THURSDAY, JULY 5, 1888.

THE DECADENCE OF THE CHEMICAL PROFESSION IN GOVERNMENT OPINION.

THE Professorship of Chemistry in the Royal Naval College, Greenwich, is, or is about to become, vacant through the resignation of Dr. H. Debus, F.R.S., and it is currently reported that the authorities have been advised to discontinue the professorship, and to substitute for it a mere lectureship or readership. We trust that this rumour may prove unfounded, or that the Government may be led in time to see the folly of degrading a subject which, if properly handled, is of such extreme value and importance to the Navy. We say degrade, because in the first place it cannot be questioned that chemistry is a science which may claim to rank with any other which enters into the curriculum at Greenwich, both on account of its educational value and its direct usefulness; and because any such change must of necessity tend to lower the value of chemical knowledge in comparison with that of other subjects in the eyes of the students.

It is scarcely necessary to point out in how many ways a knowledge of chemistry may be of service in the Navy. Our sailors are stationed in all parts of the world, and the question of water-supply both for men and boilers is an ever-present one: a decision as to the quality of a water can only be given after it has been examined chemically. Again, the action of sea-water on metals, the corrosion of metals, the decay of timber, the economical use of fuel, are all matters in which the sailor nowadays is deeply interested, and these can only be rightly understood by those who have acquired a sound knowledge of chemical principles. There are very many other ways in which chemistry is of direct value to the sailor; but, most important of all, there is no subject which, if properly and practically taught, affords the same opportunity of training the student to observe accurately and to think correctly, and it is especially on this ground that chemistry should be assigned a high position in the course at a Naval College. It will, however, not suffice to require attendance at a course of lectures in which general chemistry is treated of in slow and measured cadences and no heed is paid to the requirements of the students: the subject must be taught technically, and almost exclusively with direct reference to matters familiar to sailors and to their future requirements; and the training must be to a very large extent carried on in the laboratory, and not in the lecture-room.

If the results thus far obtained at Greenwich have not been such as to lead the authorities to appreciate the value of the subject, the most short-sighted course they can possibly pursue in the hope of obtaining better results in the future will be to assign a lower rank to chemistry. In cases of grave disease, if a practitioner, guided by particular traditions, and operating under conditions which he takes no particular pains to control, be unsuccessful, it is not usual to call in another of lower grade; but on the contrary, if possible, one of equal or higher grade is summoned, holding different and perhaps wider views, and the effort is made to improve the conditions so as to give every opportunity for his treatment to be successful: and so may it happen, we trust, at Greenwich.

In these anxious times of fierce competition the nation cannot afford that the Government should act so as in the least degree to diminish the importance of so valuable a branch of science as chemistry. Moreover, a golden opportunity will be lost if occasion be not now taken to appoint at Greenwich a chemist who not only is known to have been thoroughly trained, but who has given proof, by his own researches and those of his pupils, that he is possessed of enthusiasm, and capable of extending our knowledge. In connection with explosives, and in many other directions, there is infinite opportunity for research; and it is a disgrace to the nation that the Navy at present has not a single chemist of repute in its service, especially as such invaluable service has been rendered to the War Department by its chemist, Sir Frederick Abel.

If the professorship at Greenwich be quashed, it is unlikely that a man of proper calibre will be attracted by a mere lectureship; and thus another step will have been taken to indicate that in this country we care little for science, that our Government is blind to facts so clearly recognized by foreign Powers. Among the noted men of science now in the House of Commons, besides Prof. Stokes, there are three chemists, Prof. Maskelyne, Sir Lyon Playfair, and Sir Henry Roscoe: we feel sure that they will not allow the Government to make a false move in so important a matter without publicly warning them, and without fully eliciting their reasons.

THE LAND AND FRESH-WATER MOLLUSCA OF INDIA.

Land and Fresh-water Mollusca of India. Edited by Lieut.-Colonel H. H. Godwin-Austen, F.R.S., &c. Parts I. to VI. (London: Taylor and Francis, 1882–88.)

ALTHOUGH much has been done to elucidate the fauna of our great Eastern dependency, very much more still remains to be accomplished: vast tracts have yet to be explored scientifically, even though, year by year, new areas are visited by the naturalist and collector, and fresh species are added to the list.

