THURSDAY, MARCH 15, 1888.

LIFE CONTINGENCIES.

Institute of Actuaries' Text-book of the Principles of Interest, Life Annuities and Assurances, and their Practical Application. Part II. Life Contingencies (including Life Annuities and Assurances). By George King. (London: C. and E. Layton, 1887).

SOME years ago the Council of the Institute of Actuaries came to the conclusion that the students of actuarial science were subjected to great inconvenience and loss of time in consequence of the number of different books and scientific papers to be consulted in acquiring a knowledge of the subject. Persons actively engaged in the work, and wishing to refresh their memory as to the best methods of solving some special question, frequently felt the same sort of inconvenience. The Council, with that consideration for the students which has always been characteristic of them, resolved to provide what was wanted. They accordingly authorized the compilation and publication—the cost to be borne by the Institute—of a "Text-book of the Principles of Interest, Life Annuities and Assurances, and their Practical Application." The first volume, entitled Part I., and treating of the principles of interest (including annuities-certain), has been before the public since 1882. The second part, which is concerned with "Life Contingencies," has now been issued. The editing or authorship of this portion of the text-book was intrusted to Mr. George King, the Actuary of the Atlas Insurance Company, and formerly of the Alliance, whose practical acquaintance with assurance calculations, well-known devotion to his work, and experience as a lecturer at the Institute, qualified him, in a high degree, for undertaking the task.

In the opening chapters of the present volume, the author deals with the ordinary mortality table, its construction from different kinds of data, and its varied application by the actuary and the statist, including the determination of the probable numbers dying or surviving in a community, or in an annuity or other society. Such a table, showing out of a certain number of persons born how many attain to each year of age, may obviously be formed from records of the duration of life in a great number of individual cases; always provided the cases constitute a fair selection. Here, however, arises great practical difficulty, and mortality tables are, in consequence, usually constructed from observations yielding the probability of living one year at each year of age. This is so important a fact, at least to students commencing the study, that we should have been glad if the "elementary illustrations" given by the author had included a numerical illustration in brief detail reproducing the process underlying one or other of the standard tables. The author has proceeded wisely, we think, in first collecting the elementary formulæ of the doctrine of chances, and then showing how these may be applied to the numbers of the mortality table in order to solve the many and important questions arising in connection with single or joint lives. He points out two fallacies which it is desirable the public should recognize as such. This is one:—

"It will be found . . . that the higher the age from which we count, the greater will be the average age at death. Thus, at age 10, the average age at death is 60·257 years; at age 20, it is 62·101; at age 30, it is 64·726; and at age 60, it is 73·808. . . . It is frequently stated by shallow reasoners that some professions, such as that of the lawyer, must be conducive to longevity . . . because the average age at death of the members of that profession is much higher than that of the general population. But the general population starts from age 0; and starting from age 0 the average age at death, if the mortality were to follow the table, would be only 47·785 years, whereas . . . a lawyer does not enter the profession until he reaches manhood; and usually it is not until many years later that he attains sufficient eminence for his death to be commented upon. Therefore, even if the rate of mortality among lawyers be not more favourable than among the general population, the average age at death of those whose deaths attract notice must be greater."

Much attention is given in this portion of the book to attempts which have been made to embody the *law of mortality* in a mathematical formula which should readily lend itself to the purposes of calculation. Two such attempts are introduced to our notice: the hypothesis of De Moivre, and the hypothesis of Gompertz. De Moivre, in his treatise on "Annuities on Lives," published in 1725, made the assumption, now well known, that, out of eighty-six births, one person dies every year until they are all extinct. Gompertz, in a paper contributed to the Royal Society in 1825, just a century later, observed: "It is possible that death may be the consequence of two generally co-existing causes: the one, chance, witbout previous disposition to death or deterioration; the other, a deterioration, or increased inability to withstand destruction." It would appear, however, that he did not pursue this twofold notion to its conclusion, but contented himself with investigating the effect of supposing "the average exhaustion of a man's power to avoid death to be such that at the end of equal infinitely small intervals of time he lost equal portions of his remaining power to oppose destruction which he had at the commencement of these intervals." The words now quoted, taken alone, perhaps do not give a very precise idea of what was intended, but they really cover the assumption that the force of mortality increases in geometrical progression, and may be represented, as Mr. King says, by Bc^x, where B and c are constants, and x the age. From this, the equivalent of the differential coefficient of the log of the number living, we find the number living at age x may be expressed in the form $k(g)^{c^x}$. By judiciously choosing values for the constants k, g, and c, the results approximate more or less closely to fact for a greater or smaller extent of life, but it was left to Mr. Makeham, the present Actuary to the Church of England Assurance Company, to perfect the formula, and render it an exponent of the effect of the two co-existing causes of death originally contemplated by Gompertz. The final shape of the formula then became $ks^x(g)^{c^x}$, wherein a fourth constant, s, is introduced. In this shape, although there still remains a difficulty with the youngest ages of life, the formula has been used for adjusting crude observations and simplifying calculations involving contingencies depending on several lives. The hypothesis of Gompertz, as formulated by Makeham, is, no doubt, useful for graduating certain tables, and for dealing with some of the more complex problems of life contingencies, but we doubt whether a disproportionate consideration is not given to it and to its application. In so far as it presents itself to us as the most successful effort yet made to fasten down the law of mortality, it has, no doubt, a charm and a fascination for everyone, and especially the mathematician; but, keeping in view the limited use made of it for the ordinary purposes of assurance work, and that even for graduating it is only one of several methods in vogue, we are inclined to think a less elaborate treatment would have been more commensurate with the proper scope of a text-book and book for general reference.

The next, and of course the main, portion of the volume is concerned with the great class of questions involving the consideration of interest when combined with life contingencies; that is to say, with annuities and assurances, whether on single or joint lives, and whether absolute or contingent; with advowsons, next presentations, fines for the renewal of leases on lives; also with life interests and reversions, and the values of life policies. Explanations and demonstrations are given at length, and some of them are exceptionally good. We may note that, in the chapter on annuities and assurances, the author says: "It has been common, in treatises on life annuities, to deal with annuities and assurances separately, but the two classes of benefits are so intimately connected that they ought always to be taken together." We are not quite sure that we have caught exactly the nature of the objection entertained by the author to the common method of dealing with the two kinds of benefit. We take it the intimate connection alluded to implies that both things are built up of the elementary forms of which $v^n l_{x+n}$ is the type, and proceed on parallel lines, and not that the results for the one should be obtained by giving an algebraic twist to the results deduced by a direct process for the other. We do not infer from his words, or gather from his book, that he would not exhibit the present value of an assurance by direct reference to the present value of £1 to be received by each of the persons alive at age $x + n$, rather than obtain it by an indirect process of reasoning, such, for instance, as this:—"If here be an annuity on (x) payable at the end of each year on which he enters, and another annuity payable at the end of each year which he completes, it is evident that the difference between the two is the value of £1 payable at the end of that year on which (x) enters, but which he does not complete; that is, the value of £1 payable at the end of the year of the death of (x), or, in other words, the value of an assurance on (x). Now $v(1 + a_x)$ is evidently the value of the first-named annuity, and, deducting from this the value of the ordinary annuity, a_x, we have the value of the assurance, $v(1 + a_x) - a_x$." The building up of a formula by premising its verbal interpretation is often an admirable example of ingenuity, but this process can never be allowed to displace the established course of mathematical reasoning.

In this, the staple portion of his work, Mr. King manifests his extensive acquaintance with the subject, or, rather, subjects. With a great quantity of matter at his command, he has used the pruning-knife very sparingly, possibly too sparingly. All the usual formulæ are given for precise calculation, and a number of approximative processes are developed where an exact calculation would be too cumbrous for actual use. It is worth suggesting for consideration whether a collection of questions to be worked out by students might not with advantage be inserted in a future edition of the book. There are many precedents for such a course in connection with text-books, and a goodly supply of questions is already at hand in the examination-papers set at the Institute in past years.

There is a third portion of the work, occupying some seventy pages, in which finite differences, interpolation, and summation are treated with more fullness than branches of pure mathematics would seem to be entitled to in a volume professedly assigned to life contingencies. Indeed, the author admits in his preface that these subjects were not within the scope of the text-book as originally planned. No doubt we have placed before us propositions which are specially applicable to actuarial needs, arranged and demonstrated with Mr. King's usual ability; but it seems to us they would have been more conveniently published in some other connection than the present. A knowledge of these things in a duly regulated course of study would naturally precede the consideration of their application.

The text of the work is supplemented by a collection of interesting tables, commencing with a table of mortality based on a combination of data for young and mature lives, and intended to show the mortality of healthy male life from birth to extreme old age. We must not fail to mention that the collection embraces complete tables for finding the value of joint-life annuities up to four lives inclusive.

Looking at the work as a whole, we find the various subjects are cleverly handled, the propositions appear one after the other in well-ordered succession, the demonstrations are well chosen, and the wording is clear and effective. Altogether Mr. King has done his work diligently and with good judgment, and has placed all future students of the Institute under a debt of obligation to himself and to the Council.

ROSENBUSCH'S "PETROGRAPHY."

II.

Mikroskopische Physiographie der massigen Gesteine. Von H. Rosenbusch. II. Abtheilung. Zweite gänzlich umgearbeitete Auflage. (Stuttgart, 1887.)

IN a notice (NATURE, vol. xxxv. p. 482) of the first part of the present work, we showed that the author, adopting a natural system of classification which gives the first place to field-evidence, divides the eruptive rocks into three great groups, viz. (1) the *Plutonic* rocks; (2) the *Dyke* rocks (*Ganggesteine*); and (3) the *Volcanic* or *Effusive* rocks. Unable to free himself entirely from the idea that geological age ought to be an essential factor in rock-classification, he subdivides the third group into a *palæo-volcanic* and a *neo-volcanic* series. It is the treatment of the neo-volcanic series which constitutes the bulk of this, the second and final part of the book.

The neo-volcanic rocks, which are stated to be essentially confined to Tertiary or post-Tertiary times, occur, for the most part, as lava-streams and sheets, and are often accompanied by tuffs. They are classified by Prof. Rosenbusch as follows:—

(*a*) Family of the Liparites and Pantellerites (equivalents, on the one hand, of the palæo-volcanic quartz-porphyries, on the other, of the granitic plutonic rocks).

(*b*) Family of the Trachytes and basic Pantellerites (equivalents of the palæo-volcanic quartzless porphyries, and of the plutonic syenites).

(*c*) Family of the Phonolites and Leucitophyres (equivalents of the plutonic elæolite-syenites).

(*d* and *e*) Family of the Dacites and Andesites (equivalents of the porphyrites and diorites).

(*f*) Family of the Basalts (equivalents of the melaphyres and certain augite-porphyrites in the palæo-volcanic series; and of the gabbros and diabases among the plutonic rocks).

(*g*) Family of the Tephrites (equivalents of the theralites, *i.e.* plagioclase-nepheline rocks of the plutonic series).

From this synopsis the merits of the new classification may be appreciated. No classification that taxonomic ingenuity may devise will wholly satisfy the desires of the sanguine petrologist. Rocks, however much they may be characterized by a certain amount of geological uniformity persistent over large areas (which have aptly been termed "petrographical provinces"), are still, it must be remembered, mere mineral aggregates; and the amount of possible variation, dependent on differences in chemical constitution, and varying conditions of consolidation, is enormous. Rock-types, which may be clearly defined and sharply separated on paper, will, in the field, often be found passing over into one another by gradations so imperceptible that the petrographer must regard as hopeless any attempt to draw a hard and fast line between them.

A weak point in Prof. Rosenbusch's classification seems to us his fundamental separation of the "dyke-rocks" (*Ganggesteine*) from the plutonic and volcanic series (*Tiefen- und Ergussgesteine.*) Both plutonic bosses and volcanic sheets must necessarily be accompanied by dykes or pipes through which the eruption took place, and into the rocks composing which they pass by imperceptible gradations. The author, indeed, calls attention himself to this fact (on pp. 6 and 522), and proposes to include under the head of "*Ganggesteine*" only those rocks which occur *solely* in the form of dykes and are unaccompanied by tuffs. Still, rocks so nearly allied as these must necessarily be to the dykes and volcanic pipes and necks in immediate connection with the centre of eruption, should not, we think, be so widely separated from them. On the other hand, we find placed in this group rocks, such as granite-porphyry, which are known to occur in bosses, as, for instance, at Shap and at Dartmoor.

As to the question of age, it is so far satisfactory that the author has gone a step in what is surely the right direction, in eliminating this factor from the consideration of the plutonic rocks. With regard to the advisability of retaining the separation into an older and a younger series of the volcanic rocks, Prof. Rosenbusch refrains from expressing an opinion (p. xi. of preface.) In connection with this question, we must draw attention to one point. The structure characteristic of the dolerites (diabases of the Germans) in which allotriomorphic masses of augite are penetrated by idiomorphic crystals and microlites of felspar, and which is known as *ophitic structure*, occurs nowhere in more typical development than in the dolerites of the Western Isles of Scotland (described and figured by Judd) and of Iceland (Bréon), a statement that anybody who has seen rock-sections from these localities will support. Yet these rocks, apparently because they are of Tertiary age, are placed by Prof. Rosenbusch (pp. 725 and 733) with the basalts, and are described as possessing "*intersertal structure*," a structure characterized, according to the definition given on p. 504, by the presence of a hypocrystalline interstitial substance (mesostasis) wedged in between the felspars. That some of the rocks in question contain small wedge-shaped portions and films of glassy interstitial substance nobody will deny; but that many of them are perfectly holocrystalline and truly ophitic is equally beyond question.

Besides "intersertal structure" we notice two other structural terms used now for the first time, viz. "*pilotaxitic*" and "*hyalopilitic*." The former is applied to a holocrystalline structure, especially characteristic of certain porphyrites and basalts, in which the ground mass consists essentially of slender laths and microlites of felspar in felted aggregation, and often exhibits fluxion-phenomena. The addition of films of glass produces "*hyalopilitic*" structure.

New rock-names are *Tholeiite* (p. 504) and *Alnöite* (p. 805). The former is given to a variety of augite-porphyrite with typical "intersertal structure." Certain North of England dykes (the Hett dyke, Tynemouth dyke, and Hebburn dyke) described by Teall, are referred to this group. Several of the English, Scotch, and Irish traps, described by Allport and Hull, are, according to the author, olivine-tholeiites (p. 515). The word "*Alnöite*" is applied by Prof. Rosenbusch to a subdivision of the melilite-rocks, hitherto classed with the melilite-basalts, but differing from the latter by their occurrence in the form of dykes and their near relation to the elæolite-syenites.

Interesting to English readers are the remarks contained on pp. 417, 418. In referring to the Cambrian quartz-felsites and felsites of Wales, which have been described by Messrs. Bonney, Cole, and Rutley, Prof. Rosenbusch compliments these authors on not having overlooked the influence of dynamic metamorphism in developing their present character. He then goes on to say that he has been led, partly by Prof. Bonney's descriptions, partly by the examination of sections, to the belief that two distinct classes of rocks are here associated, viz. metamorphosed eruptive rocks (schistose porphyries), and metamorphosed slates and tuffs (porphyroïdes). A comparative study of these rocks in connection with the "*Lenne-porphyren*" and the porphyroïdes of the Thüringer Wald would, the author thinks, be productive of interesting results. Many of these rocks (*e.g.* from between Llanberis and Cwm-y-Glo, north-west of Cwm-y-Glo, Llyn Padarn, near Llanberis; also the nodular felsites from Conway Falls, and the rock from Digoed) ought, judging from the frequent occurrence of striated and microperthitic felspars, rather to be referred to the quartz-keratophyres than to the quartz-porphyries (p. 418).

We are glad to see that olivine is no longer regarded by the author as an essential constituent of basalt. This rock-name is thus made to gain considerably in significance, since it now embraces all (neo-)volcanic rocks of *basic* composition which essentially contain plagioclase and augite, whether they occur as lava-sheet or dyke. The *acid* plagioclase-augite rocks, on the other hand, whether with or without olivine, are referred to the andesites.

In connection with the basalts, it may be of interest to point out how considerable an alteration in the minor subdivisions of a rock-group has been produced by modern microscopic research. The old familiar grouping of the basalts, according to their granular texture, as dolerite, anamesite, and basalt, has been superseded. The modern petrographer distinguishes, with Prof. Rosenbusch, between the following structural varieties, which may coexist with any granular dimension: (1) "hypidiomorphic granular," (2) "intersertal," (3) "holocrystalline-porphyritic," (4) "hypocrystalline-porphyritic," and (5) "vitrophyric."

Welcome additions to the book are an appendix to the invaluable literature-index of Vol. I., bringing it up to the present date; and a useful index of localities, compiled by Dr. H. B. Patton. The book is well got up, well printed, and remarkably free from typographical errors.

F. H. HATCH.

A TREATISE ON CHEMISTRY.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol. III. The Chemistry of the Hydrocarbons and their Derivatives; or, Organic Chemistry. Part IV. (London: Macmillan and Co., 1888.)

THE present instalment of this well-known work deals with those benzenoid compounds containing respectively seven and eight atoms of carbon.

The excellent features referred to in our notices of the previous parts are preserved in this new section. The historical portions are especially valuable. Most text-books of organic chemistry restrict themselves to giving an account of the existing state of the science; but in the present work the description of every important compound, or group of compounds, is prefaced by an historical review of the various investigations which have led up, step by step, to the views now held. To students of organic chemistry, who, in ninety-nine cases out of a hundred, never see the older memoirs (and, if they did, would probably only be bewildered by the obsolete nomenclature and formulæ), these historical introductions are a great boon. As instances of this interesting mode of treatment, we may cite the historical introductions to the subjects of *toluene*, of the *nitrotoluenes*, and of *creosote*—with the account, in the latter case, of the confusion between creosote and phenol, and of the way in which this confusion was eventually cleared up. In this connection we may call the attention of our spelling reformers among English chemists to the passage (p. 33) quoted from Reichenbach's original memoir in which he first coins the word "creosote." The etymological knowledge of the average English chemist (when it exists at all) is little—and dangerous. He has learned that there is such a word as κρέας, and rashly opining that he is at liberty to derive an English word from a Greek nominative, he changes Reichenbach's spelling to "cre*a*sote"—a corrupt form which, as "creasotum," has passed into the Pharmacopœia, embalmed in the choicest apothecaries' Latin. One regrets that the zeal of the reformer was not tempered by the knowledge that Reichenbach derives the word from the contracted genitive, κρέως.[1]

The descriptive portion of the work is full and accurate. The only case that we have noticed in which the information is not up to date is in the account of the *benzaldehydines* (pp. 141 and 142), which are represented as ordinary condensation-compounds of ortho-diamines with benzaldehyde; whereas Hinsberg showed, about a year and a half ago, that they are in reality benzylated anhydro-bases. The name "Nevile" is also throughout erroneously given as "Neville."

[1] "Of course the reformer may write "creatosote" if he chooses; but "creasote" is inadmissible.

OUR BOOK SHELF.

A Text-book of Organic Materia Medica. By Robert Bentley, M.R.C.S., F.L.S. Cr. 8vo. pp. 415. (London: Longmans, Green, and Co., 1887.)

