from 90 feet near Cambridge is reduced to about 30 at Hunstanton. The Belemnite-marls are traceable in Norfolk, but either thin out or are replaced by hard white chalk near Heacham. The Melbourn rock is continuous, and maintains similar characters throughout. The total diminution in the thickness of lower chalk is from 170 feet at Newmarket to 55 feet at Hunstanton, viz. 115 feet. An endeavour was made to estimate the amount and extent of gault removed by erosion from Arlesey and Stoke Ferry.—On some occurrences of Piedmontite-schist in Japan, by Mr. B. Kotô. Communicated by Mr. Frank Rutley.

Mathematical Society, June 9.—Sir James Cockle, F.R.S., President, in the chair.—The President announced that the Council had awarded the second De Morgan Medal to Prof. Sylvester, F.R.S.—The following communications were made:—Note on the linear covariants of a binary quintic, by A. Buchheim.—The motion of a sphere in a viscous liquid, by A. B. Basset (the method of solution was by definite integrals analogous to Fourier's solution of equations determining the propagation of heat).—On the reversion of series in connexion with reciprocants, by Capt. Macmahon, R.A.—Explanation of illustrations accompanying a preliminary note on diameters of cubics, by J. J. Walker, F.R.S.

PARIS.

Academy of Sciences, June 13.—M. Janssen in the chair. —On the life and labours of M. Laguerre, Member of the Section for Geometry, by M. Poincaré. A brief sketch is given of the important discoveries made, especially in pure geometry, by this distinguished mathematician, who was born at Bar-le-Duc on April 9, 1834, and died there on August 14, 1886.—General method for the determination of the constant of aberration, by M. M. Lœwy. By means of the table published in the *Comptes rendus* for May 23, the author has determined the two azimuths relative to the horizontal direction of the terrestrial movement. The solution of this problem affords a good illustration of the easy application of the new method, as well as the high degree of accuracy of which it is capable.—Note on the earthy phosphates, by M. Berthelot. Some practical remarks are offered in connexion with M. Joly's recent communication on the earthy phosphates. While confirming the numerical data of previous thermo-chemical studies, they extend and in some respects modify their application.—Note on the residuums resulting from the action of the acids on the alloys of the metals in association with platina, by M. H. Debray. In a previous communication it was shown that the common metals, such as tin, zinc, lead, alloyed with a small quantity of the metals of platina, when heated with an acid capable of dissolving the common metal yield either the metal of platina in the crystalline state, or perfectly distinct alloys, or, lastly, residuums containing a considerable portion of water and oxygen. Here it is shown that these residuums even contain nitrogen when the acid employed is nitric acid.—Figures in relief representing the successive attitudes of a pigeon on the wing; disposition of these figures on a zootrope, by M. Marey. By the method already described and applied to other birds, the author here represents the flight of a pigeon in eleven successive attitudes taken at equidistant phases in a single revolution of the wing. The zootrope on which these phases are reproduced is an instrument derived from Plateau's phenakistiscope, which reflects the continuous flight of a bird. The large number of the images and the slow rotation of the instrument reproduce the apparent movements so gradually that the eye is easily able to follow them in all their shifting phases. The bronze figures are painted on a white ground, the illusion being completed by appropriate tints imparted to the bill, feet, and eyes.—"The Pygmies of the Ancients in the light of Modern Science," by M. A. de Quatrefages. On presenting to the Academy the work bearing the above title, the author remarks that, although now found only in scattered groups everywhere oppressed or encroached upon by larger and stronger races, the dwarf Negrito peoples existed in compact bodies forming the bulk of the population in many parts of Africa, Southern Asia, and the Eastern Archipelago. The Akkas, discovered by Schweinfurth south of the Monbuttu country, formerly reached as far north as the parallel of Khartoum, and were known by this name to the ancient Egyptians, Mariette having found it inscribed under a pygmy sculptured on a monument dating from the old empire. The Negritoes of Malaysia and Melanesia, characterized by their low stature and a relative degree of trachycephaly, are quite distinct from the Papuans of the same region, and this distinction is now generally recognized by anthropologists. The Asiatic pygmies described by the ancients are represented by these eastern Negritoes, just as the African pygmies of Herodotus and Pliny were the ancestors of the Negrilloes still surviving in many parts of Africa. In stature the modern pygmies range from 1·507 (various tribes in the Malay Peninsula) down to 1·300 metre (the Batwas recently discovered by Dr. Wolff in the Congo Basin).—Observations of the Borrelly planet made at the Observatory of Algiers, by M. Trépied.—Observations of the new planet, No. 267, discovered at Nice on May 27, by M. Charlois.—On a new form of electrometer, by M. J. Carpentier. The apparatus here described has been prepared especially with a view to industrial appliances. It is distinguished by its exceptional qualities of aperiodicity, by which its readings are rendered perfectly sure and rapid.—Researches on the trimetallic phosphates, by M. A. Joly. Here are studied the sodico-strontianic and sodico-barytic phosphates and arseniates, which are specially interesting owing to the readiness with which they are formed in the crystalline state with a considerable liberation of heat, and under conditions analogous to those yielding the ammoniaco-magnesian phosphate.—On the metallic vanadates, by M. A. Ditte. Having already prepared a number of vanadates by the dry process, the author here shows that many metallic vanadates, such as those of magnesia, lime, nickel, cobalt, zinc, copper, lead, and silver, may also be produced by the wet process. The crystallized vanadates thus obtained present, like the others, compositions analogous to those of the alkaline vanadates.—On the hydrochlorates of chlorides, by M. Engel. This paper deals more especially with the hydrochlorate of perchloride of iron.—On the composition of different butters, by M. E. Duclaux. The experiments made by the author with butters from various parts of France show that, contrary to the generally accepted opinion, the quality of this article does not depend so much on the method of preparation as on the breed of cattle and their food, the character of the pastures—that is to say, the geological constitution of the soil—the influence of the seasons, the age of the milk, &c.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Journal of the Chemical Society, June (Gurney and Jackson).—Proceedings of the Society for Psychical Research, May (Trübner).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Bulletin de la Société Impériale des Naturalistes de Moscou, No. 2 (Moscou).—Beiblätter zu den Annalen der Physik und Chemie, 1887, No. 5 (Barth, Leipzig).—Records of the Geological Survey of India, vol. xx. Part 2.—The True Sources of the Mississippi: P. Giles.—A Century of Electricity: T. C. Mendenhall (Macmillan).—Atlas de la Description Physique de la République Argentine. Deux Section, Mammifères: Dr. H. Burmeister and E. Daireaux (Buenos Aires).—Metal Plate Work: C. T. Millis (Spon).—Animal Biology: C. L. Morgan (Rivingtons)—My Hundred Swiss Flowers: M. A. Pratten (Allen).—Dinocerata, an Extinct Order of Gigantic Mammals: Prof. O. C. Marsh (Washington).—Introductory Text-book of Physical Geography, 12th Edition: D. Page (Blackwood).—On Light (NATURE Series): Prof. G. G. Stokes (Macmillan).—Manchester Microscopical Society, Transactions and Annual Report, 1886.—Geodätische Arbeiten, v. Heft; Vandstandsobservationer, iv. Heft (Kristiania).—The Nature of Fever: Dr. D. MacAlister (Macmillan).—Proceedings of the American Academy of Arts and Sciences, New Series, vol. xiv., Part 1 (Boston).—Natural History Transactions of Northumberland, Durham, and Newcastle-upon-Tyne, vol. ix., Part 1 (Williams and Norgate).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1886, No. 3 (Moscou).

CONTENTS.