This is especially evident in the case of land and freshwater Mollusca; whilst so scattered are the various descriptions of the species up and down the pages of different scientific journals and magazines, that the specialist himself has a hard task to ascertain whether a given example is new or not.

It is true that Hanley and Theobald,[1] in their now classical work, went some way towards remedying this state of things; but their task was never completed, and many new forms have been discovered since their publication was brought to a close.

Under these circumstances the present undertaking cannot fail to be most welcome. It is modestly described as "supplementary" to the work just named; but, in reality, it is something far more important, if we may

[1] The names are inadvertently reversed on the title-page of Colonel Godwin-Austen's book.

judge from the six parts (257 pp.), which, with their sixty-two hand-coloured plates, will, when the index is issued, complete the first volume. Each species figured is most thoroughly described, and, when not new, full quotations with the synonymy are given. The figures are also the handiwork of Colonel Godwin-Austen, and though they by no means attain to that standard of excellence with which Sowerby at his best made us familiar, they are effective and (fortunately) under, rather than over, coloured. The illustrations of the living animals, which are copied from drawings by a native artist, are extremely spirited and life-like. Anatomical details where obtainable are given, and, what is yet more important from the systematic point of view, the Radulæ are figured; for, whatever may be the case with marine forms, in the Pulmonates certainly it is of the greatest importance.

How truly gigantic the task Colonel Godwin-Austen has set himself, becomes apparent when it is seen that, disregarding political boundaries, under "India" are included "South Arabia, Baluchistan, Afghanistan, Kashmir, Nepal, Burmah, Pegu, Tenasserim, Malay Peninsula, Ceylon, and other islands of the Indian Ocean"; whilst, when necessary for purposes of comparison, genera from yet other countries are also described and figured (*e.g. Geomalacus, Africarion*)—of a truth there does not seem to be any probability that the author will ever, like some scientific Alexander, be in want of fresh fields for conquest!

The weak point of the work appears to be that "the genera and sub-genera are treated of in no particular order, ... but as data concerning them can be put together and the drawings completed." Nothing, we feel sure, but the necessity of doing so, if the work was to be published at all, can have induced the author to adopt such a course. Few things are more provoking to the student than the necessity of turning to many different pages in the same work when engaged on a particular subject, an inconvenience which even a good index does not obviate; whilst in its absence matters are not improved by such a table as the one given on p. 253, which professes to be "a classification of families and genera treated of in the preceding pages," but which only includes those placed by the author in Fam. Zonitidæ (or, as it is misprinted, Zon*a*tidæ).

This infringement of Nature's first law renders it hard to disabuse one's mind of the unfortunate impression derived on a first examination that the author had transcribed and enlarged his preliminary notes without previously sorting them. Nor does the reason alleged seem altogether sufficient: "the classification can be hereafter attempted; we shall then be better able to judge what weight, generic or sub-generic, to give to the many genera now recorded from the Indian region." This did not preclude the author from giving—as we trust he will do in a future part—what all who try to follow him would find of great assistance; namely, a provisional table of classification in which the main divisions at all events should be shown.

Such a scheme would be none the less useful seeing that he evidently, like most authorities, has his own notions on the subject, which at present can only dimly be guessed at by a careful perusal of the text. Thus at p. 165 he speaks of "the two great natural divisions of land Mollusca, . . . the Helicidæ and Cyclophoridæ." Again, he agrees with Fischer (v. p. 59) that *Hyalimax* belongs to the same group as *Succinea*; but on pp. 64–65 gives a "key to genera of Limacidæ and Arionidæ" in which *Hyalimax* figures.

Another drawback, if it may be so described, is the undue prominence given to minor differences, and the consequent elevation into genera of what in the eyes of the general conchologist are sub-genera, or even mere sections of sub-genera. This, however, raises a very wide and much vexed question, into which far be it from us to enter.

In thus briefly indicating what appear to us the shortcomings of this important work, we are by no means blind to its great value, and we most heartily wish success to its author in his arduous undertaking, which bids fair to prove as endless as that of Sisyphus.

RECENT MATHEMATICAL BOOKS.