IT is a difficult matter to produce a text-book of materia medica which shall answer the requirements of the student in these days. No subject is less clearly defined either by teachers or by the authorities at Examining Boards. Prof. Bentley indicates this difficulty in his introduction, where he first defines "materia medica" and the allied words "pharmacology" and "therapeutics," and then confesses that our first English authority in this department of science, Dr. Lauder Brunton, has used some of the terms in a different sense. There is one advantage, however, in this difference of view—namely, a variety in the treatment of the subject; and we have to thank Prof. Bentley for having produced a work which departs in many directions from the somewhat stereotyped arrangement of English works on materia medica.

As might have been expected from the accomplished Professor of Botany in King's College, the work is mainly devoted to a careful description of the characters of medicinal plants and their products. The arrangement of the plants is founded, so far as the Phanerogamia are concerned, upon that adopted by Bentham and Hooker in their "Genera Plantarum." The descriptions are given very fully, so as to enable the student to recognize the drugs with facility and certainty, and thus at the same time readily to detect any adulteration. The author is right when he expresses his belief that in the latter respect the book will be especially valuable to the pharmacist. To the medical student and to the medical practitioner adulteration is no longer a subject of direct interest. The day has gone by when crude drugs came into the dispensary of the doctor, who now buys all the preparations ready made; and the Examining Bodies, aware of this, have relieved medical students of the laborious subject of drug adulteration, and now require of them the recognition of but a few of the most important specimens. No doubt the book will find its largest circle of readers amongst young men preparing for the examinations of the Pharmaceutical Society.

In our opinion it would have been better to give the strength as well as the dose of the more important preparations, such as those of opium.

The sections on the chemical composition of drugs have been carefully brought up to the level of recent researches. The methods of the separation of active principles, such as morphine and atropine, from the crude substances, and their reactions, are not given.

Prof. Bentley does not undertake to give more than the most general indication of the action of the remedies he has so fully described. All that is said of rhubarb, for instance, under the heading of medicinal action, is that "it possesses tonic and slightly astringent properties, and in large doses it acts as a purgative." This is a very good system for pharmaceutical students, and according to some authorities for medical students also at the commencement of their career. But it manifestly encourages learning by rote. What impression of definiteness or value does the word "tonic," for example, represent in the mind of the juvenile reader? Of course none.

Again, whilst we acknowledge that Prof. Bentley has on the whole confined himself to an account of the actions of the various drugs on the healthy organism, we must object to the heading "Medicinal Properties," which is put before the paragraphs descriptive of these. A drug has an action quite apart from the circumstance that it may be employed as a "medicine," *i.e.* in relation to the treatment of disease.

The book contains a number of beautiful illustrations of plants and drugs. It is remarkably free from typographical errors, and the style of its production reflects credit on the publishers.

Catalogue of the Fossil Mammalia in the British Museum (*Natural History*). Part V., containing the Group Tillodontia, the Orders Sirenia, Cetacea, Edentata, Marsupialia, Monotremata; and a Supplement. By Richard Lydekker, B.A., &c. (London: Printed by order of the Trustees, 1887.)

WITH this part Mr. Lydekker completes his laborious and very meritorious work of cataloguing the large collections of Mammalian fossil remains in the British Museum.

The named species are 719 in number, and are arranged under 301 generic and 100 family headings, 106 out of this total being regarded as not to be distinguished from existing forms.

Rich as is the collection in the British Museum, it is very far from including all the known existing fossil forms of Mammalia; but, failing any treatise on such, this work will be of the greatest assistance to all workers in this field. Though at the commencement of his Catalogue Mr. Lydekker did not give descriptions of all the forms detailed, yet, as it proceeded, he somewhat altered his method, giving some of the more important distinctive characters, and so the value of the work to the student has been increased.

A volume of this nature is not capable of being described in any detail, and it will suffice to add that it will be quite a necessary book of reference in the library of a biologist.

Lehrbuch der Histologie. Von Dr. Philipp Stohr, a. o. Professor der Anatomie zu Wurzburg. (Jena: Gustav Fischer, 1887.)

THIS is an excellent little treatise on the same lines as Ranvier's larger "Traité Technique d'Histologie" and Prof. Schäfer's smaller "Essentials of Histology." The various tissues are systematically described with clear and well selected wood-cut illustrations; and after each section of the systematic description a full and careful account is given of the best methods of preparation, which will enable the student to verify the descriptive account. The microscopic structure of the chief organs is treated in the same way. The directions as to *technique* are not merely those suitable for an elementary student, but such as will be useful to one who is advancing in the direction of original research. The figures are, with the exception of a few diagrams, actual representations of what the student should be able to obtain by the particular mode of preparation recommended. An introductory chapter treats of the arrangement of the laboratory, and the apparatus and reagents necessary. E. R. L.

A Treatise on Photography. By Captain Abney, R.E., F.R.S. (London: Longmans, Green, and Co., 1888.)

THE appearance of a fifth edition of this well-known book is sufficient proof of its popularity, and no trouble seems to have been spared by the author to make this issue a success. The volume has been thoroughly revised, and much new matter added. The author gives the results of his researches, communicated to the Royal Society, on the "Effect of the Spectrum on the Haloid Salts of Silver;" concluding with a chapter on celestial photography, and photography with the microscope.

LETTERS TO THE EDITOR.

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

Coral Formations.

I HAVE read Captain Wharton's paper on "Coral Formations" (p. 393), and the letters of Mr. John Murray and Mr. G. C. Bourne in your issue of March 1.

There is, doubtless, room for difference of opinion as to this important and many-sided question, but I think the balance of evidence is in favour of Mr. Murray's view as to the formation of lagoons.

In this connection the fact that carbonate of lime is soluble in water had been practically overlooked, and its increased solubility in sea-water seems to have been unnoticed before Mr. Murray formulated his views as to their formation. The active life in coral reefs is practically outwards (assuming a shape similar to fairy rings on grass), leaving the central portion more or less dead, or with wide spaces of coral sand and only scattered patches of living animals. The organic matter in this dead coral, by its oxidation, produces carbonic acid, which dissolving in the sea-water exalts its solvent action on the carbonate of lime, now more or less in an amorphous condition.

Reducing such a question to figures has a great advantage, and is often the only way of arriving at a safe conclusion. With assistance derived from the Scottish Marine Station, I have lately been conducting some experiments on the solubility of carbonate of lime in sea-water, the results of which may interest the readers of NATURE at the present time.

The experiments were conducted with sea-water of specific gravity 1·0265 (obtained from the German Ocean 20 miles from land), and at temperatures of from 70° F. to 80° F., which reefs require. The corals used were several species of *Porites*.

Dead or rotten coral exposed to sea-water under these circumstances is soluble to the extent of 5 to 20 ounces per ton.

Take now a reef with a lagoon already formed, half a mile in diameter. This will give an area of about 600,000 square yards, and supposing the water to be 3 feet deep and only one-sixth part of this to be in actual contact with the dead coral, we have 100,000 tons exerting its solvent action. This would give, were the sixth part of the lagoon water to be expelled and replaced with fresh sea-water at each tide, and taking the solvent action at only 10 ounces to each ton, an amount of carbonate of lime removed equal to about 3000 tons each year.

I do not insist that such an amount of carbonate of lime *must* year by year be removed from the lagoon, but I think these experiments show that the carbonate of lime so removed may easily exceed any additions to the lagoon by secretions of animals living in it, or by coral sand carried into it by wind and waves from the outer edge in the same space of time, and therefore I think the balance of evidence is in favour of Mr. Murray's explanation of lagoon formation.

Could the experiment be made, it would be a matter of extreme interest to know if, and in what proportion, carbonate of lime really exists in lagoon waters, as also the proportion in the waters outside the reef, where new coral formation is actively at work.

It is quite reasonable to suppose that the dead coral so dissolved in the formation of lagoons is carried out as material for fresh coral growths. ROBERT IRVINE.

Royston, Edinburgh, March 6.

IN reference to the interesting discussion on coral formations which has recently appeared in NATURE, a few words from the chemist's point of view may not be out of place.

For some time past I have been endeavouring to satisfy myself regarding the solubility of calcium carbonate in sea-water, and with this end in view I immersed weighed pieces of dead coral (dried at 212° F. till constant) in sea-water. These were protected by suspending them under glass bells floated in about 18 inches of water, and allowed to remain at rest for a known length of time. The following are the results obtained:—

First Experiment.—Oculina varicosa, from St. Thomas, West Indies, weight 16·3164 grammes, with a surface of, roughly, 8 square inches, lost by solution in twenty days, 0·0748 gramme.

Second Experiment.—Madrepora scabrosa, from Levuka, Fiji, weight 21·8540 grammes, surface of 16 square inches, lost 0·1497 gramme in thirty days.

Third Experiment.—Montipora foliosa, Amboyna, weight 15·3334 grammes, surface of 15 square inches, lost 0·1223 gramme in forty-six days.

Every care was taken that the corals should not be subjected to the action of other than convection currents. The temperature ranged between 30° and 40° F. Specific gravity of the water found less than 1·026.

Mr. W. G. Reid, in a paper communicated to the Royal Society of Edinburgh, showed that the solubility of carbonate of calcium increased with pressure; and when determining the percentage of $CaCO_3$ in certain soundings I found that the greater the depth the less carbonate derived from surface shells was present, while it is a well-known fact that in the red clay or other deep-sea deposits, $CaCO_3$ almost completely, if not entirely disappears, as has frequently been pointed out by Mr. Murray.

From the above considerations there can be little doubt that there is considerable action going on in the waters of the ocean.

Take, for instance, a circular lagoon four miles in diameter; this would give a superficial area of 12½ square miles. Taking the results obtained in Experiment 1, and applying them to this imaginary case, then in twenty days, in absolutely still water, there would be dissolved 464 tons of $CaCO_3$, equal to 8472 tons in a year. If the specific gravity of carbonate of calcium be taken at 2·65, this amount would give a thickness of half an inch covering the whole area of the lagoon. In other words, at the same rate it would require about a century to deepen the lagoon one fathom.

These results must be, however, very much under-stated, as the temperature in the coral regions is about twice what I could obtain; the sea-water is denser; there is the action of carbonic acid gas, CO_2, which is constantly being generated by decomposing organic matters, especially in these warm areas, and all which would increase materially the solubility. Moreover, there are the tides and currents continually replacing, or rather mixing with, the denser waters.

The coral animals in the lagoon are, however, constantly laying down new material in the shape of $CaCO_3$, assimilated either directly from the sea or through the medium of other organisms upon which they feed, or both combined. Now it depends upon the excess of the one process over the other whether there be an increase or decrease in the depth of the lagoon.

Growth is restricted mainly in reefs to the outer periphery, leaving large spaces of coral sand in the interior to be freely acted upon. In this way the coral formation increases outwards, while there is a deepening of the interior, albeit this deepening is very small. JAMES G. ROSS.

14 Argyle Place, Edinburgh, March 10.

CAPTAIN WHARTON in his interesting paper satisfactorily explains a condition of reef-growth previously little known and but imperfectly understood. I was pleased to learn that Mr. Bourne's long-expected account of Diego Garcia will soon be published. His remarks concerning the *directing* influence of currents agree closely with those of Semper ("Animal Life," vol. xxxi. Internat. Sci. Ser. p. 228). Of the importance of this agency there can, I think, be no doubt; but solution is also an important agency within the lagoon, and one more capable of actual demonstration than the directing force of the currents. But amongst the supporters of the *anti-subsidence* theory of Murray there is a difference of opinion as to the relative importance to be attached to solution; and we cannot accept the name of "theory of solution" for the new view if it is intended to exclude the other agencies that previously cause the death of the coral, such as the repressive influence of sand, the diminished food-supply, the tidal scour, &c. With this exclusive meaning, the name "theory of solution" would contradict itself, and we should be regarding the problem in much the same light as if we were solely to contemplate the mystery of our own existence from the point of view of the undertaker.

The development of the new theory should be borne in mind. Chamisso, seventy years ago, advanced the view that an atoll owes its form to the growth of the corals at the margin and to the repressive influence of the reef-debris in the interior; but this view gave no satisfactory explanation of the foundation of such a coral reef, and Darwin was driven to his theory of subsidence. The great defect in the view of Chamisso was, however, removed by Murray, who supplied the *foundation* of an atoll without employing subsidence; and investigations in the Florida Sea and in the Western Pacific have confirmed his conclusions. The *forms* of reefs he attributed to well-known physical causes; but Semper and Agassiz have dwelt upon the importance of other agencies, and in our present state of knowledge it will be wisest to combine in one view the several agencies enumerated by these three naturalists as producing the different forms of coral reefs. On the outer side of a reef we have the directing influence of the currents, the increased food-supply, the action of the breakers, &c. In the interior of a reef we have the repressive influence of sand and sediment, the boring of the numerous organisms that find a home on each coral block, the solvent agency of the carbonic acid in the sea-water, and the tidal scour. These are all real agencies, and we only differ as to the relative importance we attach to each. Future investigations will probably add others to the list, besides ascertaining the mode and degree of action of each cause.

March 10. H. B. GUPPY.

Reason and Language.

THE kindness of Prof. Max Müller's reply I recognize with pleasure but without surprise, since those who know him know him to be as remarkable for his courtesy as his great learning.

In answer to his first question, I must say that I made a point of attending his Royal Institution lecture on the day his "Science and Thought" was published, and was greatly disappointed that illness hindered my attending the others. But I immediately obtained his book, and applied myself to understand what seemed to me its essence, though I have not read it from cover to cover. Should I have to review it, of course I shall conscientiously peruse the whole of it.

Before replying further, it may be well to restate my position as follows.

Man is an intellectual being able to apprehend certain things directly and others indirectly. Normally, his conceptions clothe themselves in vocal sounds, and get so intimately connected therewith, that the "word" becomes practically a single thing composed of a mental and an oral element. But these elements are not *identical*, and the *verbum mentale* is anterior and superior to the *verbum oris* which it should govern and direct. Abnormally, conceptions do not clothe themselves in oral expressions at all, but only in manual or other bodily signs, and this shows that concepts may be expressed (however imperfectly), in the language of gesture without speech. One consequence of these relations is that neither the utterance of sounds (articulate or inarticulate) nor bodily movements could have generated the intellect and reason of man, and Noiré's hypothesis falls to the ground. On the other hand, beings essentially intellectual, but as yet without language, would immediately clothe their nascent concepts in some forms of bodily expression by means of which they would quickly understand one another.

As to the expressions "reason" and "reckoning," I would observe that a study of an organism's embryonic development is a most valuable clue to its nature, and no doubt a similar utility attends historical investigations in Prof. Max Müller's science. Nevertheless, we cannot understand the nature of an animal or plant by a mere knowledge of an early stage of its existence; an acquaintance with the outcome of its development is even more important. Similarly, I venture to presume, the ultimate meaning of a word is at least as much its true meaning as is some archaic signification which may have grown obsolete. The word "spirit," if it once meant only the breath, means more now—as we see from the Professor's first letter. Similarly, if "reason," in its Latin form, once only meant "reckoning," that is no "reason" why it should only mean reckoning now. Here it would seem as if we had an instance of the *verbum mentale* having acted upon and modified the *verbum oris*. I cannot but regard the representation that affirmative and negative propositions are mere cases of addition and subtraction as an incorrect and misleading representation, save when they refer to mathematical conceptions. I am compelled also to object to another of the Professor's assertions. He says:—"There is a wide difference between our apprehending our own activity and apprehending that A is A. Apprehending our own activity is inevitable, apprehending that A is A is voluntary." It is true there is a great difference between these apprehensions, though they both agree in being instances of apprehensions which are not inferences, and as such I adduced them (NATURE, February 16, p. 364). Nevertheless in my judgment the difference between them is not the difference which the Professor states. Both are alike voluntary, regarded as deliberate reflex cognitions, and both are alike inevitable, regarded as indeliberate, direct perceptions. The labourer inevitably perceives that his spade is what it is, though the nature of that perception remains unnoticed, just as he inevitably perceives his own continuous being when he in no way adverts to that fact.

I must further protest against the assertion that the idea "therefore" is "present in the simplest acts of cognition"—that every perception of an object is an inference. This I regard as one of the fundamental errors which underlie all the madness of idealism. Akin thereto is the notion that a philosopher who desires to speak with the very strictest accuracy ought, instead of using "the big I," to say, "a succession of states of consciousness." To me it is certain that even one state of consciousness (to say nothing of "a series") is no more immediately intued by us than is the substantial ego; each being cognized only by a reflex act. What I intue is my "self action," in which intuition both the "ego" and the "states" are implicitly contained, and so can be explicitly recognized by reflection. I was myself long in bondage to these two errors, from which it cost me severe mental labour to escape by working my way through philosophical subjectivism. These questions I cannot here go any further into, and I only mention them in consequence of Prof. Max Müller's remarks. I will, however, in turn, refer him to my "Nature and Thought," as well as to a larger work which I trust may before long be published, and which, I venture to hope, he will do me the honour to look at.

My object in calling attention to the fact that one word may have several meanings, and several words one meaning, was to show that there could not be "identity" between thought and language. This point the Professor seems practically to concede, since he now only calls them "inseparable, and in one sense identical." I do not understand degrees of identity. No mere closeness of resemblance or connection can make two things absolutely identical. I did not, however, content myself with denying this "identity" on account of polyongeny and homonymy; I also referred to common experience (which shows us that men do not invent concepts for preformed words, but the reverse), and I appealed to certain facts of consciousness. To my assertions about consciousness the Professor replies: "The object of all scientific inquiry is the general and not the individual." But this is a quite inadequate reply, since our knowledge of general laws is based on our knowledge of individual facts, and if only one man could fly, that single fact would be enough to refute the assertion that flight is impossible to man.

With respect to evolution, I never said that Prof. Max Müller misunderstood "natural selection," but only that he misrepresented it—of course unintentionally. It is of the essence of natural selection not to affirm teleology as formerly understood, although, of course, it can say nothing (for the whole of physical science can say nothing) about a primordial teleology at the foundation of the entire cosmos. I, in common with the Professor, look forward to "the ultimate triumph of reason and right," but my confidence is not due to any "faith" I have in "Nature" or anything else. I profoundly distrust "faith" as an ultimate basis for any judgment; I regard my conviction as a dictum of pure reason—the certain and evident teaching of that science which underlies and gives validity to every other. I therefore agree with Prof. Max Müller in regarding it as a lesson which "true philosophy teaches us."

ST. GEORGE MIVART.

Oil on Troubled Waters.

IT may interest some of the readers of Captain Wharton's paper on this subject to have their attention called to a curious narrative in Bede, illustrative of the power of oil over troubled waters. When a certain presbyter, Utta, was sent from the North of England by Oswiu to fetch his bride from Kent, he applied to Aidan, the greatest teacher of his day, for his blessing. Aidan gave him not merely his blessing, but some consecrated oil, and told him that on his way back from Kent by sea he would encounter a storm, and thereupon he was to pour the oil on the sea, which would immediately become calm. It happened as St. Aidan had foretold. Utta and his fair charge were duly overtaken by a fearful tempest; the waves were breaking over the ship, when Utta bethought himself of Aidan and his oil. "Assumpta ampulla, misit de oleo in pontum, et statim, ut prædictum erat, suo quievit a fervore" ("Historia Ecclesiastica," lib. iii. cap 15). Aidan had been brought up at the monastery of Iona. Did the boatmen of the Western Islands in the seventh century know of this use of oil? and did Aidan bring the knowledge from thence that saved from shipwreck Utta and the bride Eanfleda?