A Chapter in the Integral Calculus. By A. G. Greenhill, M.A. (London: Hodgson, 1888.)

A Treatise on Plane Trigonometry: containing an Account of Hyperbolic Functions, with Numerous Examples. By John Casey, F.R.S. (Dublin: Hodges, 1888.)

A Higher Arithmetic and Elementary Mensuration. By P. Goyen, Inspector of Schools, New Zealand. (London: Macmillan, 1888.)

The Harpur Euclid. Book II. By E. M. Langley, M.A., and W. S. Phillips, M.A. (London: Rivingtons, 1888.)

THE first book in this list is intended to be used by way of supplement to any ordinary treatise on the calculus. It might almost be said that Prof. Greenhill is nothing if not *hyperbolic*, for he expatiates in seas of these functions and the kindred Weierstrassians. No one has done better work than he in his endeavours to make them "familiar as household words" to students, to whom, as Dr. Casey remarks in the preface to his "Trigonometry," they are very interesting and important, not only in pure mathematics but also in mathematical physics. Our author, who is quite in accord with this opinion, considers that "the hyperbolic functions have not received adequate treatment in ordinary text-books; to illustrate this importance, a digression has been made on their principal properties, illustrated by examples of their application."

In the course of thirty-six pages he gives an exceedingly clear sketch, and works out in detail several examples, viz. the different forms of the result of $\int dx/(x-p)\sqrt{R}$, where $R \equiv ax^2 + 2bx + c$, and several kindred forms. The analogies and properties of the hyperbolic functions are considered; three sections are given up to hyperbolic trigonometry; three more to relations connecting true, excentric, and mean anomaly in an elliptic and hyperbolic orbit; and a section to Abel's theorem and the general integral $\int \frac{N}{D} \cdot \frac{dx}{\sqrt{R}}$, and to the rectification of some curves.

There is a large collection of examples, and the whole pamphlet is "teres atque rotundus."

Dr. Casey's "Treatise on Plane Trigonometry" is quite independent of the "Elementary Trigonometry" by the same author. It is a most comprehensive work, and quite as exhaustive as any ordinary student will require. Dr. Casey shows his usual mastery of detail, due to thorough acquaintance, from long teaching, with all the *cruces* of the subject. He has embraced in his pages all the usual topics, and has introduced several points of extreme interest from the best foreign text-books. A very rigid proof is given of the exponential theorem, and a section is devoted to interpolation. Dr. Casey approves of, but does not at present venture to adopt, the practice of French authors who use log sin A instead of our old friend L sin A, *i.e.* he would prefer $\bar{1}{\cdot}859$ to 9·859.

Chapters V. and VI., which are devoted to triangles and quadrilaterals, are exceedingly interesting, and contain quite a crop of elegant propositions culled from many fields. Following the course adopted by other recent writers, he gives a systematic account of imaginary angles and hyperbolic functions. "The latter are very interesting, and their great and increasing importance, not only in pure mathematics but in mathematical physics, makes it essential that the student should become acquainted with them." We may remark that Dr. Casey adopts the following notation: sh, ch, th, coth, sech, cosech, for sinh, cosh, &c.; and has gone further than his English predecessors in introducing at this early stage the angle τ, Hoüel's *hyperbolic amplitude of* θ (τ = amh. θ). Numerous illustrative examples and tables afford practice to the student in this branch.

The modern geometry has a small niche, and here we note, as one of several small clerical errors come across, in addition to the list furnished, that (440) should have *cosecants* in place of *secants*. The special results, which on Dr. Casey's useful plan are numbered consecutively, reach 810. The book is rich in examples, and will be sure to find for itself a place on the mathematician's shelves within easy reach of his hand.

The object of the author of "A Higher Arithmetic and Elementary Mensuration" is to furnish a work suited to "the senior classes of schools, and candidates preparing for public examinations." A large number of typical exercises are worked out, and the student, being left to observe and think for himself, acquires, or should acquire, a sound practical knowledge of the subject, which the author rightly thinks will be more abiding than the knowledge of rules and definitions obtained by the mere committal of them to memory. For the benefit of beginners, in many of the examples the steps of the reasoning are given at some length, but the student is advised, as he grasps the details, to shorten the work as much as possible in the examples he subsequently works out. The text covers all the ordinary divisions under which arithmetic is discussed in the books, even our old friend alligation having a chapter assigned to it. The last two chapters are devoted to the mensuration of plane surfaces and of solids. There are 400 exercises at the end, in addition to a very great number scattered throughout the book. The whole is a vast storehouse of well-put matter, which should render a reader quite independent of any other text-book, and, we might say, of a teacher.

Book II. of "The Harpur Euclid" is on the lines laid down in the edition of Book I., and the subject is handled in an interesting manner. There is a sufficient number of good illustrative examples, with assistance enough to enable a thoughtful boy to work them out by himself. We are glad to see a few examples on antiparallels and symmedians. These lines must soon force their way to a foremost position even in a school curriculum. This is a useful and handy edition brought out in accordance with the Syllabus of the Association for the Improvement of Geometrical Teaching.

THE BOTANY OF THE AFGHAN DELIMITATION COMMISSION.

The Botany of the Afghan Delimitation Commission. By J. E. T. Aitchison, M.D., F.R.S., Naturalist attached to the Mission. Being Trans. Linn. Soc., Ser. 2, Bot. v. 3, pp. 1–139, tt. 1–48; with two Maps. (1888.)

OF this expedition Dr. Aitchison has already published, in the *Pharmaceutical Journal and Transactions*, Ser. 3, v. 17 (1887), a report on the drugs, and he is preparing a report on the zoology to appear in the Transactions of the Linnean Society.

In several previous collections and papers relating to the Punjab flora ("Flora of Jhelum," "Lahul, its Flora and Vegetable Products," "Flora of Hushiapore," "Hand-book of Trade Products of Leh"), and especially in his Report on the plants of the Kuram Valley, Dr. Aitchison had shown himself an excellent collector and an enthusiastic botanist; and by the knowledge of the Afghan flora he had acquired in this preceding work he was eminently qualified to make the most of the opportunities afforded on hasty marches and in rough camps. The Secretary of State for India, who employed Dr. Aitchison on this duty, may certainly be well satisfied with the present botanic section of the Report. In 28 quarto pages Dr. Aitchison describes the country traversed, and the general character of the vegetation, interspersed with many economic and agricultural remarks. The remainder of the Report consists of a list of the plants collected in order, with descriptions of the new species, most of which are figured. There are about 800 plants catalogued, whereof 53 are new to science. The whole forms a most valuable addition to our scientific knowledge of an interesting frontier region. Dr. Aitchison started from Quetta on September 22, 1884, and proceeding west struck the Helmund on October 19; following the course of the Helmund and Harut, he was close to Herat on November 4; the remaining nine months, up to September 1885, he was in Khorassan and Badghis, *i.e.* in North Cabul.

The dry region of South-West Asia extends into Western India—into Sind, the Punjab, Rajputana; but in his "Flora of British India," Sir J. D. Hooker accepts the political frontier of India as his western limit. It is impossible in local floras to find natural boundaries. Beluchistan and Cabul are thus excluded from the "Flora of British India." They are included in Boissier's "Flora Orientalis"; but Boissier had by no means plentiful material for this frontier. The additions now made by Dr. Aitchison are not to be estimated by the 53 new species alone, but by the further light thrown on numerous little-known species, and especially by the quantity of economic information collected.

Of the 800 plants enumerated, the richest orders are Leguminosæ with 78 species, Compositæ with 77 species, Gramina with 63 species, Cruciferæ with 57 species, Chenopods with 38 species. The large Umbelliferæ allied to Asafœtida are finely illustrated in plates 18 to 29; four new species are described. There remain still many points about these valuable gum-producing plants of Central Asia that are obscure. Of the 78 Leguminosæ, no less than 37 are of the genus Astragalus, and of these 13 are new. Of the petaloid Monocotyledons the most prominent are the Iridaceæ (2 new species of Iris), and the Liliaceæ (26 species, of which 3 are new).