EDW. FRY.

Were the Elephant and Mastodon contemporary in Europe?

ONE of the most effective services which NATURE does for the cause of science is to enable students who live far apart to exchange ideas in its correspondence columns. May I be allowed to ask a question of some interest, perhaps, to others besides myself? It is a singular fact that we probably know less of the *sub-aërial* conditions prevailing in so-called Pliocene times than we do of those of most geological horizons. The marine Mollusca of this age have been preserved in large numbers and in many places, but the remains of the land fauna are singularly sporadic and broken.

I know of no fragment of a land surface of this age which exists in Britain. In the Crags we have a very puzzling medley of mammalian bones and marine shells mixed heterogeneously, and pointing unmistakably to the beds having been rearranged, and, as the French say, *remanié*.

Unfortunately the Pliocene period has been largely defined on the evidence of these very unsatisfactory beds—unsatisfactory not merely because *it is certain* that the remains of land and marine animals are confusedly mixed up in them, but also because *it is exceedingly probable* that the debris of two geological stages have been mixed together also.

It seems clear to me that, if the Pliocene age is to be clearly defined, we must not rely upon the evidence of the English Crags for defining it, but go elsewhere—namely, to France, Italy, &c.

It is very well known that nowhere in France has the mastodon, which is generally accepted as a very typical Pliocene mammal, been found in the same beds with the elephant. In the English Crags, no doubt the older type of elephant (the *E. meridionalis*) and possibly also molars of the later forms (*E. antiquus* and *E. primigenius*) have occurred with mastodon remains and the remains of other so-called Pliocene beasts; but the mixed character of these deposits puts them out of court, and we are bound to follow the evidence of the French beds, which occur *in situ* and unmixed, if we are to be assured of our position.

My purpose in writing is to ask whether the Italian evidence is the same as the French. Unfortunately the Italian beds do not seem to me to have been studied with the minute care which they deserve. No doubt enormous numbers of mastodon remains and also of remains of *E. meridionalis* occur close together in Italian deposits, but so far as I know the question has not been critically tested as to whether they occur in the *same* beds or not. Prof. Capellini, of whom I asked the question at the meeting of the British Association at Manchester, could not answer me. *Primâ facie* we should certainly expect the Italian evidence to support the French, but this is by no means the conclusion to be drawn from text-books, in which it is generally taken for granted that in Italy the elephant and mastodon have been found at the same horizon.

The question is one of very great interest and importance, and an answer to it would be especially valuable to me. Perhaps some of your readers may have the means of answering it.

HENRY H. HOWORTH.

21 Earl's Court Square, February 28.

True Average of Observations?

I HAVE long been dissatisfied with the method of taking the arithmetic mean as the most probable value of a *comparatively few* direct observations of a quantity. This is certainly the legitimate result of the theory of probability, or "method of least squares," when one knows nothing to guide one in giving more weight to one than to another observation.

But without knowing anything of the conditions under which the observations were made, or, otherwise, no choice among them being possible by considering these conditions, still, when one comes to compare the results among themselves, this comparison seems to me to afford means of judging between them. Thus, if all the results are plotted on sectional paper, they are found to be grouped closely together at one place and to be scattered wide apart at others. Now the most probable result (whatever be the right method of finding it) lies certainly somewhere about the place of close grouping; and it seems fair to consider those results that come near this place as the *better ones*, and to allow to them *more weight* than to the others in calculating the mean.

If the observations were extremely numerous, there can be no objection to taking the arithmetic mean as the true probable value. But one has usually to content one's self with a few only, and in order to get a better approximation in this case I have constructed the following formula. I would be glad if some of your correspondents will express their opinions as to its legitimacy. In a case of this kind one ought not to trust entirely to one's own judgment; one should submit one's own judgment to be checked by that of several others.

The method I propose is as follows.

First fix upper and lower limits outside which the true value cannot possibly lie, and reject absolutely all measurements outside these limits. The result will not be appreciably affected by taking these limits a little higher or lower, and it is better to err in taking them too wide apart than *vice versâ*. One usually has, or ought to have, a general notion of the quantity sought for, sufficient to determine these limits; but if this be not so, they may be determined by adding to and substracting from the arithmetic mean what is thought to be the maximum possible error.

Let x_1, x_2, x_3, &c., be the *excesses* of the various measurements above the lower of the above possible limits. Let x_0 be the *excess* above the same limit of the as yet unknown most probable value as determined by the formula below.

Attach to each x the weight $\left\{ 1 - \left(\frac{x - x_0}{x_0}\right)^2 \right\}$, *and take as* x_0 *the mean of the x's with these weights attached.*

Note that equal weights are given to measurements equally above and below x_0. Also to an x coinciding with the lower possible limit, a weight zero is given. Zero weight is also given to an x as much above x_0 as the lower possible limit is below it.

The rule results in the following formula:—

$$\text{Weight for } x = 1 - \left(\frac{x - x_0}{x_0}\right)^2 = \frac{2x_0 x - x^2}{x_0^2},$$

$$x \times \text{weight} = \frac{2x_0 x^2 - x^3}{x_0^2}.$$

Therefore, the mean equals—

$$x_0 = \frac{2x_0 \Sigma x^2 - \Sigma x^3}{2x_0 \Sigma x - \Sigma x^2}.$$

This is a quadratic for x_0, the solution of which is—

$$x_0 = \frac{3}{4}\frac{\Sigma x^2}{\Sigma x}\left\{1 + \sqrt{1 - \frac{8}{9}\frac{\Sigma x \Sigma x^3}{(\Sigma x^2)^2}}\right\}.$$

Of course the labour of finding this mean is greater than that of finding the arithmetic mean; it involves summing the first, second, and third powers. But the method is only intended to be used when the number of values to be dealt with is not large, and with the help of a table of squares, cubes, and square roots, the work is not really very laborious.

It is easy to prove that this result is identical with the arithmetic mean in the following three cases: (1) all the x's equal; (2) the x's all equidistant, *i.e.* forming an arithmetic progression; (3) the x's infinitely numerous.

The practical meaning of the rule may perhaps be made clearer by the annexed table, giving the weights attachable to various values of x where x_0 is taken equal to unity.

x	1	·9 or 1·1	·8 or 1·2	·7 or 1·3	·6 or 1·4	·5 or 1·5	·4 or 1·6	·3 or 1·7	·2 or 1·8	·1 or 1·9	0 or 2
$1 - \left(\frac{x - x_0}{x_0}\right)^2$	1	·99	·96	·91	·84	·75	·64	·51	·36	·19	0

The following is a numerical example:—

x	x^2	x^3
1·73	2·993	5·178
·89	·792	·705
·42	·176	·074
1·21	1·464	1·7715
1·17	1·369	1·6016
$\Sigma x = 5·42$	$\Sigma x^2 = 6·794$	$\Sigma x^3 = 9·330$

$$\sqrt{1 - \frac{8}{9}\frac{\Sigma x \Sigma x^3}{(\Sigma x^2)^2}} = ·162 \text{ and } x_0 = 1·0925.$$

The arithmetic mean or $\frac{\Sigma x}{5} = 1·084$.

Mason College, February 4. ROBERT H. SMITH.

Crepuscular Rays in China.

IMMEDIATELY after sunset enormous rays of light are frequently seen spreading from the part of the horizon where the sun has disappeared, and also—though somewhat fainter—from the opposite part of the horizon. Sometimes the rays stretch right across the sky, and when strongly developed they appear first in the east, and then in the west, and resemble auroral rays, glowing in a yellow or red colour, while the sky between the rays is deep blue or greenish. They appear to be caused by invisible cirro-stratus clouds high up in the air. This phenomenon is never seen in England, or at any rate it is by no means so conspicuous as here. Ancient Greek mariners may have had their imagination impressed by a similar phenomenon, ῥοδοδάκτυλος ἠώς being so frequently mentioned in Homer.

Crepuscular rays at sunrise or sunset are seen at all seasons in Southern China, but they are most frequent at the height of the typhoon season, and most intense just before typhoons, which latter are indicated beforehand by crepuscular rays as well as by halos.

The following table exhibits the number of evenings when strong crepuscular rays were registered in each month of the past three years, and also the mean monthly frequency of the strongly developed phenomenon:—

	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1885	—	—	3	2	4	3	—	—
1886	—	1	1	1	3	7	—	1
1887	1	—	—	2	3	—	—	—
Mean	0·3	0·3	1·3	1·7	3·3	3·3	0·0	0·3

W. DOBERCK.

Hong Kong Observatory, December 31, 1887.

"An Unusual Rainbow."

I READ with interest a letter with the above heading in NATURE (vol. xxxvi. p. 581) from Mr. S. A. Hill of Allahabad, India, of date September 18, 1887. He describes a brilliant rainbow which he saw after the sun had set, and states that such a phenomenon "must be of rare occurrence," and that he had "never before seen anything similar, nor read anywhere a description of a rainbow after sunset." I had not read his letter when, on the evening of the 1st inst. I observed a similar rainbow. I saw it first at 7h. 25m. p.m., the registered time of sunset here for that day. It lasted for nearly fifteen minutes. The western horizon was cloudy, and the sunset a fine one. The bow was exceedingly brilliant, and as far as I could judge, a perfect semicircle, the ends of the arc being about 4° above the horizon. There was a secondary bow equally perfect, and of remarkable brightness; the brilliant glow below the primary, and the marked dulness between it and the secondary, added to the beauty of the sight. After reading Mr. Hill's letter, I published my observations in a letter to the *Argus*, that others might confirm or correct them. I have received six replies, all in accord with my observations. One of my correspondents informed me that he had, some years ago, seen a lunar rainbow formed just before the moon had risen. H. M. ANDREW.

The University, Melbourne, January 26.

The Nest of the Flamingo.

IN an interesting article by Mr. Bowdler Sharpe, entitled "Ornithology at South Kensington," published in the December number of the *English Illustrated Magazine*, there is a description and figure of the flamingo's nest, and an opinion is expressed that the previously-held ideas about the nest being tall, and the female sitting upon it in a straddling manner, might now be considered as exploded.

I have seen numbers of these tall nests in the shallow pans of water—or "vleys," as they are locally called—in Bushmanland, Cape Colony, particularly at Klaver Vley. These quaint nests were built in the water where it was a few inches deep, and at a considerable distance from the shore. They were conical in form, about 18 inches high, and 6 inches in diameter at the top, with a shallow basin-like cavity for the eggs; built, so far as I can recollect, of slimy mud. To perform the office of incubation, the bird must have straddled over the nest. The species no doubt differs from the one described in the article. There should be no difficulty in securing specimens of these nests. Possibly the object aimed at in building the nests in the water is to secure them against some enemy, and the height of the nest, besides conveniencing the long-legged owner, provides for the rising of the water-level. E. J. DUNN.

Pakington Street, Kew, near Melbourne.

Dynamical Units and Nomenclature.

IN his review of Prof. MacGregor's "Kinematics and Dynamics," on page 361, Prof. Greenhill tilts a lance against those whom he terms mathematical precisionists. I do not know this book, and I hold no brief in its defence; but as I owe to these precisionists whatever clear ideas I have on mechanics, I feel bound to enter into the lists on their behalf, little as they need my aid.

Both the precisionists and practical men start with the same two dynamical quantities, which they respectively call *mass* and *force*, *weight* and *force*; of these they select arbitrary units, and respectively name them *pound* and *pound-weight*, *weight-of-a-pound* and *force-of-a-pound* (or *pound-weight* and *pound-force*).

To the single word *pound* the practical man does not, so far as I know, attach any single definite idea, and he cannot, therefore, use this word singly without introducing possible confusion; for it characterizes matter and force equally, and yet *is* neither. On this view Prof. Greenhill's own expression "the attraction of the earth on a pound," should for accuracy and consistency be "the attraction of the earth on the weight of a pound (*or* on a pound-weight)."

To the precisionist a pound *is* a certain mass, just as a foot *is* a certain length, so that the practical man's "weight of a pound" is simply the "pound" of the precisionist, who would no more dream of 'distinguishing' it as "the mass of a pound" than of distinguishing a foot as "the length of a foot."

The attraction of the earth on a certain amount of matter is called "the force of 10 pounds" by practical men, and "the weight of 10 pounds" by precisionists: these are purely *definitions*, so that the phrases are absolutely equivalent. If, then, in the specification of a force produced otherwise than by the attraction of the earth a precisionist is required to speak of it as "a force equal to the weight of 10 pounds," the practical man must follow suit with "a force equal to the force of 10 pounds." These expressions stand, or rather fall, together, and the consistent precisionist would specify the force as "10 pounds-weight" merely.

If, however, a *body*, such as a brickbat or the iron block supplied with a balance and called a "pound weight," is to be introduced into the specification, a precisionist would very properly say "a force equal to the weight of 10 brickbats or of 10 pound-weights"; and the *complete* idea hereby conveyed cannot be expressed by the practical man otherwise than by "the attraction of the earth on 10 brickbats or on 10 pound-weights."

In no way, then, is "a force equal to the weight of a mass of 10 pound-weights," the precisionist equivalent of the practical "force of 10 pounds," nor is it even consonant with precisionist nomenclature.

Since, therefore, the precisionist uses *mass*, *force*, *pound*, *pound-weight*, as the exact equivalents of the practical man's *weight*, *force*, *weight-of-a-pound*, *force-of-a-pound*, the advantage does not seem to lie on the side of the latter, more especially when he is untrue to himself in loosely using the word "weight" as often in the sense of "force" as according to his definition.

But so far both practical men and precisionists labour under the immense disadvantage of dealing with a variable force-unit which can be made precise only by a specification of place; and it is greatly to the credit of the latter that they have introduced a simple invariable force-unit by which all forces, whether due to gravitation or other physical action, may be expressed absolutely in a form which allows of direct comparison between them. With this unit ma is the correct measure of a force, and when Prof. Greenhill speaks of "the mathematician straining after the equation $F = ma$, when using the gravitation unit of force," I utterly fail to understand what is meant, considering that this expression of a force necessarily implies an *absolute* force-unit; and I further feel strongly tempted to deny that either for this unintelligible operation or for any other the precisionist ever uses g pounds as a mass-unit, though, if he ever does use a variable mass-unit in measuring the invariable mass of a body, he is surely countenanced by the practical man who does not hesitate to use a variable force-unit in measuring the invariable force exerted by a given spring compressed to a given extent. I might further add that the precisionist *never* measures the weight of a body in "pounds," even if he denotes it by w, and that, if he does sometimes denote this variable force by the same number irrespective of place, it is only when using the practical man's variable force unit.

With regard to confusion arising from the use of the equation $w = mg$ any more than from the use of the equation $w = m$, this would be to me inconceivable, did I not notice that Prof. Greenhill uses the phrase "if the equation $w = mg$ is supposed to be used with absolute units." Does there indeed exist a single man who thinks that this equation can be used with other than absolute units? If such there be, to him certainly will confusion be not only possible, but probable too, and deservedly so; but to others there can surely be no more confusion in expressing a (precisionist) weight as m or mg indifferently than in expressing an angle as θ or $180\,\theta/\pi$, it being of course premised that the proper unit—(*precisionist*) *pound weight* or *poundal*, *radian* or *degree*—is named.

Further, how it can be a solecism to measure pressure in poundals per square foot any more than in pounds-weight per square inch—which latter is the precisionist equivalent of what an engineer would loosely and most inaccurately call "pounds"—I am at a loss to understand, since pressure is the measure of the distribution of force over area, and a poundal is as much a force as "the force of a pound," and very much more definite. And how the expression of the (precisionist) weight of a body in poundals rather than in pounds-weight is a solecism also demands explanation.

Lastly, I must seriously protest against the suggestion that a precisionist should ever ask for, or want to buy, "half a poundal of tea": what he wants is the tea itself, the substance of it and not the earth's action upon it, and very rightly and properly he asks for "half a pound," which the consistent practical man would have to term "the weight of half a pound."

In the above I am not concerned to defend the practice of those mathematicians who select fantastic units of mass or force as a foundation for some puzzling questions of no utility whatever: I have merely attempted to define the position of the physicist or precisionist, and to rebut *seriatim* the charges brought against him in Prof. Greenhill's criticism.

February 27. ROBERT E. BAYNES.

Too many Decimal Places.

A COMMUNICATION in NATURE of January 26 (p. 294) ends with the sweeping suggestion "that, as a rule, only experimentalists are capable of judging the limits of accuracy of experiment, and that they may be trusted to save themselves trouble where trouble may be saved without sacrificing accuracy."

On the contrary, is it not true that experimenters, as a class, have shown a marked tendency to give unnecessary trouble, both to themselves and to those who utilize their results, by using too many significant figures in their numerical work? The strictures of mathematicians have done much to check this tendency. But can it yet be claimed that their habits need no critical inspection in this respect? Not being prepared to bring forward statistics, I can only make this remark in the form of a query, which applies to the general statement quoted, rather than to the merits of the special discussion which gave rise to it. In vol. lxi. (1871) of the Journal of the Franklin Institute, Prof. Pickering has shown by graphical methods how greatly Regnault's coefficients may be simplified. J. RAYNER EDMANDS.

Harvard College Observatory.

"The Teaching of Elementary Chemistry."

IN NATURE of February 23 (p. 389), an anonymous correspondent, signing himself "Z.," draws attention to what he calls "a few highly misleading passages in the two books reviewed under the above heading in NATURE of January 19."

In the name of the authors of these books, I challenge "Z." to make good his statement that the passage which he quotes from p. 65 of the "Elementary Chemistry," concerning the reaction between sodium and water, is "highly misleading." We assert that the sentence is not misleading. The second statement quoted by "Z." is not quite correct: chlorine monoxide is prepared by passing dry chlorine over yellow mercuric oxide, which has been previously dried at 300°–400°, at the ordinary temperature, not over heated mercuric oxide, as stated on p. 116 of the "Elementary Chemistry." We thank "Z." for the correction. But, inasmuch as the result of passing chlorine over yellow mercuric oxide dried at about 100° is to evolve oxygen without forming chlorine monoxide, the correction does not affect the argument, and it may still be justly said that in making chlorine monoxide "we carry out a reaction in which oxygen is produced in presence of chlorine." The supposed contradiction found by "Z." between the directions given in the "Practical Chemistry" to the student who is burning a weighed quantity of magnesium—not to remove the lid of the crucible lest some of the magnesia should be "volatilized and lost"—and the statement in the "Elementary Chemistry," that "no compound of magnesium has been gasified," rests upon a verbal quibble. *Volatilized* and *gasified* have not precisely the same connotation. I confidently assert that no student is in danger of being misled by either of the statements which "Z." has quoted.