The introductory narrative, with the lists of characteristic plants at different levels and localities, enables a phytographic botanist to apprehend the nature of the country and climate. Cabul is clearly a much richer country agriculturally than has been hitherto supposed. Corn can be cultivated without irrigation either above 3500 feet altitude, or in the vicinity of a river; and a large area between these levels is capable of irrigation. The dry and hot summer is, as was before well known, very favourable to the production of fruit, and it now appears almost equally so to the production of vegetables. Dr. Aitchison found "not uncommon," in clefts of rocks and escarpments of hill-sides, the common fig (*Ficus Carica*, Linn.), apparently wild; and collected both male and female branches, some of the male receptacles containing both male and gall flowers. Dr. Aitchison had few opportunities of examining the country above 5000 feet; at the spots he did visit he found a very scanty flora, and above 7000 feet absolute sterility.

Dr. Aitchison compared his collection in the Kew Herbarium, and had the assistance of Mr. W. B. Hemsley in the technical botanic work, and in arranging the plates; and the new species described are given as of "Aitchison and Hemsley," except a few Liliaceæ, &c., attributed to "Aitchison and Baker." By this plan Dr. Aitchison gives to botanists who cannot refer to the specimens a guarantee that the new species are "good," and that the list of names has been accurately worked out. It is indeed the closeness with which a list of the present kind is worked out that gives it more than a temporary value.

Praise is due to Dr. Murie, the Assistant Secretary of the Linnean Society, for the style in which this number of the Society's Transactions has been put out. Credit may certainly be given to the India Office for assisting in a publication of this class; somebody there must have discovered that the money spent by the old Company on Roxburgh and Buchanan-Hamilton, on Royle and on Wallich, was not money spent on ornamental books, but has been returned, many times over, to the Government coffers.

OUR BOOK SHELF.

The Principles of Agricultural Practice as an Instructional Subject. By John Wrightson, Professor of Agriculture and Principal of the College of Agriculture, Downton. (London: Chapman and Hall, 1888.)

THIS is a useful text-book, written in an interesting style, and by one who shows that in addition to being scientific he is thoroughly practical. The subject-matter of the book was first delivered as lectures to science teachers, and it deals with the duties of teachers as well as the defects of students under examination. It exposes in commendable language the narrow grooves into which agricultural teaching under the Science and Art Department has fallen. This is called "molecular and microscopic" in place of "bold and comprehensive," which ought to be the suitable form of description if the Department were properly constituted.

The book is the first of a series of text-books. It disposes in a clear and unmistakable manner of many knotty points of difficulty to the farmer and to the student, in matters relating to the nature and composition of soils, kinds and qualities of manures—"artificial and natural," "general and special,"—also to the cultivation of soil, and the growth and rotation of crops. Under these various headings many popular fallacies are exposed, connected with the classification of soils, the action of lime and nitrate of soda when applied to soil, the value of silica and of farm-yard manure, the sources of the supply of nitrogen to the growing plant, and the supposed ultimate exhaustion of soil—called a "store-house, a laboratory, a vehicle"—by systems of cropping.

The merits and methods of "autumn-cleaning" are duly introduced. The valuable work of the Rothamsted experiments is fully acknowledged and concisely explained.

This new contribution to agricultural literature comes at an appropriate season, when there is a growing demand for text-books of a trustworthy kind: so few can be found which are not simply the incoherent drivel of men who have but a very limited and imperfect knowledge of the subject.

The work is written in a style which will lead the student to think for himself, and but for one serious blunder in the later pages we should have pronounced it to be exceptionally perfect. Partial toleration is extended to the practice of sowing down land to pasture with seeds swept from the stable-loft. The loss sustained by the country through Miss Ormerod's warble-fly is thrown into the shade by the loss which has resulted from this exploded system of seeding down to grass. We hope to see the error corrected in a second edition, which, judging from the value of the book, cannot be long in making its appearance.

A Season in Sutherland. By J. E. Edwards-Moss. (London: Macmillan, 1888.)