"Z." states that the results of an experiment on the reaction between potash and iodine, described on p. 63 of the "Practical Chemistry," contradict the sentence on p. 62 of the same book concerning the similarities between the chemical properties of chlorine, bromine, and iodine. I reply that "Z." has here shown himself to be unacquainted with the methods of chemical classification; and also that he has taken the word *similar* to mean the same as *identical*.

If "Z." will bring forward proofs that the statements he has quoted are "highly misleading," and will sign his name to the letter in which he states these proofs, I am ready to argue each point with him in detail. But, if "Z." continues to charge the authors of the books he has deigned to notice with making misleading statements, while he himself remains anonymous, I shall decline to take any notice of his communications.

Cambridge, February 29. M. M. PATTISON MUIR.

The Gale of March 11.

I BEG to inclose the readings of my standard Robinson's cup-anemometer during the gale of March 11:—

11–12 a.m.,	64 miles.
12– 1 p.m.,	67 ,,
1– 2 ,,	71 ,,
2– 3 ,,	73 ,,
3– 4 ,,	63 ,,

General direction, S.W.; altitude, 600 feet above mean sea-level. C. E. PEEK.

Rousdon Observatory, Lyme Regis, March 13.

THE DISPERSION OF SEEDS AND PLANTS.

IN a recent number of NATURE (vol. xxxv. p. 151) I mentioned instances which had come under my observation, in which birds had taken an active part in the dispersion of seeds and plants. Since then I have come across further notes bearing upon the subject which is one of considerable interest and importance, as it throws a direct light upon some at least of the agencies whereby plant life has been distributed over the surface of the globe. Although birds, from their greater adaptability to rapid and extensive locomotion, are more concerned than any other animals in the dispersion of plants, they are by no means alone in this work.

It may seem strange, at first sight, to assert that cattle have been the means of distributing the seeds of certain plants from one country to another, but a statement is made by Grisebach[1] respecting *Pithecolobium Saman* (N.O. Leguminosæ), a large tree native of Tropical America, now naturalized in Jamaica, that the "seeds were formerly brought over from the continent [of America] by cattle." This statement has been carefully examined, and it is fully borne out by facts. Formerly, Jamaica, like Trinidad at present, was dependent for cattle on Venezuela. The food of the animals during their voyage consisted amongst other things of the pulpy legumes of *Pithecolobium Saman*. The seeds being very hard were uninjured by the process of mastication and digestion, and they were dejected by the animals in the pastures, where they germinated and grew up into large trees. In this instance the seeds were carried across the sea a distance of about a thousand miles, and there is no doubt that the cattle were directly concerned in their introduction. Indeed, without them the seeds, even if accidentally introduced amongst the fodder, would not have been placed under such circumstances as would have enabled them to give rise to plants. In the first place, by being passed through the animals the seeds were softened and the period of germination hastened. In the second place, being embedded in the droppings of the animals the seeds had a suitable medium to protect and promote germination; and this medium enabled the young plants to withstand the season of drought which is incidental to almost every tropical country. In this instance we have cattle not only the means of introducing the seeds of a valuable tree, but also involuntarily instrumental in establishing the tree in a new country, and providing shelter, shade, and food for their progeny. Those acquainted with the guango or rain-tree, as this *Pithecolobium* is locally called, will fully realize its value as a shade and food-tree for cattle, and they will also appreciate the singular concourse of circumstances by means of which such a tree was introduced to a new country by the very animals which required it most.

It is possible there may be some who will doubt the possibility of seeds retaining the power of germination after undergoing the processes of mastication and digestion, and especially in the special case of ruminating animals. There is, however, very clear evidence on the subject. It is a common occurrence in India to utilize the services of goats to hasten the germination of the seeds of the common *Acacia arabica*, known as the babul. This tree belongs to the same natural order as the *Pithecolobium*, and grows in the poorest and driest soils of India. The babul seeds will not germinate readily in the hot weather, and it is the regular habit, in order to save a season, for a person desirous of a crop of seedlings to make a bargain with a herdsman or a neighbour who possesses a flock of goats to quarter them for some days in a small inclosure in which they are fed on babul leaves and pods. The droppings of the animals contain a certain number of seeds which are uninjured, and these now readily germinate, and give rise to plants the same

[1] "Flora, British West India Islands," p. 225.

season. I am informed by Dr. Watt that in India "several other plants are treated in the same way." The seeds of the several species of cultivated Guava are hard and do not easily germinate. These, however, are said to germinate more freely and readily when they are picked up in night soil.

While on this subject I would mention that when at St. Helena in 1883 I expressed some surprise that no attempt was made to utilize "urban" manure in the neighbourhood of Jamestown, when the land was so impoverished and yielded such poor crops. I was met by the fact that if such manure was largely used the land would become overrun with plants of the prickly pear, *Opuntia Ficus-indica*, the fruit of which is largely consumed by the inhabitants. There is little doubt that the seeds of this plant, like those of the Guava, and I suspect also species of *Passiflora*, which are swallowed whole, are capable of germination after they have passed through the human body. Another instance occurs to me where the use of manure has been the means of distributing an undesirable plant on cultivated lands. In many tropical countries a grass known as Para, Mauritius, or Scotch grass, and sometimes as water grass (*Panicum barbinode*), has been introduced from Brazil, and highly esteemed for its rapid growth and nourishing properties. It grows well in moist situations, on the banks of streams, and even in soils so swampy as to be suitable for nothing else. In such situations it spreads rapidly and yields abundant food for cattle and horses. Nothing, however, could be worse than this grass for cultivated areas, where the land is required to be kept free from weeds, and where crops of sugar-cane, coffee, tea, and cacao are raised. It has been found that where animals are fed on this grass the joints even after passing through the animals have been known to grow. Hence the manure, if freshly used, has been the means of establishing the plant over wide areas.

In a recent work Mr. Ball has drawn attention to numerous introduced plants which are met with in South America. He naturally mentions the cardoon, the wild state of the common artichoke, which is now more common in temperate South America than it is anywhere in its native home in the Mediterranean region. Darwin[1] doubts whether any case exists on record of an invasion on so grand a scale. Several hundred square miles are covered with this introduced plant, which has over-run all members of the aboriginal flora. The introduction of the cardoon appears to have been effected directly by man for the purpose of contributing to the food supply of cattle; but as regards another widely-spread plant the mode of its introduction is not clearly known.

Mr. Ball states:—"As to many of these [introduced South American plants] it appears to me probable that their diffusion is due more to the aid of animals than the direct intervention of man. This is specially true of the little immigrant which has gone farthest in colonizing this part of the earth—the common stork's-bill (*Erodium cicutarium*), which has made itself equally at home in the upper zone of the Peruvian Andes, in the low country of Central Chili, and in the plains of North Patagonia. Its extension seems to keep pace with the spread of domestic animals, and as far as I have been able to ascertain it is nowhere common except in districts now or formerly pastured by horned cattle. It is singular that the same plant should have failed to extend itself in North America, being apparently confined to a few localities. It is now common in the Northern Island of New Zealand, but has not extended to South Africa, where two other European species of the same genus are established."[2]

Erodium as a genus is separated from the true Geraniums amongst other reasons on account of the tails of the carpels being bearded and spirally twisted on the inside. It is possible that these characteristics have enabled the seeds to attach themselves to the legs and bodies of cattle and so effected their distribution over wide areas in such situations as are favourable to their growth.

[1] "Naturalist's Voyage round the World," by Charles Darwin, new ed. 1870, p. 119.

[2] "Notes of a Naturalist in South America," by John Ball, F.R.S., London, 1887, pp 164, 165.

In the Island of Jamaica we have a remarkable instance of the naturalization and wide distribution of an introduced plant in the case of the Indian mango. In an official Report, published in 1885, I stated that to the mango, possibly more than any tree in the island, is due the reforesting of the denuded areas in the lower hills; and as in consequence of the changes taking place in the climate members of the indigenous flora are unable to maintain their ground, it is fortunate the island possesses in a vigorous and hardy exotic like the mango the means of counteracting the baneful effects of deforestation. It specially affects land thrown out of cultivation, and the sides of roads and streams where its seeds are cast aside by man and animals. It practically re-clothes the hills and lower slopes with forest, and it enables the land to recuperate its powers under its abundant shade-giving foliage.[1] It is strange that in Ceylon, which is so much nearer the home of the species, the mango does not spread by self-sown seedlings. This corroborates Mr. Ball's statement with regard to *Erodium cicutarium*. The latter is widely spread in South America, but only sparingly found in other countries under apparently exactly corresponding conditions. We cannot say why such anomalies exist. They do exist, however, and offer problems which can only be solved by a closer study of the conditions of plant life, and the interdependence of plants and animals acting and reacting one upon the other.

The orange-tree was introduced to Jamaica more than a hundred years ago. It is now found practically wild over the settled parts of the island, and the fruit is exported to the value of nearly £50,000 per annum. Up to quite recently very few trees were planted. Nearly the whole were sown by the agency of frugivorous birds, who carried the seeds from place to place and dropped them in native gardens, coffee plantations, sugar estates, and grass lands. In such localities the orange-trees grew and flourished, and now a demand has arisen for the fruit in the United States an important industry has been established, the active agents in which have been birds. The agency of birds in the distribution of the seeds of plants is too large a subject to be discussed at length here. A valuable contribution of facts in this direction has lately been made by Dr. Guppy in his important work on the Solomon Islands. As the most recent addition to our knowledge of what takes place in oceanic islands at the present time it deserves careful attention. It will suffice only to quote one or two sentences:—"Whilst through the agency of the winds and currents the waves have stocked the islet with its marginal vegetation, the fruit-pigeons have been unconsciously stocking its interior with huge trees, that have sprung from the fruits and seeds they have transported in their crops from the neighbouring coasts and islets. The soft and often fleshy fruits on which the fruit-pigeons subsist belong to numerous species of trees. Some of them are as large even as a hen's egg, as in the case of those of the species of *Canarium* ('Ka-i'), which have a pulpy exterior that is alone digested and retained by the pigeon. Amongst other fruits and seeds on which these pigeons subsist, and which they must transport from one locality to another, are those of a species of *Elæocarpus* ('toa'), a species of laurel (*Litsea*), a nutmeg, (*Myristica*), an *Achras*, one or more species of *Areca* (palm), and probably a species (of another palm) *Kentia*."

D. Morris.

[1] Annual Report, Public Gardens and Plantations, Jamaica, for the Year 1884, p. 45.

ON THE APPEARANCES PRESENTED BY THE SATELLITES OF JUPITER DURING TRANSIT.

A PAPER was read by Mr. Edmund J. Spitta, at the November meeting of the Royal Astronomical Society, of especial interest to those who have devoted their attention to Jovian phenomena. As the paper itself is a long one, being the result of over four years' work, we must refer our readers for details to the paper itself; but, speaking briefly, the author observes that since the discovery of the satellites by Galileo in 1610, astronomers have been puzzled by their discordant appearances during transit, but more especially by the fact that these phenomena do not apply equally to all the satellites, or even in some instances to the same satellite in two successive revolutions. It appears that notably the fourth—the farthest from its primary—as it approaches the disk of Jupiter, becomes rapidly and increasingly fainter until it arrives at contact. When once on the limb it shines with a moderate brilliancy for about ten or fifteen minutes, then becomes suddenly lost to view for another period of about the same duration, and lastly reappears, but as a dark spot which grows darker and darker until it equals the blackness of its own shadow on the planet. The appearance presented by the second satellite, however, is entirely different, for it seems never to have been seen otherwise than pure white during transit; whereas the first and third differ yet again from the preceding two. The former is sometimes a steel-gray, and at others a little darker, whereas the latter has been seen perfectly white, and yet so black as to be mistaken for the fourth; both appearances having been witnessed by Maraldi as far back as 1707, and that too in successive revolutions.

The author seems to have spent some years in examining these phenomena on all possible occasions, and under different conditions, such as before, during, and after opposition; and to have collected all published and unpublished observations; and also to have devised an occulting eye-piece—movable shutters in the focus of a Ramsden eye-piece—for the express purpose of shutting off the light of Jupiter; but, to use his own words, "without adding to the pre-existing knowledge of the subject."

The fact of having witnessed, when on the banks of the Rhine in 1886, the transit of a brilliantly illuminated ship's lantern as a dark spot on the disk of the rising full moon, suggested the carrying out of a series of experiments to ascertain the proportions of light which two bodies must possess, so that the smaller should appear gray or black when superimposed on the larger; and it was hoped that if the facts and figures thus experimentally obtained corresponded with the albedos of the satellites themselves as compared with Jupiter, it would not be unreasonable to suspect that the abnormal appearances presented by the satellites depended on functional idiosyncrasies of the eye itself, rather than upon physical peculiarities of the Jovian system.

Space will not allow a description of the experiments, which were somewhat numerous, the photometer employed being an adaptation of that arranged by Prof. Pritchard, of Oxford; but, speaking in short, small disks of different tintings of Indian ink, representing the satellites, were superimposed on larger ones of various sizes of pure white cardboard, and it was found that, with certain restrictions, the difference of albedo (a term expressing "the relative capacity for reflection of diffused light from equal areas") between the smaller and the larger caused the gray and black appearances, and that they were not due to any difference in the *quantity* of light reflected from either. For a moon to appear gray or black, a difference of albedo was required of 0·42 in the first case, and of 0·87 in the second, whilst moons of a superior albedo remained white during transit.

Further, the effect of one moon approaching another, was gone into, and the fading of the smaller was likewise found to be in direct proportion to the relation its albedo bore to that of the greater, and was in no way connected with the *amount* of light reflected by either. The effects in the appearance of the same little moons when in transit over different portions of a sphere were also studied, and, strange as it may seem, *the whole of the phenomena of the dark transit were thus accidentally reproduced*, and this caused much surprise, seeing it was brought about by such simple means. The concluding experiments consisted in photometrically ascertaining, for the first time, the reflective ability of different portions of an unpolished sphere; and the results obtained are set forth in the following abridged table; column 1 giving the exact angle of the observation, and column 2 the resulting albedo.

30°	...	...	·735
40	...	...	·500
50	...	...	·367
60	...	...	·323
65	...	...	·261
70	...	...	·172
75	...	...	·133
80	...	...	·080
83	...	...	·049
86 30′	...	...	·027

A large number of facts and figures having been ascertained, attention was then directed to obtaining the relative albedos of the real satellites themselves as compared with Jupiter. The reduction of the observations was attended with several difficulties, each of which had to be dealt with; but one of them especially deserves a passing mention, and it is this, viz. that the eye does not seem to be impressed in the photometer with the light coming from an object of sensible area, such as Jupiter, to the same extent as it is from a point of light such as is shown by the satellites. A suggestion from Capt. Abney, however, relieved the difficulty, and, this systematic error removed, the results came out in an extremely satisfactory manner, for it was then found that the albedos of the satellites corresponded very approximately with the requirements of the experiments, as the following abridged table shows; in column 1 is shown the number of the satellite, in column 2 its difference in magnitude with that of Jupiter, and in column 3 the resulting albedo.

I.	...	8·12	...	·656
II.	...	8·40	...	·715
III.	...	7·88	...	·405
IV.	...	8·73	...	·266

Thus is it shown to be more than probable that the reason the fourth satellite is uniformly black during transit, when it has passed its period of disappearance, is owing to its albedo being so low as to grant the difference between it and the background necessary for a body to appear black when superimposed on another as ascertained by the experiments. Its preliminary whiteness and disappearance are also shown to be a question of relative albedo, for they are due to the fact that a sphere at its limb and edges loses so much in reflective ability, that up to that moment, the satellite possesses sufficient albedo (as compared with the background in that situation) to maintain its whiteness. So too with the second satellite: its albedo proves to be so high that it is capable of preserving its brilliancy throughout the entire transit. The third and first satellites evidently possess sides of differing albedo, one high enough to maintain a brighter aspect than the other, or even, as in the case of the third, to make it appear white when one side is presented to the earth, and dark when the other. In conclusion, to quote from the original paper, "it is not unreasonable to conclude that these anomalous phenomena are due to functional idiosyncrasies in the eye itself, rather than to physical peculiarities of the Jovian system."

THE MONSOONS.[1]

EVERY School Board pupil who reads a shilling primer of physical geography knows that the monsoons are periodical winds which blow over the Indian Ocean at different seasons of the year; but very few, even among regular meteorologists, are fully aware of the interesting but complex nature of the details of these phases of atmospheric circulation.

The two publications which are the subject of this notice contain a vast amount of information and research connected with these winds. The charts of the Bay of Bengal consist of a series of maps of mean pressure, resultant wind, and ocean currents for every month of the year; with a page of descriptive letter-press for each. They were compiled by Mr. W. L. Dallas, and are published in the inconvenient size of 23 by 18 inches.

The memoir on the winds of the Arabian Sea is a long and exhaustive report by the same author, with a critical and theoretical discussion of the results obtained all over the North Indian Ocean. This is published in a large quarto form, and contains small-scale charts of mean pressure, and of both wind force and direction, for every month of the year; while similar maps of temperature and vapour-tension are given for the months of April, May, and June only.

Space will permit us to notice only the extreme conditions which characterize the months of January and July, or the most pronounced periods of the north-east and south-west monsoons respectively. It will be well to take the north-east monsoon first, as it is much the simpler of the two. One of the most important results of Indian research has been to modify the crude idea that the north-east monsoon blows directly all the way from the great Siberian winter anticyclone down to the equator. Now it has been shown that there is in the month of January a small anticyclone over the Punjab, and an area of high pressure over the Persian Gulf.

This fact is of far more than local importance. The typical distribution of pressure over the globe consists of an equatorial belt of low pressure, with a belt of anticyclones on either side, about the line of the two tropics. Heretofore we have been constrained to look on the Siberian anticyclone—centered near the Arctic Circle—as the representative of the tropical belt of high pressure, but now there is the strongest presumption that these smaller anticyclones are the true, but diminutive, equivalents of the tropical belt.

There is a curious irregularity in the sweep of the isobars and winds over India towards the equator. The charts indicate a local depression all along the west coast of India, and a slight general protrusion of pressure over the Bay of Bengal. This latter is important, as we shall have to refer to the converse condition in the opposite monsoon.

The conditions of the south-west monsoon are a good deal more complicated, for in July we have to explain the following relations of pressure and wind. A belt of high pressure runs along the twentieth degree of south latitude almost from Australia to long. 70° E.; but then the isobars mount up to the equator along the coast of Africa. An irregular area of low pressure lies over Scinde, but the baric slopes all round are by no means symmetrical. The most noticeable irregularity is an area of relatively low pressure over the south-west of the Bay of Bengal, so that the mean isobar of 29·80 which runs towards the north-east from Africa to near Bombay, bends then to the south-east until it arrives near Trincomalee, in Ceylon, when it turns again to the north-east. The wind conforms partially to this distribution of pressure. South of the Line the south-east trade blows with great uniformity, crosses the equator with a regular sweep into the Arabian Sea, turning first to the south-west, and eventually to the west, between Karachi and Bombay. But in the Bay of Bengal the situation is rather different. The depression, before noted, is associated with a west-north-west wind over Southern India, but a light westerly current and rainy weather prevails all over the south of the Bay, from the latitude of Ceylon, down to the equator, while a strong south-west monsoon blows all up the Bay itself. Hence a ship going up to Calcutta will find the south-east trade replaced by light irregular winds between south and west, with much rain, from the equator to about 10° N., before she encounters the fresh south-west monsoon in the upper part of the Bay.

Mr. Dallas gives many interesting details in this memoir, such as a discussion of the so-called "soft place" in the monsoon between Bombay and Aden. This is a region described in the East Indian sailing directories as lying along, or about, the ninth parallel in the Arabian Sea; but the present series of observations afford very little evidence of the existence of this tract of quiet conditions.

The author seems to find some difficulty in explaining the cold air found along the African coast during the height of the monsoon, but this is almost certainly due to the cold water which wells up from below, as the hot surface water is driven to the north-east. The weather shore of a tropical coast in a steady atmospheric current is always cold for the same reason.

Mr. H. F. Blanford has worked out the precipitation of the south-west monsoon in his great memoirs on "Indian Rainfall," and has brought out most clearly a great meteorological principle. He finds that even with the saturated atmosphere of the Indian Ocean—air that contains nearly twelve grains of water in a cubic foot, as compared to about six grains in our own climate—no great precipitation takes place without dynamical cooling. That is to say, unless the air is forced upwards by local obstacles, &c., and so cooled by expansion, no great rainfall can occur.

But the great question, about which there is still some doubt, is the precise relation of the south-west monsoon to the south-east trade. Dové started the theory that the south-east trade turns to south-west after crossing the equator, owing to the influence of the earth's rotation; and there can be little doubt that in the Arabian Sea the trade wind does sweep directly across the Line and grow into the monsoon.

But in the Bay of Bengal, Mr. Blanford finds that the south-west monsoon is not linked up habitually with the south-east trade, though it is so occasionally; and he considers that the monsoon is drawn from a reservoir of air over the equatorial zone fed by the south-east trades, but that it is not the south-east trade simply diverted from its ordinary course.

This opinion is based on the following facts, brought out by the charts under review, for—

(1) The south-east trades are strong, but the winds are light and variable from the equator to 10° N., above which fresh winds are again developed. There is, then, some hitch in the sweep of the south-east current across the equator.

(2) The winds just north of the line are nearly from the west, while they flow from south-west at the top of the Bay. Theoretically the wind should get more and more westerly the further north we go.

(3) The south-east trade is tolerably dry; the equatorial belt of westerly winds is very wet and squally; while the precipitation of the south-west monsoon is not very great out at sea.

Though these facts undoubtedly indicate some irregularity in the flow of the south-east trade across the

[1] "Weather Charts of the Bay of Bengal and adjacent Sea north of the Equator." Issued by the Meteorological Department of the Government of India. (Calcutta, 1887.)

"On the Winds of the Arabian Sea and Northern Indian Ocean." By W. L. Dallas, late of the Meteorological Office, London. Published by the Meteorological Department of the Government of India. (Calcutta, 1887.)

Line, still we are constrained to think that the south-west monsoon is still part of the same system. If the monsoon was independent of the trade, there must be a belt of high pressure between the two; and of this there is absolutely no trace.

We must therefore look to some explanation other than the conception of an independent circulatory system over the Bay of Bengal; but materials are at present wanting to form a definite conclusion on the point at issue. There are two ways by which the question could be settled.

A few sets of observations of cloud-motion on ships coming up the Bay from southward, would almost infallibly give decisive results. If the upper clouds over the west winds, just north of the Line, come from the south or south-east, the surface wind has been drawn across the equator; but if, on the contrary, the clouds drive more and more from the north of west the higher they are, then the circulation over the Bay of Bengal is not fed directly by currents which have crossed the line.

A set of daily weather charts for the whole Indian Ocean would also clear away many doubts. When differences of pressure are small, and winds are variable, charts of mean monthly isobars, and of resultant winds, are very delusive; for the average relation of pressure, wind, and weather, may be quite different from that on any actual day.

The materials at present available point unmistakably to some connection between the anomalous wind and weather in the southern portion of the Bay, and the local area of low pressure over Southern India. It is very conceivable that the whole width of the south-east trade does not cross the equator with an unbroken front; but that for some reason or other a great local eddy may be developed in the Bay of Bengal. No river ever flows regularly, but is broken up into ripples and backwaters; and though there are many differences between the flow of water and of air, still there are certain properties common to the motion of every fluid.

Very few English meteorologists care much for theoretical discussions of air motion; but the Indian workers use mathematics freely in their investigations. Mr. Dallas calculates the flow of a current of air from 10° S. latitude to 10° N., according to the formula given by Mohn and Gulberg. He takes a gradient directed N. 30° E., across the Arabian Sea, and notes the difference both of force and direction between the observed and calculated winds. No doubt there is a certain accordance between the results so obtained; but still there are errors, which, taken with other things, suggest that the theory is still imperfect.

According to the formula—a modification of Ferrel's theory—when air flows northwards down a gradient, the angle between the wind and the gradient should decrease as we approach the equator, disappear altogether on the line, and then gradually increase as we proceed further north. But in practice the trade keeps steadily in the south-east from about 20° S. almost to the equator, then turns rather suddenly to south-west, and the monsoon advances steadily in that direction from about 5° to 20° N. In the opposite monsoon, the north-east winds run steadily from about 20° N. down to the line, and then turn rapidly to north-west.

It is well known in our own latitudes that, though the wind rotates in contrary directions round cyclones and anticyclones, the sweep of the wind is usually less than the curvature of the isobars would suggest. For instance, if an anticyclone lies to the north of Great Britain, all the winds will often be from about north-east instead of sweeping gradually from north-east through east to south-east. This and many other similar observations point to a north-east and south-west set of the winds all over the northern hemisphere, which has not yet been accounted for by any theory.

In conclusion, we may remark how thoroughly the author has discussed the subjects of his memoirs; though some will doubtless differ considerably from him in the theoretical portion of his work. India presents a field for research unique from that in any other part of the world; and those who are acquainted with the magnificent equipment, order, routine, and system of inspection inaugurated by Mr. Blanford, will feel confident that every year will add to our knowledge of a region that presents the most fascinating problems to the student of atmospheric dynamics.

RALPH ABERCROMBY.

NO. 2 MUSEUM, KEW.

THE Museum of Monocotyledonous Products in the Royal Gardens, Kew, better known, perhaps, as No. 2 Museum, which was recently closed for rearrangement, has been again opened to the public. The entire collection has been classified according to the plan of the "Genera Plantarum," so that the whole of the collections contained in Museums Nos. 1 and 2 are now arranged according to the system adopted by Bentham and Hooker.

A new room which was added to the Museum a few years since has now been utilized; this has given space that was much needed for the proper display of the products of such important natural orders as *Scitamineæ*, *Bromeliaceæ*, *Amaryllideæ*, *Liliaceæ*, *Palmeæ*, *Aroideæ*, *Cyperaceæ*, and *Graminaceæ*. In the first named order, a large number of valuable economic plants are included, such as ginger, turmeric, cardamoms, arrowroot, bananas, and others; while in *Liliaceæ* we find sarsaparilla, asparagus, onions, squills, medicinal aloes, and New Zealand hemp. All these have had much more space given to them than hitherto, and the fine collection of native New Zealand garments made of the indigenous hemp (*Phormium tenax*), which are rapidly becoming scarce, are now opened out and fully shown. A very large increase of space has been given to the *Palmeæ*, and as it is one of the most important orders to mankind generally, especially in tropical countries, it was but fitting that this unique collection of palm products should be fully displayed. In such a series as that at Kew it is difficult to particularize any one exhibit as more important than another, but we may draw attention to the fine set of specimens illustrating the coco de mer, or double cocoa-nut of the Seychelles (*Lodoicea sechellarum*). This comprises a fine series of fruits, including a model of the fruit in which the nut is inclosed, made and presented by the late General Gordon, of the so-called double or usual form, as well as quadruple, sextuple, and others, besides seeds showing the mode of germination, very fine male spadices, and carved shells. The series of products of Palmyra palm (*Borassus flabelliformis*) is also a very complete one, comprising sections of the trunk, both longitudinal and transverse, toddy collecting apparatus and various manufactures from the leaves.

In the *Gramineæ*, which was very much crowded throughout, a large increase of space has enabled the interesting collections of maize, sorghums, sugar-cane products, rice, and the numerous grains of India, to be easily examined, while in the *Cyperaceæ* the Indian mats from the culms of *Cyperus Pangorei* and *C. tegetum* and other products of the order have been opened out, and now form a striking series.

APPARATUS FOR EXPERIMENTS AT A HIGH TEMPERATURE, IN GAS UNDER HIGH PRESSURE.[1]

A DIFFICULTY often experienced in laboratories is how to raise a body to a high temperature while surrounded by a gaseous atmosphere under considerable pressure.

[1] Translated from *La Nature*, February 11, 1888.

The apparatus which I constructed several years ago makes it possible to bring bodies to a temperature approaching that of the fusion of platinum, whilst maintaining them in a gaseous atmosphere, of which the nature and pressure may be varied at will.

This apparatus (Fig. 2) is composed of a mass of steel

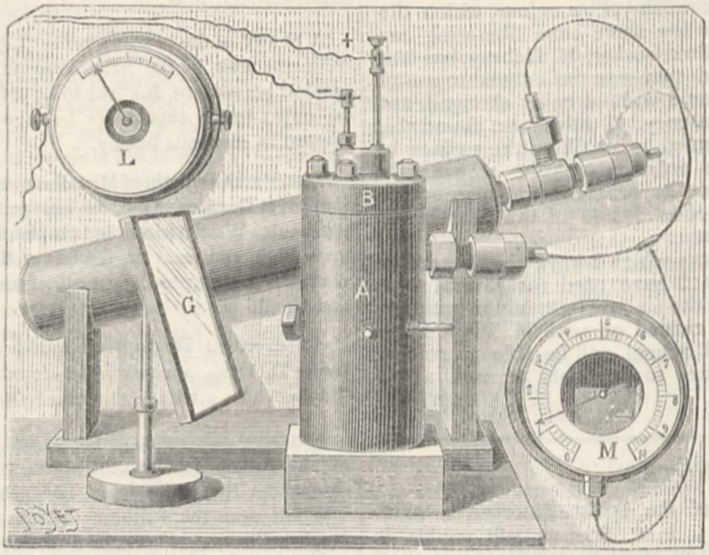

FIG. 1.—Apparatus of M. Cailletet. A, mass of steel with cylindrical bore, with its stopcock B (see the details in Fig. 2); G, mirror permitting the reaction to be seen; M, manometer; L, amperemeter.

A, in which there has been hollowed out a cylindrical space of about a quarter of a litre capacity. This species of test-tube may be closed by means of a metallic stop-

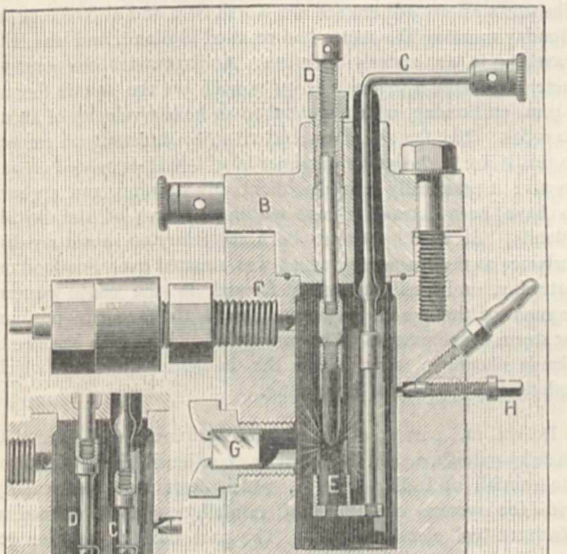

FIG. 2.—Explanatory figure:—(1) Arrangement for obtaining the electrical arc. The insulated charcoal is shaped in the form of a crucible. (2) Arrangement with wire of platinum rolled spirally.

cock, B, furnished with screw. Two copper wires are fixed to this movable portion; the one, C, is insulated, whilst the other, D, is in contact with the metal. At the ends of these two wires there is fixed, according to the requirements of the experiment, either a sheet of platinum moulded into the form of a crucible, or a wire of platinum rolled spirally, a kind of receptacle for the body experimented on, and which is brought to the desired temperature by the passage of an electric current. Two or three accumulators are sufficient for these experiments. A fragment of gold, placed in the spiral, melts in a few seconds. When it is desired to maintain the temperature long, the exhausted accumulators are replaced by others in readiness, simply by use of a commutator. The high temperature developed by the electric arc may also be turned to account; in that case two charcoal rods are arranged, of which one, movable, is fixed to the extremity of a screw, D, capable of being adjusted from the outside in order to place it in communication with the other charcoal rod, E, insulated and shaped in the form of a crucible.

The block of steel is pierced by an orifice, F, connected by a metallic capillary tube with the reservoir which contains the compressed gas. A window furnished with a thick glass, G, allows the phases of the experiment to be followed by looking in an inclined mirror, so as to be secure from all danger in case of the glass breaking. Lastly, the gases contained in the apparatus may be collected, by means of a stopcock at the screw H, in cases where it is desirable to analyze them.

The gas used for the experiments is compressed previously in a holder by means of the mercurial pump, a description of which I have already published; it is also easy to employ the carbonic and sulphuric acid furnished by commerce.

A metallic manometer fixed to the apparatus renders it possible to ascertain that the pressure of the gases exercises an energetic cooling influence upon the bodies which are heated by the electric current.

Thus, the current which causes the fusion of the wire or sheet of platinum produces only a sombre red temperature when the pressure is sufficiently great. I have been able to lessen this cause of cooling, by placing the body on which I was experimenting in a small test-tube, which resists the motion of the gases, and which is not represented in the figure. I have repeated, with this apparatus, the classical experiment of Hall on carbonate of lime. A fragment of chalk, heated in a spiral of platinum, diminishes sensibly in volume, while it is being changed into a hard body of a brownish-yellow colour, which dissolves slowly in acids, at the same time liberating carbonic acid. Also, our fellow-worker, M. Debray, has long since shown that Iceland spar can be carried to a high temperature in carbonic acid without being changed, and without losing its transparency. I have also found that a crystal of spar transformed to chalk on the surface by the action of heat under ordinary pressure recovers the lost carbonic acid, but not its primitive transparency; I have not been able to effect fusion of the spar in the course of my experiments.

To sum up, the apparatus which I have the honour to make known, and which I have used for several years past, in experiments upon the electric light under pressure, researches which I have carried on with M. Violle in his laboratory at the Normal School, will be able to render, I hope, numerous services to chemists as well as to mineralogists. L. CAILLETET.

NOTES.

AT the Bath meeting of the British Association, which will begin on September 5, Prof. Schuster will preside in Section A (Mathematics and Physics); Prof. Tilden in Section B (Chemistry); Prof. Boyd Dawkins in Section C (Geology); Mr. Thiselton Dyer in Section D (Biology); Colonel Sir C. W. Wilson in Section E (Geography); Lord Bramwell in Section F (Economic Science and Statistics); Mr. W. H. Preece in Section G (Mechanical Science); and General Pitt-Rivers in Section H (Anthropology).

THE Croonian Lecture of the Royal Society will, at the request of the Council, be delivered this year by Prof. W. Kühne, of Heidelberg. As is well known, Prof. Kühne has for many years devoted attention to the endings of nerves in muscle, and in the Croonian Lecture he proposes to dwell on the light thrown on the nature of muscular contraction and nervous action by the study of these nerve-endings. Since the rooms of the Royal Society are not well adapted for showing illustrations to large audiences, the lecture, which will be largely illustrated, will be delivered, by the permission of the Managers of the Royal Institution, in the lecture theatre of the Royal Institution. The date fixed is Monday, May 28, at 9 p.m.

IN reply to a question put by Lord Herschell in the House of Lords on Monday, Lord Cranbrook stated that he had come to the determination to recommend the issue of a small Royal Commission to inquire as to the necessity for a Teaching University for London, and he hoped that at no great distance of time it would be able to report upon the subject.

IN accordance with the rule which empowers the election of nine persons annually "of distinguished eminence in science, literature, or the arts, or for public services," Prof. A. W. Rücker, F.R.S., has been elected a member of the Athenæum Club.

THE Royal Meteorological Society's ninth annual Exhibition of Instruments will be held at the Institution of Civil Engineers, 25 Great George Street, Westminster, in conjunction with the Society's meeting on Wednesday, the 21st inst., and will be very interesting and instructive. The Exhibition is devoted to apparatus connected with atmospheric electricity. A most valuable collection of some fifty photographs of flashes of lightning from all parts of the world will be shown, as well as some curious effects of damage by lightning, including the clothes of a man torn off his body by lightning, &c. The Exhibition will remain open till Friday, the 23rd inst. Persons not Fellows, wishing to visit the Exhibition, can obtain tickets on application to Mr. W. Marriott, Royal Meteorological Society, 30 Great George Street, S.W.

A PLANT of the common coffee (*Coffea arabica*) is now loaded with ripe fruit in the palm-house at Kew. Seldom, even on tropical plantations, is a tree to be seen with such a crop. Such an object-lesson should not be missed by those who take an interest in economic botany.

THE March Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, contains papers on Forsteronia rubber, patchouli, West African indigo-plants, vanilla, streblus paper, urera fibre, and tea. In the last of these papers valuable information is given as to the growth of tea in Jamaica, Madagascar, and Natal.

AN excellent biographical sketch of the late Asa Gray, by James D. Dana, appears in the *American Journal of Science* for March. The article is also issued separately.

A HEAVY gale was experienced last Sunday in nearly all parts of the British Islands, the storm continuing in many places throughout the entire day. The greatest violence of the gale was felt over the southern districts of England and in the English Channel, where the direction of the wind was from the south-west and west. In Ireland, Scotland, and the North of England, the direction of the wind was easterly, the central area of the disturbance passing completely over the middle of England from west to east. At 8 o'clock on Sunday morning the centre of the storm was close to Pembroke, where the barometer was reading 28·57 inches, and at 6 o'clock in the evening it was over Lincolnshire, the barometer reading 28·8 inches. The storm afterwards crossed the North Sea, and at 8 o'clock on Monday morning the centre had reached Holland, and was still travelling in an easterly direction. At Greenwich the anemometer registered a pressure of 31 pounds on the square foot at 5 p.m. on Sunday, which is equal to an hourly velocity of about 80 miles. The feature of especial scientific interest with respect to this storm is the sudden manner in which it appeared on our coasts: it practically arrived without any warning, and appears to have been formed almost within the area of the British Islands. It would seem to be a secondary or subsidiary disturbance to the storm area which was situated over Scotland on Saturday, and was apparently formed in the south-western segment of the parent cyclone, which is the favourite position for storm development. The passage of such a storm across our islands illustrates very clearly the immense difficulty which underlies any system of forecasting.

IN vol. iii., part 2, of the Indian Meteorological Memoirs, recently published, Mr. Blanford has continued his discussion of the rainfall of India. Part 1, which dealt more particularly with the average conditions of rainfall, was fully noticed in NATURE (vol. xxxvii. p. 164). The part now in question relates to the variations and vicissitudes of rainfall in past years, and their connection with other elements. With the view of ascertaining whether any general laws can be detected, an endeavour is made to determine what peculiarities are associated with the different distribution of rainfall, *e.g.* the variations of prevailing wind currents, distribution of atmospheric pressure, and the frequency and courses of cyclonic storms. The periodical recurrence of droughts and famines since 1769 is recorded, and, from general conclusions drawn, it appears that serious droughts occur in Southern India at intervals of nine to twelve years, and that they generally happen about a year before the sunspot minimum. In Northern India, droughts sometimes occur in years of maximum sun-spots.

AT the meeting of the French Meteorological Society, on February 7, it was announced that M. Janssen had offered five prizes, consisting of silver medals, for the best works relative to the application of photography to meteorology, and M. Teisserenc de Bort offered a similar prize for the best measurements of the height of clouds. M. Moureaux (Secretary) presented a paper on the periodicity of disturbances of declination and horizontal force at Parc-Saint-Maur Observatory for the years 1883–87, showing, by means of curves, that the monthly values of both those elements exhibited two maxima at the equinoxes, and two minima at the solstices; and that, while the monthly variation of the number of disturbances appeared to follow a general law, the diurnal variation seems to be subject to complex laws. M. H. Lasne presented a note on the gyratory movements of the atmosphere, in connection with the experiments of MM. Weyher and Colladon on the motions of fluids. M. Maillot exhibited a kite, arranged to maintain a constant height for some time, and designed for the purpose of facilitating the registration of variations of temperature at certain altitudes.

A TETRASULPHIDE of benzene has been prepared in the pure state by Dr. Otto, of Brunswick (*Journ. für. prakt. Chemie*, 1888, Nos. 3 and 4). When a current of sulphuretted hydrogen gas is led through a warm dilute solution of benzene-sulphinic acid, $C_6H_6SO_2$, in alcohol, the sulphinic acid is reduced to phenyl-disulphide, $(C_6H_5)_2S_2$, a substance already well known. The behaviour, however, is entirely different when a very strong solution is employed: the liquid becomes rapidly yellow, and eventually monoclinic crystals of sulphur and a yellow oil separate. This yellow oil was found to consist of phenyl-tetrasulphide, $(C_6H_5)_2S_4$, the analyses indicating an exceptionally pure product, after careful separation from the free sulphur by dissolving in ether and subsequent evaporation. This tetrasulphide at the ordinary temperature is a very viscid, heavy, highly refracting oil, possessing an unpleasant odour reminding one of mercaptan. It is a comparatively stable compound, remaining unattacked on treatment with sodium sulphite, even when warmed for a long time; but on warming with colourless ammonium sulphide it is reduced to disulphide, polysulphide of ammonium being formed. According to Klason, phenyl-tetrasulphide is also the product of the action of dichloride of sulphur, S_2Cl_2, upon thio-phenol, $C_6H_5 . SH$, the mercaptan of the benzene series, and Otto shows that this is really the case, the reaction going best when the two substances are gradually mixed in carbon bisulphide solution. No extraneous heat is necessary, the operation being itself attended by a considerable evolution of heat. On distilling off the bisulphide of carbon, the resulting oil is found to be identical with the phenyl-tetrasulphide prepared in the above manner.

THE thirty-ninth Bulletin of the U.S. Geological Survey consists of a paper embodying the results of the investigations of Mr. Warren Upham upon the upper beaches and deltas of the extinct Lake Agassiz, which, in Glacial times, occupied the basin of the Red River of the North. Mr. T. C. Chamberlain, geologist in charge of the Glacial Division, in transmitting Mr. Upham's paper to the Director of the U.S. Geological Survey, for publication, wrote:—"This is but an initial contribution, embracing only so much of the data gathered as from their degree of completeness and interest warrant present publication as a record of results. The investigation is still in progress, and the general discussion of data and the eduction of conclusions are reserved until its completion. Meanwhile the great mass of carefully-determined facts here recorded will, besides their inherent independent value, be of important and immediate service to the students of other extinct and shrunken Glacial lakes."

THE U.S. Department of Agriculture has issued an interesting descriptive catalogue of manufactures from American woods, as shown in the exhibit of the Department at the Industrial and Cotton Exposition at New Orleans. The compiler is Mr. C. R. Dodge. He has brought together many interesting facts about the uses of woods in architecture and building, in transportation, in implements of industry, in articles relating to trade, in articles for man's physical comfort or luxury, and in articles for education, culture, or recreation. There is also a paragraph on "miscellaneous uses," under which are such headings as "Gun-stocks," "Artificial Limbs," "Crutches," and "Umbrella-sticks and Canes."

MESSRS. GURNEY AND JACKSON will issue in April the first part of "An Illustrated Manual of British Birds," by Mr. Howard Saunders. The work will be completed in about twenty monthly parts.

WE have received the eighteenth Annual Report of the Wellington College Natural Science Society. It contains a record of much good work done during the past year. The Report includes abstracts of lectures delivered before the Society, observations made of the plants, insects, and birds contained in the Royal Meteorological Society's lists, and a meteorological report for every day of 1887.

IN the twelfth Annual Report of the President of the Johns Hopkins University, Baltimore, Dr. Gilman says that during the last year the number of teachers in connection with the institution was slightly enlarged, and the number of students considerably increased. A new department of instruction—pathology—was initiated; a physical laboratory, the largest and costliest building yet erected for the University, was completed and occupied; a building was set apart for the petrographical laboratory; and an astronomical observatory, for the instruction of students, was equipped. The cost of the physical laboratory, including the land, furniture, gas-fitting, steam-heating, and astronomical dome (but not including large amounts paid previously for instruments and apparatus, and not including the dynamos, nor the telescope), stands, in the books of the treasurer, 174,765·86 dollars. This building will be used by classes studying mathematics, astronomy, and physics.

THE Calendar, for the year 1888, of the Royal University of Ireland has just been issued. The Drapers' Company have offered an exhibition of the average annual value of £35 for three years, to be awarded, on the result of the matriculation examination of this University, to the girl who, complying with certain conditions stated in the Calendar, shall be awarded either first or second class honours in at least two subjects, and who shall obtain the highest aggregate of marks at the examination to be held on July 4 next.

WE have received the Calendar, for 1887-88, of the Imperial University of Japan. An address by President Watanabe, on the occasion of the graduation ceremony, July 9, 1887, is printed as an appendix. If we may judge from the tone of this address, the University is in a prosperous condition, and doing justice, in its courses of instruction, to science no less than to literature and law.

ON February 12, Mr. Jeremiah Curtin read, before the Anthropological Society of Washington, a paper of some interest on the folk-lore of Ireland. Last year Mr. Curtin went to Ireland for the express purpose of finding out how far the old "myths and tales" were still alive in the minds of the people. He visited some secluded parts of the western coast, and "took down personally a large body of myths and stories, some very long, others not so long." "This collection of materials," he says, "is sufficient to fill a couple of 12mo volumes, and will give some idea of what yet remains in the Celtic mind of Ireland. It is, however, but a small part of the mental treasure still in possession of the people."

In the Proceedings of the American Philosophical Society (July–December 1887) there is a most interesting paper by Dr. D. G. Brinton on ancient footprints in Nicaragua. The discovery of human footprints in volcanic rocks near the shore of Lake Managua, Nicaragua, under circumstances which seemed to assign to them a remote antiquity, was announced several years ago. Dr. Brinton refers especially to a specimen on tufa sent to him from Nicaragua, by Dr. Flint, an accurate representation of which accompanies the paper. It is the impression of a left foot. The total length of the impression is 9½ inches, the breadth at the heel 3 inches, at the toes 4½ inches. The apparent length of the foot itself was 8 inches. The instep was high, and the great toe large, prominent, and exceeding in length the second toe. The greatest depth of the impression is at the ball of the foot, the weight being evidently thrown forward, as in vigorous walking. At this part the maximal depression below the plane of the superficies is 2 inches. Dr. Brinton has no doubt as to the genuineness of the footprints; but their antiquity, he thinks, is uncertain. His own opinion is that there is not sufficient evidence to remove them beyond the present post-Pliocene or Quaternary period.

PROF. DAVID P. TODD, astronomer in charge of the recent American Eclipse Expedition to Japan, has issued a Preliminary Report (unofficial) on the total solar eclipse of 1887. Associated with this document is a Preliminary Report by Dr. W. J. Holland, naturalist of the Expedition.

WE have received an illustrated catalogue of the astronomical instruments and observatories of Sir Howard Grubb, Dublin. During the last few years Sir Howard Grabb has executed important astronomical work for many Governments, Universities, scientific Societies and Academies, and the catalogue affords striking proof of the care he takes to bring his various methods and processes to perfection.

MR. STANFORD has issued an interesting volume, by Mr. A. B. Macdowall, entitled "Facts about Ireland." It is an attempt to show, by means of curves, the recent history of various elements in the social life of the Irish people. Sections are devoted to population, agriculture, education, emigration, evictions and drunkenness, crime, consumption of spirits, bank deposits, &c., and occupations. The mode of representation, which has been made familiar to most people by weather charts, has enabled Mr. Macdowall to bring together in brief compass a great mass of information about some very complicated and difficult subjects.

LAST month Mr. J. Clayton read before the Bradford Naturalists' Society a paper on *Pinus sylvestris*. This fact is worth mentioning, because by using the autocopyist apparatus the author was able to give each member a sheet of drawings, and another of explanations. We have received specimens of these sheets, and it seems to us that the plan might often be adopted with advantage by readers of papers, and by lecturers, on scientific subjects.

INQUIRIES have been made by several correspondents as to the photographic apparatus used by M. Marey in obtaining the results as to the flight of birds set forth in the article in *La Nature* of which we lately printed a translation (p. 369). No complete account of the apparatus has yet appeared, but a summary of the facts relating to it was given in the *Comptes rendus* for July 3, 1882. A note on the subject was printed in the same publication on August 7, 1882. M. Marey proposes to give a full description in a work on the flight of birds and insects, which will be issued in the course of the present year. The object is to obtain an indication, at every instant, of the swiftness of the moving body which is to be photographed, in its passage from point to point. To secure this indication it is necessary to produce, at known intervals, equal to one another, and as short as possible, interruptions in the arrival of light into the interior of the photographic apparatus. These interruptions M. Marey obtains by causing to turn, before the objective, by means of machinery, a wheel which makes ten revolutions in a second. This wheel has ten spokes, each one of which, in its passage, interrupts the light. The "eclipses" thus caused occur, therefore, a hundred times per second; so that in the photograph the space between two consecutive points represents the space crossed by the photographed body in 1/100 of a second. In order to indicate the relative positions of the different parts of the body at the same instant, M. Marey makes one of the spokes of the wheel twice as large as the others. The result, of course, is that there is a longer "eclipse" at the moment when this spoke passes. This arrangement enables the observer to determine without hesitation the relative positions of the different points of the body at every tenth of a second; and it has also the advantage of facilitating the calculation of the times in which the movements are made.

AT Stevens's rooms, on Monday, an egg of the extinct great auk (*Alca impennis*) was sold to Mr. J. Gardner for £220. It belonged to the collection of Mrs. Wise, whose husband bought it of a dealer in Oxford Street in 1851 for £18. It was originally brought to England from Paris, and is now said to have been bought for America.

THE Exhibition of Japanese engravings at the Burlington Fine Arts Club, and that of Japanese pictures in the White Gallery in the British Museum, contain much that is of a specially scientific interest; as, indeed, could scarcely fail to be the case with such exhaustive and well-arranged collections of the pictorial art of a people who, beyond all others, went to Nature herself as the fount of their inspiration. Thus the collection of guide-books and topographical hand-books in cases K, L, and M, at the Burlington Club, give a remarkable picture of the physical features of Japan, and one that, taken in conjunction with such a work as Dr. Rein's, should be of much assistance to geographers. Probably no literature in the world is so plentifully supplied with guide-books as that of Japan; every province, town, and district, has one or more of its own. In many cases they are works of ambitious scope and wide utility. They indicate "all the spots famous for landscape beauties, collect learned records of the historical and legendary lore of the localities described, enumerate the various objects of curiosity and archæological importance preserved in the neighbourhood, contribute scientific notes upon the flora and fauna of the district, and open a fund of practical information as to industries, commerce, and a hundred other matters of interest both to resident and visitor." Botany is remarkably well illustrated in the books shown in case O; while the silhouettes in case H, traced with great accuracy from nature, represent almost every type of the lower middle class Japanese, and should be of some ethnographical value, especially as there is a considerable number of them. The many hundreds of birds and other animals represented in the British Museum collection (it will of course be understood that we are now referring to the whole of the Anderson Collection, consisting of about 4500 examples, not merely to the 273 on exhibition) would form a supplement to the works of Siebold and later writers. For the student of religions the Buddhistic pictures supply many details not to be found in any written records, and the many volumes of popular picture-books show a thousand elements of Oriental folk-lore, customs, and handicrafts that are now on the verge of extinction.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mrs. A. Ballard; a White-fronted Capuchin (*Cebus albifrons* ♂) from South America, presented by Mrs. E. A. Lediard; a Binturong (*Arctictis binturong*) from Malacca, presented by Mr. J. P. Rodger, of Selangor, Malay Peninsula; a Common Quail (*Coturinx communis*), captured at sea, presented by Captain Christian; a Brazilian Tortoise (*Testudo tabulata*) from Brazil, deposited; four Cape Colys (*Colius capensis*) from South Africa, received in exchange.

OUR ASTRONOMICAL COLUMN.

ANNALS OF HARVARD COLLEGE OBSERVATORY.—We have received Part 2 of vol. xiii. of the Annals of Harvard College Observatory, containing zone observations with the transit wedge photometer attached to the 15-inch equatorial. These observations were undertaken in order to extend our knowledge of the relative brightness of the fainter stars, and to determine the scales of magnitude employed in the estimates of certain observers, as compared with magnitudes as obtained by means of the meridian photometer. These zone observations were not, however, made with the meridian photometer, but with an adaptation of Prof. Pritchard's wedge photometer, which had been devised by Prof. Pickering. Instead of slipping the wedge along by hand, the telescope and wedge are fixed, and the star is carried from the thin part of the wedge towards the thick by the diurnal motion. An occulting bar is fixed near the thin edge, and the interval between the time of the occultation of a star by the bar, and its extinction by the wedge, is proportional to the magnitude of the star on the assumption of a uniform scale of absorption throughout the wedge. In this way the relative magnitudes, right ascensions, and (by estimating the point on the bar where they are occulted) the declinations of a number of stars were determined with great rapidity, and the results made comparable with magnitudes observed with the meridian photometer by the observation of a sufficient number of standard stars. The observations were made in three zones each 10' in breadth, and lying immediately to the south of N. Decl. 1°, 50°, and 55°, the first zone being part of those observed more than twenty years ago by Prof. Bond, and the other two being situated on the north and south margins of the zone recently revised with the Harvard College meridian circle. A comparison of the D.M. magnitudes between the 7th and 9th with magnitudes as determined in the preceding manner show that the former closely correspond to the magnitudes derived from the mean of the three zones, the zone at 1° N. giving a value of about two-tenths of a magnitude less than the other two. But for fainter stars the three zones are in close accordance with each other, whilst the D.M. values give in comparison too small a magnitude, the difference increasing rapidly until 9·5 magnitude in the *Durchmusterung* is found to correspond to 10·5 with the wedge photometer. Prof. Bond's scale, on the other hand, corresponds fairly to that of the photometer from 7·0 magnitude up to 11·0, but beyond gives magnitudes which are too large, so that his 13·5 magnitude corresponds to about 12·5 of the wedge.

Prof. Pickering is still continuing the investigation, and proposes to give hereafter a far more complete comparison for D.M. stars brighter than 9·0 magnitude with magnitudes as given by the meridian photometer.

WASHINGTON ASTRONOMICAL OBSERVATIONS, 1883.—The volume of the Observations of the Naval Observatory, Washington, for 1883, has been published, and contains the usual routine observations, the bulk of the volume being devoted to the work with the transit-circle, beside three Appendixes, of which two, by Prof. Hall, on the orbits of the inner satellites of Saturn, and on the observation of certain stars for stellar parallax, have already been noticed. The third Appendix is on the Observatory temperature-room and the competitive trials of chronometers in 1884 and 1886. A number of double stars, the satellites of Saturn, Uranus, and Neptune, and the ring of Saturn, had been observed with the 26-inch equatorial; but no remarkable changes were noticed in the ring. The prime vertical was brought into use on November 14, 1882, and 580 observations of stars with small meridian zenith distances, at the times of the maxima of aberration, were secured. The meridian transit instrument of 5½ inches aperture, by Estel, was also used regularly, and 1408 observations secured with it. The 26-inch equatorial was used for the observation of minor planets, comets, and occultations. The Report of the Superintendent includes a notice of the Transit of Venus Expeditions of 1882, and of the reduction of the zone observations made in Chili in the years 1850-51-52, under Capt. Gilliss. A copy of the letter of the Superintendent, asking for a grant of $586,138 for the purpose of erecting the new Observatory, is also given, together with the recommendation of the architect that the entire amount be appropriated in one sum.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *MARCH* 18–24.

(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 March 18

Sun rises, 6h. 7m.; souths, 12h. 8m. 2·0s.; sets, 18h. 9m.: right asc. on meridian, 23h. 54·0m.; decl. 0° 39' S. Sidereal Time at Sunset, 5h. 56m.

Moon (at First Quarter March 20, 21h.) rises, 8h. 52m.; souths, 16h. 26m.; sets, 0h. 10m.*: right asc. on meridian, 4h. 13·0m.; decl. 16° 30' N.

Planet.	Rises. h. m.		Souths. h. m.		Sets. h. m.		Right asc. and declination on meridian. h. m.		° '
Mercury..	5 23	...	10 42	...	16 1	...	22 27·5	...	8 51 S.
Venus.....	5 21	...	10 18	...	15 15	...	22 3·8	...	12 50 S.
Mars	20 47*	...	2 7	...	7 27	...	13 51·8	...	8 38 S.
Jupiter....	0 22	...	4 34	...	8 46	...	16 18·6	...	20 25 S.
Saturn....	12 22	...	20 21	...	4 20*	...	8 8·1	...	20 47 N.
Uranus ...	19 41*	...	1 16	...	6 51	...	12 59·9	...	5 38 S.
Neptune..	8 17	...	15 57	...	23 37	...	3 43·4	...	18 3 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

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

March.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
18 ...	B.A.C. 1351 ...	6½ ...	18 42 ...	19 49 ...	162 287
18 ...	75 Tauri	6 ...	22 2	near approach	48 —
20 ...	χ^3 Orionis ...	6 ...	17 11 ...	18 32 ...	70 297
20 ...	68 Orionis ...	6 ...	22 21 ...	23 25 ...	136 302
23 ...	B.A.C. 2683 ...	6 ...	0 23 ...	1 13 ...	154 264

March.	h.	
20 ...	4 ...	Sun in equator.
22 ...	8 ...	Jupiter stationary.
23 ...	4 ...	Saturn in conjunction with and 1° 21' north of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° '			h. m.	
Algol	3 0·9 ...	40 31 N. ...	Mar.	24,	1 44	*m*
λ Tauri...	3 54·5 ...	12 10 N. ...	,,	18,	20 57	*m*
R Canis Majoris...	7 14·5 ...	16 12 S. ...	,,	18,	23 32	*m*
T Hydræ	8 50·2 ...	8 43 S. ...	,,	18,		*M*
W Virginis	13 20·3 ...	2 48 S. ...	,,	18,	1 0	*m*
δ Libræ	14 55·0 ...	8 4 S. ...	,,	21,	0 14	*m*
T Libræ	15 4·4 ...	19 36 S. ...	,,	18,		*M*
U Coronæ	15 13·6 ...	32 3 N. ...	,,	23,	23 32	*m*
S Scorpii	16 11·0 ...	22 37 S. ...	,,	23,		*M*
S Ophiuchi	16 27·8 ...	16 55 S. ...	,,	20,		*M*
S Herculis	16 46·8 ...	15 8 N. ...	,,	18,		*m*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,,	21,	3 46	*m*
			,,	21,	23 52	*m*
X Sagittarii... ...	17 40·5 ..	27 47 S. ...	,,	18,	3 0	*M*
Z Sagittarii... ...	18 14·8 ...	18 55 S. ...	,,	19,	1 0	*M*
β Lyræ...	18 46·0 ...	33 14 N. ...	,,	24,	2 0	m_2
S Vulpeculæ ...	19 43·8 ...	27 1 N. ...	,,	22,		*m*
χ Cygni	19 46·3 ...	32 38 N. ...	,,	19,		*M*
S Sagittæ	19 50·9 ...	16 20 N. ...	,,	19,	2 0	*m*
T Vulpeculæ ...	20 46·7 ...	27 50 S. ...	,,	23,	1 0	*m*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers.

	R.A.		Decl.		
Near 55 Aurigæ	98°	...	46° N.	..	March 14–25.
,, θ Ursæ Majoris ...	143	...	49 N.	...	March 20.
,, β Ursæ Majoris ...	162	...	58 N.	...	Rather slow.

THE PUBLIC GARDENS OF BRITISH INDIA, ESPECIALLY THE BOTANIC GARDENS.[1]

THE appearance of the hundredth Annual Report of the Royal Botanic Garden, Calcutta, is an event of no little interest in the botanical world, not alone for what it contains, but also for the evidence it affords of the vitality and vigour of the institution, the primary object of which was to disseminate useful information respecting the vegetable products of the possessions of the "Company," and to introduce exotic plants of economic value.

Dr. George King, F.R.S., the present able Superintendent, gives a concise history of the foundation and progress of the Garden down to the present time; and the appendices show that the establishment was never conducted with greater activity. We might make some interesting extracts from the present Report; but our object now is to give a foreigner's view of the principal horticultural establishments in India.

Mr. Warburg roughly classes the gardens under three heads, according to their degree of scientific and practical utility, as distinguished from purely pleasure-gardens, though no hard and fast line can be drawn, because some of the gardens are maintained partly for pleasure and partly for profit. There are only three real botanic gardens in India—we let Mr. Warburg speak for himself—namely, Calcutta, Madras,[2] and Saharunpore, unless we count the garden at Ganesh Khind, near Poona, which is often erroneously called a botanic garden. Besides these, there is the botanic garden at Peradeniya in Ceylon, which, however, comes under the Colonial Office. Of the officially so-called botanical gardens, two were originally founded as such by far-seeing officials: Calcutta by General Kyd in 1786, and the Ceylon Garden by Sir Joseph Banks in 1810; the latter having been established at Peradeniya ever since 1821. The origin of the Sarahunpore garden in the North-West Provinces I did not ascertain [it was originally a pleasure garden of the native princes, and when Lord Moira conquered the Mahrattas he caused it to be transformed into a botanic garden; and the first Superintendent was Dr. Govan (1816–23), who was succeeded by the better-known Dr. Royle, Dr. Falconer, and Dr. Jameson]; and the gardens of Ootacamund and Singapore have passed through various stages before attaining their present condition. Of agricultural experimental gardens I am acquainted with those of Kandesh (Bombay Presidency), Saidapet (near Madras), Nagpore (Central Provinces), and Hyderabad (in the Deccan).

There is also a horticultural garden in Lucknow, an agri-horticultural garden in Lahore (Punjab), and the beautiful garden at Madras belonging to an Agri-horticultural Society. Similar Societies exist in Calcutta, Rangoon, and probably in other places; the first publishing a special Journal.[3]

In almost every town where there is a considerable European population or garrison there are ornamental gardens or parks, called into existence by the demand, and almost necessity, for some such place for social recreation—riding, driving, and walking—in a tropical country, where many of the pleasures and amusements of our Europeans towns cannot be enjoyed. Then there are numerous extensive and costly gardens belonging to the native princes and nobles.[4]

Respecting the gardens having a practical aim, we may be very concise, as their objects are much the same, subject only to the climatal differences of the various provinces, and consequently the kinds of plants that may be profitably cultivated within their several radiuses of activity. The manner in which these practical ends are attained consists on the one hand of experiments and trials in the acclimatization of useful and ornamental exotic plants; and on the other hand of raising new and improved varieties of native plants; and when successful results follow, propagation on a large scale is practised for free distribution or sale. Thus, for instance, during the year 1884–85 the Calcutta Garden sent out 23,500 living plants to various places in India, and forty-two Wardian cases of plants to foreign countries. Further, some 3000 packets of seeds were distributed; yet the proceeds amounted to only 1075 rupees, because one of the principal functions of the Calcutta Garden is to provide the public gardens and pleasure-grounds with plants.

In the same year the Saharunpore Garden distributed as many as 42,000 plants and 21,300 packets of seeds; whereof 31,400 plants and 14,000 packets to private persons; the amount received being 8500 rupees. But ornamental plants, both as living plants and seeds, occupy the first position, while fruit-trees, timber-trees, and seeds of vegetables take a secondary place.

The Singapore Garden sent out the large number of 163,000 living plants in 1884. These figures, however, are merely extracted as examples of what is done by the different establishments, and afford no idea of their relative importance, inasmuch as the number of plants distributed by each one is subject to the greatest fluctuations; in illustration of which it may be mentioned that the Saharunpore Garden distributed 146,000 plants in 1882–83, against 42,000 in 1883–84; the difference being almost made up by 100,000 plants of agave. Similarly in 1884 the Horticultural Gardens in Madras sold 100,000 plants of the "Mauritius hemp," *Fourcroya gigantea*.

As already observed, the nature of the work of the different gardens varies according to the requirements of each district. In many parts, especially in Ceylon, the Nilghirries, British Sikkim, the interests of European planters have to be considered first; in the rice-growing districts of the Ganges, Malabar, and Ceylon, the things cultivated in the gardens and plantations engage special attention. In Bengal, jute, indigo, and to some extent opium, and in Central and Northern India improvements in the cultivation of cereals, are of primary consideration; while in the Bombay Presidency and some parts of Ceylon cotton is added thereto; often associated with the latter the sugar-yielding palm, *Borassus flabelliformis*. For the dry regions of the Punjab it is a question of finding suitable woody plants for afforestation, as well as for the saline soil of the North-West Provinces, in order to provide fuel for the agricultural districts, and thereby gain the dung of cattle for purposes of manuring. And among other things of vast importance is the conservation and renewal of the rapidly disappearing caoutchouc forests of Malacca.

The Singapore Garden has only been a scientific establishment since 1882, when it was placed under the direction of Mr. Cantley; but much has been done in these few years without destroying the natural beauties of the old garden. A small herbarium has been formed, and the most necessary buildings erected. The new plantations are, as far as possible, systematically grouped. A special charm of this Garden is a remnant of the original forest, traversed only by a few paths, where one can enjoy, in a small way, the delights of tropical vegetation without the fatigue attending excursions in pathless forests. The fern garden and the palmetum promise to be very rich and attractive; but a larger income is necessary to carry out the functions of a botanic garden fully and expeditiously. It is perhaps superfluous to add that the Director has to superintend the gardens and promenades of the town; but in order to understand the whole of the circumstances, it is important to bear in mind that he has also been placed at the head of the newly created Forest Department for the whole of the Straits Settlements—an arrangement which of course causes him no inconsiderable amount of additional labour.

Seeds and plants are continuously being distributed from Kew, where all new things are reported and presented, and where competent authorities are consulted on the merits of the samples sent in. At this centre advice is sought, and there is a constant interchange of ideas and experiences between it and the Indian establishments, the advantages of which are so evident that it is unnecessary to enumerate them.

With the exception of rice, tropical cultivation generally is so uncertain and subject to fluctuation, owing to the conditions of labour, communication, and credit, that improvements are very slow; and the experimental work is not so systematically con-

[1] Chiefly from an article by O. Warburg in vol. xliv. of the *Botanische Zeitung*.

[2] Mr. Warburg refers here doubtless to the Madras Presidency, as the botanic garden is at Ootacamund in the Nilghirries, and not at Madras. It should be understood that we are only extracting passages from a rather long article.

[3] And we may add that there is an experimental garden in the mountains at Mussoorie in connection with Saharunpore; another at Darjeeling, partly pleasure and partly practical; and an important experimental garden at Mongpo (Sikkim), under Mr. J. Gammie: the two last offshoots of Calcutta.

[4] We must pass on to what Mr. Warburg has to say concerning the conditions and functions of the botanical gardens and their adjuncts.

ducted as with us. There are too few officers, and everybody has too much to do; nevertheless many of the reports exhibit an amount of zeal and industry deserving of all the more recognition on account of the difficulties under which much of the work is done.

From this point Mr. Warburg explains and describes in some detail what has been effected by the combined action of Kew and the Indian botanic gardens in the introduction, resulting in the extensive cultivation, of economic plants of the first importance, such as the cinchona, tea, and coffee, the cultivation and manufacture of which have developed into industries of incalculable value. He further alludes to the cultivation of rubber-trees, ipecacuanha, fibre-yielding plants, &c., which is, in many instances, still in a more or less experimental stage. He also enters into particulars and comparisons of the climate of different districts in its relations to cultivation, and altogether his Report is an interesting and instructive one, containing much information new to the English public. He specially mentions the great interest taken in the Madras gardens by Sir Mountstuart Grant-Duff, and the material assistance he extended to Prof. Lawson. And he concludes with a brief review of the literature directly or indirectly connected with the botanic gardens of India, culminating in Sir Joseph Hooker's gigantic undertaking, "The Flora of British India." With regard to the intimate connection between Kew and the Colonial and Indian gardens, Mr. Warburg thinks it is at present most beneficial, though he looks forward to the time when they shall have developed so far as to be less dependent on a central institution.

SCIENTIFIC SERIALS.

Revue d'Anthropologie, troisième série, tome iii. fasc. 1 (Paris, 1888).—On the colour of the eyes and hair among the non-nomadic Tunisian tribes, by Dr. R. Collignon, based on the observations of Capt. Rebillet and Lieut. Fannezo. These observations, which were conducted in accordance with the methods employed in France for similar investigations, refer to more than 2000 individuals belonging to the "sedentary" or settled populations of the towns and rural districts. The men observed being all regular soldiers, the tables do not refer to any nomads of Arab race, since all the dwellers in tents are exempt from conscription in Tunis. Expressed in general terms, among these 2030 individuals, dark eyes occurred in 1543 cases, or 7·6 per cent., and light eyes in 69 cases, or 3·5 per cent.; while dark hair occurred in 1887 cases, or 92 per cent., and light hair only in 7 cases, or 0·4 per cent. On considering the data obtained from a comparison of the tables referring to different districts, it is found that the blond type occurs only sporadically, and almost exclusively in the littoral settlements, on which account Dr. Collignon thinks it may be assumed that its presence in the Tunisian population is due to the incidental amalgamation of foreign elements through invasion or immigration by more northern races.—On the colour of the eyes and hair in Denmark, by Herr Soren Hansen (communicated to the Society by Dr. Topinard). From this paper we learn that observations made on 2000 males of the age of twenty, belonging to the southern and eastern districts of Jutland, yielded the following results: light, *i.e.* blue, eyes, 1527; dark eyes, 65; leaving 408 of medium colour. In regard to the colour of the hair it was found necessary to establish four groups, which gave the following figures: dark brown, 306; medium, 1267; light (blond), 333; and red, 94. From this it would appear that the majority of the population have blue eyes, and medium brown, or chestnut, hair. A further analysis of Herr Hansen's tables shows that while the perfect brown type—*i.e.* where both hair and eyes are dark—occurs only in 2·7 per cent.; blond hair and light eyes are met with in 16·2 per cent. Finally the curious circumstance has been deduced that while light eyes are twenty-four times more frequent than dark ones, light hair is only seven times more frequent than dark hair; hence Dr. Topinard is led to ask whether the explanation of this peculiarity may not have to be sought in some general law by which in a mixed race, descended from blond and dark races, the eyes may be more generally transmitted from the former, and the hair from the latter.—On recruiting in the cantons of St.-Omer, by Dr. H. Favier. The enormous difference in the cantons north and south of St.-Omer in the number of persons available for military service has been attracting much notice among French officers of late years. According to M. Costa, who wrote on the subject in 1866, these differences are due to hygienic causes; the district north of St.-Omer, where the rejections are only 227 in 1000, being well adapted to agricultural and other rural pursuits, while in the southern canton, where the rejections amount to 342 in 1000 the lands are almost all marshy, exposing the inhabitants to fevers and other malarian influences by which the race is deteriorated. Dr. Favier does not believe that these causes affect the question in any way, but, even if they did so when M. Costa wrote, statistics prove that of late years, more especially since the stricter law of conscription of 1872 has been put into force, the south canton has shown a gradual diminution in the numbers of rejections; and while he denies the action of malarian causes or the influence of differences of ethnic origin between the people of the two cantons, he believes that to industrial centres, such as d'Arques in the southern canton, may very possibly be ascribed certain conditions antagonistic to the success of recruiting.—On the "*castellets*" of Mont Sainte-Baume in Provence, by Dr. Beranger-Féraud. The presence of numerous little heaps of stones on the higher peaks of Mont Sainte-Baume has repeatedly arrested the attention of strangers, and the fact of their having been deposited by the hand of man is now confirmed by Dr. B. Féraud, who last year made the ascent of the mountain for the purpose of investigating their character and purpose. These so-called "*castellets*" (little castles) are either composed of several stones forming a rude sort of pyramid, or of one large stone inserted in a fissure of the rocky soil. Although widely distributed, they are most frequent in the vicinity of the oratory of Saint-Pilon, where they are found at an elevation of nearly 1000 feet, close to the edge of the vertical wall of rock forming the northern boundary of the range. On inquiry he learnt that these structures were also locally designated *moulouns de joye* (heaps of joy), and that they were not alone intended to testify to the successful ascent of the pilgrims to the summit of St. Pilon, but were frequently designed to propitiate St. Magdalen, to whom prayers are made on the spot for approval of the special maiden whom the worshipper may desire to marry. In the latter case the mound is visited by the builder at the end of a year, and if he finds the stones undisturbed he considers that the saint approves of his choice; if, however, the heap is broken up, this is generally regarded as a decisive barrier against the intended marriage. In this superstition, Dr. B. Féraud sees a survival of the ancient usage of erecting stone monuments as altars, pillars, menhirs, &c., to commemorate some important personal event.—On inequality amongst men, by M. de Lapouge. In this address the view is boldly advocated that a man is what his birth made him, and that education can do no more for him than develop the pre-existing germs derived from his progenitors in accordance with the laws of heredity. This reasoning is extended to classes, nations, and races, who are assumed to be unequal, and incapable of attaining to an equal degree of perfection. The writer divides men into four classes, in the first of which he places those possessed of creative and initiative faculties above their fellows, while it is to the relative numerical preponderance of this class over the others that he refers the undoubted superiority of one race over another. He thus sees in the dolichocepalic blonds the most favoured of all the races of humanity, since, from the dawn of history, all heroes and leaders among men have belonged to this type. In modern times the Anglo-Saxon race has owed its superiority to the preponderance of this dolichocephalic element. He believes that France is suffering from the diminution of this type in its population, together with the rising predominance of the brachycephalic type to which the lower classes of the community belong, while he anticipates as inevitable a great deterioration of the general national character through the amalgamation of the two. Similarly he sees in the present movement for raising the negro races a deep source of danger in the future to the more highly gifted Aryan races, who may in time find themselves beaten down by the brute force of teeming masses of inferior brachycephalic peoples. Such are some of the leading points in M. de Lapouge's treatise, which, notwithstanding its redundancy of diction, and the dogmatism with which certain views are maintained, is a highly interesting, suggestive, and learned contribution to ethical inquiry.

Bulletin de l'Académie Royale de Belgique, December 1887.—On some new derivatives of normal heptylic alcohol compared with their homologues, by C. Winssinger. After describing the mode of formation and special properties of normal heptylic alcohol, of the chlorides of heptyl, heptylic mercaptan, oxysulphide, sulphone, and some other new bodies, the author develops some general considerations on the homologous series to which belong the heptylic sulphureted derived substances. These considerations throw fresh light on the evolution of the physical and chemical properties of compound bodies through the various species of a common genus. Thus it is shown that the chemical character of the heptylic combinations must be considered as the development of properties whose source or origin is already found in the lower terms of the series of which heptyl is a member.—A contribution to the study of the development of the epiphysis and of the third eye in reptiles, by M. Francotte. This third eye, of the invertebrate type, already described by Graaf and Spencer, is here exhaustively studied in a large number of reptilian embryos from the province of Namur, in all of which it is very distinctly traced from the epiphysis at the roof of the thalamencephalon to the complete development of the pineal organ. In one species of lizard this eye passes through a series of successive phases each realized in a permanent way in one or other of the adult reptiles. But in all of them the optic nerve has disappeared, which connected the organ with the nerve-centres for a short time in the embryonic state.—This number of the *Bulletin* contains an exhaustive memoir on the fresh-water fishes of Belgium, by Baron Edm. de Selys Longchamps.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 16.—"A new Method of determining the Number of Micro-organisms in Air." By Prof. Carnelley, D.Sc., and Thos. Wilson, University College, Dundee. Communicated by Sir Henry Roscoe, F.R.S.

This is a modification of Hesse's well-known process. It consists essentially in the substitution of a flat-bottomed conical flask for a Hesse's tube. Its chief advantages are: (1) much smaller cost of flask and fittings as compared with Hesse's tubes; (2) very much fewer breakages during sterilization; (3) great economy in jelly; (4) freedom from leakage during sterilization; (5) results not vitiated by aërial currents.

"Notes on the Number of Micro-organisms in Moorland Air." By the same Authors.

A number of determinations made last August "on the heather" in the north of Forfarshire show that the pure air from the hills and moors far removed from towns was free from Bacteria, but contained on the average 3·5 moulds per 10 litres of air. In winter the number would be still less.

Linnean Society, March 1.—Mr. Carruthers, F.R.S., President, in the chair.—An interesting collection of ferns from the Yosemite Valley was exhibited by Mr. W. Ransom, who also showed some admirable photographs of rare plants, many of them of the natural size.—Mr. J. E. Harting exhibited a coloured drawing, life-size, of a South American game bird (the Rufous Tinamu) which has been successfully introduced into this country at Brightlingsea, Essex, by Mr. J. Bateman, and made some remarks on its affinities, peculiarities of structure, and habits. In a discussion which followed Prof. Mivart, Mr. Christy, and Mr. W. H. Hudson took part, the last-named giving some account of the bird from personal observation of its habits in the Argentine Republic.—The first paper of the evening was then read by Mr. E. G. Baker on a new genus of Cytinaceæ from Madagascar. This curious plant, to which the author has given the name of *Botryocytinus*, grows parasitically on the trunks of a tree of the natural order *Hamamelideæ*. Its nearest ally is *Cytinus*, of which the best known species grows on the roots of the *Cistuses* of the Mediterranean basin. The Madagascar plant is without any stem, and the sessile flowers grow in clusters, surrounded by an involucre. Each cluster is unisexual, and the ovary is unicellular, with about a dozen parietal placentæ and innumerable minute ovules. It was discovered during a recent exploration of the Sakalava country, by the Rev. R. Baron, of the London Missionary Sooiety.—The next paper, by Mr. J. F. Cheeseman (communicated by Sir Joseph Hooker, F.R.S.), was entitled "Notes on the Fauna and Flora of the Kermadec Islands," and as regards the flora might be considered as supplementary to a paper on the flora of these islands, published by Sir Joseph Hooker more than twenty years ago (Journ. Linn. Soc., 1856). These islands, situated about 450 miles north-east of New Zealand, between that country and Fiji, were shown to be of volcanic origin, with a fauna and flora resembling to a great extent those of New Zealand. A few land birds were noted as common to New Zealand; and to the list of plants drawn up by Sir Joseph Hooker, from collections made by Macgillivray, several new species were added by Mr Cheeseman, chiefly ferns. A discussion followed, and in illustration of Mr. Cheeseman's remarks, Mr. J. G. Baker exhibited specimens of a new endemic *Duvalia* closely allied to the well-known *D. canariensis* of the Canary Islands and Madeira.

Geological Society, February 17.—Annual General Meeting.—Prof. J. W. Judd, F.R.S., President, in the chair.—The Secretaries read the Reports of the Council and of the Library and Museum Committee for the year 1887. The President presented the Wollaston Gold Medal to Mr. Henry Benedict Medlicott, F.R.S. He also handed to Dr. Archibald Geikie the balance of the proceeds of the Wollaston Donation Fund for transmission to Mr. John Horne, and the Murchison Medal for transmission to Prof. J. S. Newberry. The balance of the proceeds of the Murchison Geological Fund was handed to Dr. Henry Woodward for transmission to Mr. Edward Wilson; and the President presented the Lyell Medal to Prof. H. Alleyne Nicholson, one moiety of the balance of the proceeds of the Lyell Geological Fund to Mr. Arthur Humphreys Foord, and the second moiety of the balance of the proceeds of the Lyell Geological Fund to Mr. Thomas Roberts. The President then read his Anniversary Address, which we have already printed.—The ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—President: W. T. Blanford, F.R.S. Vice-Presidents: John Evans, F.R.S.; Prof. T. McKenny Hughes; Prof. J. Prestwich, F.R.S.; Henry Woodward, F.R.S. Secretaries: W. H. Hudleston, F.R.S.; J. E. Marr. Foreign Secretary: Sir Warington W. Smyth, F.R.S. Treasurer: Prof. T. Wiltshire. Council: W. T. Blanford, F.R.S.; John Evans, F.R.S.; L. Fletcher; A. Geikie, F.R.S.; Henry Hicks, F.R.S.; Rev. Edwin Hill; W. H. Hudleston, F.R.S.; J. W. Hulke, F.R.S.; Prof. T. McKenny Hughes; Prof. T. Rupert Jones, F.R.S.; Prof. J. W. Judd, F.R.S.; R. Lydekker; Lieut.-Col. C. A. McMahon; J. E. Marr; E. T. Newton; Prof. J. Prestwich, F.R.S.; Prof. H. G. Seeley, F.R.S.; Sir Warington W. Symth, F.R.S.; W. Topley; Rev. G. F. Whidborne; Prof. T. Wiltshire; Rev. H. H. Winwood; Henry Woodward, F.R.S.

February 29.—W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—An estimate of post-Glacial time, by T. Mellard Reade. The author showed that there exists on the coasts of Lancashire and Cheshire an important series of post-Glacial deposits which he has studied for many years. The whole country to which his notes refer was formerly covered with a mantle of low-level marine boulder-clay and sands, and the valleys of the Dee, Mersey, and Ribble were at one time filled with these Glacial deposits. These Glacial beds have been much denuded, especially in the valleys, where the rivers have cleared them out, in some cases, to the bed rock. Most of this denudation occurred during a period of elevation succeeding the deposition of the low-level boulder-clay. On this eroded surface and in the eroded channels lie a series of post-Glacial beds of a most interesting and extensive nature. They consist of estuarine silt and *Scrobicularia* clay covered by extensive peat-deposits, containing the stools of trees rooted into them. Upon these lie, in some places, recent tidal silts, and on the coast margin blown sand and sand dunes. The series of events represented by the denudation of the low-level boulder-clay and the laying down of these deposits is as follows:—(1) Elevation succeeding the Glacial period, during which time the boulder-clay was deeply denuded in the valleys. (2) Subsidence to about the 25-feet contour, when the estuarine silts and clays were laid down. (3) Re-elevation, representing most probably a continental connection with the British Isles, during which time the climate was milder than at present, and big trees flourished where now they will not grow. (4) Subsidence to the present level, the submersion of the peat and forest-beds, the laying down of tidal silt upon them, and the accumulation of blown sand along the sea-margin extending to a considerable distance in an inland direction. It was estimated, from a variety of considerations, that these events, all posterior to the Glacial period, represent a lapse of time of not less than 57,500 years, allotted as follows: 40,000 years for the elevation succeeding the Glacial period, measured by the denudation of the boulder-clay in the valleys; 15,000 years for the accumulation of the estuarine silts, clays, peat, and forest beds; and 2500 years for the blown sand. In the discussion which followed the reading of this paper Prof. Prestwich, Mr. De Rance, Dr. Evans, and others took part.—Note on the movement of scree-material, by Charles Davison. Communicated by Prof. T. G. Bonney, F.R.S.—On some additional occurrences of tachylyte, by Grenville A. J. Cole.—Appendix to Mr. A. T. Metcalfe's paper "On Further Discoveries of Vertebrate Remains in the Triassic Strata of the South Coast of Devonshire, between Budleigh Salterton and Sidmouth," by H. J. Carter, F.R.S. Communicated by A. T. Metcalfe.

Mathematical Society, March 8.—Sir J. Cockle, F.R.S., President, in the chair.—The following papers were read:—Supplementary remarks on the theory of distributions, by Capt. P. A. MacMahon, R.A.—Complex multiplication moduli, by Mr. A. G. Greenhill.—Geometrical proof of Feuerbach's nine-point circle theorem, by Prof. Genese.—Isostereans, by Mr. R. Tucker.

Anthropological Institute, February 28.—Francis Galton, F.R.S., President, in the chair.—The election of Mr. Henry C. Collyer was announced.—Dr. Edward B. Tylor read a communication from Mr. Basil Hall Chamberlain, on the Japanese "go-hei," or paper offerings to the Shinto gods. In olden times the offerings were made of cloth, but later on, when Chinese civilization had brought a variety of manufactures in its train, hempen cloth ceased to be regarded as a treasure worthy of divine acceptance, and paper began to be used instead. The "go-heis" used by different sects differ slightly from one another, chiefly in the number of the folds: the Yoshida sect sanctions the use of four folds, while the Shirakawa sect has eight. There is said to be no symbolism attaching to the shape, number of folds in the paper, or the length of the stick; each sect has clung to its traditional practice in these matters. Specimens of "go-heis" were exhibited in illustration of the paper.—Mr. Henry Balfour exhibited a series of decorated arrows from the Solomon Islands, in illustration of his theory of the manner in which the decoration of the shafts was gradually developed.—Dr. Tylor gave a brief account of a paper by Mr. A. W. Howitt, "Further Notes on the Australian Class Systems," and in the course of the discussion the President showed a very simple method of understanding the complicated-looking system of Australian marriages, by supposing a cross-division of the tribes.

Edinburgh.

Royal Society, February 6.—Sir W. Thomson, President, in the chair.—Prof. Crum Brown showed and described an apparatus for exhibiting the action of the semicircular canals. The apparatus is also capable of application as an instrument for the measurement of the irregularity of angular motion.—Mr. John Murray read a paper on the temperature and currents in the lochs of the west of Scotland, as affected by winds. He showed that when the wind is blowing off shore the warm surface water is blown outwards and cold water takes its place from beneath. When the wind blows on shore the warm surface water is driven inwards. This point is of great importance, as it has an evident bearing on the growth of coral-forming animals.—Mr. Murray also communicated a paper by Mr. W. G. Reid on the solution of carbonate of lime in sea water under pressure. The results of Mr. Reid's experiments show that the solubility is increased by pressure.—Mr. Murray then discussed the distribution of carbonate of lime on the floor and in the waters of the ocean.—Mr. John Aitken read a paper (see Nature, March 1, p. 428) on the number of dust particles in the atmosphere, giving a full account of the apparatus used and the method of experimenting.

Paris.

Academy of Sciences, March 5.—M. Janssen in the chair.—Remarks on the first volume of Fourier's works presented to the Academy, by M. G. Darboux. This volume of the complete edition of Fourier's works, now being issued with the aid of the Minister of Public Instruction, contains the full text of the "Théorie analytique de la Chaleur," carefully revised by MM. Darboux and Paul Morin.—On the transformation of the nitrates present in the soil into nitrous organic compounds, by M. Berthelot. The experiments here described have been carried out for the purpose of showing that the nitrates contained in the ground do not occur in an integral state even independently of the formation of the higher plants. On the contrary, they may be changed into nitrous principles of organic nature under the influence of chemical agents properly so-called, or of certain microbes present in the soil. It is suggested that these microbes assimilate the combined nitrogen when presented to them in a convenient form, preferring it to the free nitrogen of the atmosphere, thus reversing the action of the microbes of nitrification. The general inference is that the assimilation of the nitrogen of the nitrates by plants is accompanied, if not preceded, by their transformation into nitrous organic compounds in the earth under the influence of chemical reactions and special microbes. These microbes are perhaps the same as those which fix free atmospheric nitrogen in soil destitute of nitrates. In this way might be formed true azoic compounds derived at once from the oxygenated and hydrogenated compounds of nitrogen.—On perfect numbers, by Prof. Sylvester. A slight omission pointed out by M. Mansion in the author's recent paper on this subject is shown in no way to affect the validity of the demonstration.—On *Saccharomyces ellipsoideus* and its industrial applications to the manufacture of a barley wine, by M. Georges Jacquemin. A process is described by which a tartarized wort of barley is made to yield a true wine of pleasant taste, and more nutritive than grape wine, containing as it does more respiratory aliments, besides an albuminoid substance, and a larger proportion of phosphates calculated to restore the nervous system and the bony tissues. It also differs from white grape wine by being copiously precipitated by tannin, while a portion of the malt may be replaced by crushed grain (wheat or barley) that has not sprouted. This wheat or barley wine is stated to be equal in quality and cheaper than that of pure malt, and the vinous wort in question is an alcoholic fermentation of a totally distinct character from the ordinary yeast of beer.—Immediate solution of equations by means of electricity, by M. Felix Lucas. A method is described by which an algebraic equation of any degree with real numerical coefficients may be directly solved without calculations by means of electricity. The process here explained is much more rapid than the two methods indicated in previous communications. However high the equation, a single operation suffices to obtain all the roots, real or imaginary. "The power of electricity as a calculator is not to be limited."—On the electric conductibility of concentrated nitric acid, by M. E. Bouty. In previous papers it was shown that a very slight addition of alkaline nitrates to the acid increases its conductibility to a considerable extent. Here it is made evident that the addition of water also causes an increase of conductibility nearly proportionate to the quantity of added water. This approximate proportion is maintained even much further than with the nitrates, nearly to $NO_5,4HO$. A table is given showing the degrees of conductibility measured at 0° C., and referred to that of the normal solution of nitric acid at one equivalent per litre, the specific resistance being 4·59 ohms.—On cinchoniline, by MM. E. Jungfleisch and E. Léger. In previous communications the conditions were explained under which cinchoniline is formed and separated in the state of a di-iodhydrate. Here the authors deal with this base and its chief derivatives. That this substance, which has the formula $C_{38}H_{22}N_2O_2$, is isomerous with cinchonine, is made evident not only by the analysis of the base itself, but also of that of a large number of combinations. In ether it forms magnificent rhomboidal prisms, colourless, anhydrous, and often attaining a weight of several grammes. It dissolves readily in ordinary alcohol, but with difficulty in water, its aqueous solution giving a deep blue tint to turnsol (Dutch orchil), and a red to the phthaleine of phenol. Its basic and neutral salts present some remarkable crystallographic properties.—Products of the oxidation of the hydronitrocamphenes, by M. C. Tanret. From the oxidation of these substances the author has obtained several new compounds, which are here described. The new substance, answering to the formula $C_{80}H_{64}N_4O_{16}$, he proposes to call nitrocamphene (*azo-camphène*), distinguishing its two modifications as cyanonitrocamphene and leukonitrocamphene. They are isomerous, their analysis yielding the same constituents.—On terpinol, an artificial reproduction of eucalyptol (terpane), by MM. G. Bouchardat and R. Voiry. These researches show that the terpinol of List is formed of a crystallized inactive terpilenol or terpol, $C_{20}H_{18}O_2$, boiling at 218° C.; of terpane, $C_{20}H_{18}O_2$, boiling at 175°, and capable of crystallizing at −1°; lastly of inactive terpilene, $C_{20}H_{16}$. Terpane, which term is here substituted for the older cineol, eucalyptol, cajeputol, spicol, &c., differs also from the active and inactive terpilenols by refusing to combine either with the acids or the anhydrides to yield ethers. —Deleterious influence of alcohol on offspring, by MM. A. Mairet and Combemale. The results are described of some experiments on dogs, showing that their progeny were injuriously affected for two successive generations by the influence of alcohol administered under various conditions to the parents.

BERLIN.

Physiological Society, February 10.—Prof. du Bois Reymond, President, in the chair.—Dr. Baginski spoke on the origin and course of the auditory nerve. As the result of experiments on young cats, in which the peripheral end of this nerve had been destroyed, and which were then killed at the end of six weeks, he was able to follow the course of the degeneration by means of a series of sections through the root of the nerve to the posterior corpus quadrigeminum. In this way his earlier experiments on rabbits were fully confirmed. The degeneration spread to the olivary body of the same side, and was continued through the trapezium of the pons. After removal of the facial nerve the olivary body was similarly found to be affected. These observations are closely connected with those of von Monakow, who found that destruction of the auditory centre, described by Munk, led to a degeneration which could be traced right into the hinder corpora quadrigemina. At present no observations are in existence as to the course of the anterior root of the auditory nerve.—Dr. Rawitz gave an account of the results of his researches on the eyes of mussels, and explained the same by reference to preparations which he exhibited. Three distinct types may be observed among the eyes, sometimes to the number of one hundred, which occur on the edge of the mantle of Pecten. Each eye consists of an epithelial layer, a lens, and a retina composed of rods, whose ganglionic layer is on the side turned towards the light, while the rods are turned away from the light and abut on the tapetum and layer of pigment cells. The speaker had been able to trace the endings of the nerves through the cells connected with the rods into the rod itself. The mussels are only able to see with the central portions of each eye.—Dr. Virchow presented and explained a plaster cast of the gluteal region. He had had this cast made in order to throw light upon a deep furrow which extends from the gluteus maximus to the tensor muscle, and is not due to the edge of either of these muscles. This furrow may be observed in the sitting posture, and is due to the stretching by the point of the trochanter of a portion of the fascia which envelop the gluteus medius: by this means the gluteus medius is divided into two projecting portions. When this muscle contracts, the furrow disappears.

February 24.—Prof. du Bois-Reymond, President, in the chair. —Prof. Liebreich spoke on the testing of the action of local anæsthetics on animals. There are a number of substances which, when injected subcutaneously, give rise to a localized anæsthesia in the immediate neighbourhood of the place where they are injected. Antipyrin, sal-ammoniac, salts of tannin, resorcin, chloride of iron, and other substances have this action, although there is neither chemical nor physiological similarity between them. They possess, however, this property in common, that they all have a corrosive action on the tissues, when this expression is understood to imply any kind of alteration of molecular structure. The alkaloids, in the cases where they possess a local anæsthetic action, act in the same way, as, for instance, erythrophoein. Cocaine alone is an exception to the rule, inasmuch as it is a local anæsthetic, but does not corrode the tissues. When applied subcutaneously to man, the above substances either produce no localized anæsthesia, or one which is very imperfect. When testing the action of anæsthetics on the eye, it is essential to take into account the difference in sensitiveness of the conjunctiva and cornea, as already pointed out by Claude Bernard.—Dr. Virchow exhibited a plaster cast of the hip-region taken from a female corpse in a hanging position. It brought to light a whole series of most surprising relationships which can never be observed, in preparations made from a corpse in the recumbent position, as at all corresponding to those existing in the erect posture. One of the most striking facts is the considerable stretching of the sciatic nerve, which must be still greater when the leg is advanced, as in walking. —Dr. Virchow further spoke on the striæ medullares acusticæ in man, in connection with the statement made before the Society a fortnight before by Dr. Baginski. His experiments have shown, in correspondence with the results of many other observers, that the striæ can be traced through the raphe to the other side of the medulla. It must still remain an open question whether the fibres which lead to the anterior root of the auditory nerve have a different course in cats and rabbits (examined by Baginski) than they have in man (examined by the speaker), or whether in the above-named animals we have to deal with a frequently-recurring division and rearrangement of the fibres of any one tract.

Physical Society, February 17.—Prof. Helmholtz, President, in the chair.—Prof. Lampe made a report on McGregor's book, "An Elementary Treatise on Kinematics and Dynamics." —Prof. Börnstein exhibited an electricity-meter which enables the intensity of the current to be read off direct.—Dr. Gerstmann gave an account of a preliminary communication by Aubel on the influence of temperature and magnetization on the electrical resistance of bismuth.—Dr. Kötter spoke on a problem in the theory of projectiles—namely, that a bullet shot out of a rifle tends to deviate in a direction away from the side on which the bayonet is attached to the muzzle.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Johnston's Botany Plates (Johnston).—The Testing of Materials of Construction: W. C. Unwin (Longmans).—Leitfaden der Zoologie: Dr. B. Graber (Tempsky).—Science Sketches: D. S. Jordan (McClurg).—Home Experiments in Science: T. O. Sloane (Low).—Memoirs of the Manchester Literary and Philosophical Society, 3rd series, vol. x.; Proceedings of the Manchester Literary and Philosophical Society, vols. xxv. and xxvi. (Manchester).

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