THIS is a pleasant little book, though it affords no kind of information to the naturalist or to the sportsman, while it can hardly pretend to rank as a contribution to *belles lettres*. But Mr. Edwards-Moss is acquainted with certain districts in the north of Sutherlandshire; he has thrown a fly, and shouldered a breechloader; and he writes of his experiences in an unpretentious and graceful way which ought to commend the little volume as an accompaniment to an after-dinner cigar. He also quotes freely from contemporary and other authorities, including amongst these that profound thinker and teacher, Mr. Mallock. Mr. Mallock, as quoted by Mr. Edwards-Moss, tells us that we should "learn to love the sea, and the woods," and also "the wild smell of the heather"; from which we may gather that Mr. Mallock has probably discovered some portion of the country in which the heather smells of patchouli.

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.*]

"Sky-coloured Clouds" at Night.

IN NATURE, June 28 (p. 196), Mr. Backhouse notes the appearance of illuminated clouds to northward at night. Similar clouds are seen from here on almost every clear night near the summer solstice. For the last two years special note has been taken of them. In 1887 they were first seen at midnight on June 13, and last seen on July 20; this year their first appearance at midnight was on June 4, and they are still visible every clear night. The clouds are not, as far as I have observed, coloured, but shine with a pearly or silvery lustre. I have seen them at midnight as high as 30° altitude, but they are generally confined to the first 10° or so above the northern horizon. The facts that they vary greatly from night to night in appearance, being sometimes almost absent, and that one or two photographs that have been taken of them show them simply as ordinary cirrus clouds, all seem to indicate that they really are very high cirrus lighted by the sun.

I may add that the upper glows continue to be seen here, though with varying intensity, on every clear night both before sunrise and after sunset, but for the past year no reddish ring or glare has been observed round the sun in the day-time.

Ben Nevis Observatory, July 2. R. T. OMOND.

Micromillimetre.

THE Council and the Fellows in general meeting have taken into consideration the objection raised by Prof. Rücker to the term micromillimetre.

This term was in use by microscopists long before the British Association Committee formulated their system of nomenclature; but nevertheless the Society are unwilling, on a question of precedence only, to insist upon retaining a word which may give rise to confusion.

The Council have therefore directed the editors of the Journal to discontinue the use of the term "micromillimetre," and to substitute for it that of "micron," which has been in use for as long a time as the former word.

This resolution has been confirmed by a general meeting of the Society, who agree with the Council in thinking that the term "micromētre," proposed by Prof. Rücker, would give rise to considerable confusion from its similarity to "micrometer."

FRANK CRISP, Secretary.

Royal Microscopical Society, June 21.

A Prognostic of Thunder.

AMONG prognostics of thunder given in books and elsewhere I have never met with mention of what has for years been to me one of the most trustworthy of weather signs, viz. the formation of *parallel streaks or bars*, definite in form but limited in number, extent, and persistence, appearing chiefly in cirrus and cirro-stratus, but also on the surface (apparently) of nimbus. In cirrus they give often almost the first intimation of coming change after settled weather, and are almost, if not quite, invariably followed within twenty four or thirty-six hours by thunder. When they appear on nimbus the interval is much less, but they are not seen, I think, on the thunder-cloud itself. These small patches of definitely marked "parallel bars" are to be distinguished from the more general parallel arrangement which is often seen on a much larger scale, but which has not, so far as my observation goes, any very distinct value as a weather prognostic.

As the thundery season is now on, it would be interesting to have the observation confirmed by others, and the connection of this particular form of cloud with electric disturbance explained. I have no doubt of the fact, and have often, and several times within the present year, pointed out these "parallel bars" to friends who had never observed them, and hardly ever has my prediction of thunder failed to come true. In the very few cases in which thunder has not followed in the same locality, I think I may say that there have never been wanting instances of its occurrence within a moderate distance. B. WOODD-SMITH.

Branch Hill Lodge, Hampstead Heath, June 29.

Parasites of the Hessian Fly.

ALTHOUGH numbers of these most useful insects were bred last year from puparia of 1886 and 1887, there seemed to be a good deal of doubt among some entomologists as to whether the American species, *Merisus destructor*, had occurred. I bred a large number of various kinds, four of which appeared to me to agree in every respect as to form, colour, and marking with the description given by Prof. Riley.

During the present month (June) I have bred a very large number of this parasite, specimens of which (both male and female) I sent to Dr. Charles Lindeman, of Moscow, who has just replied that "the specimens of parasites sent, bred in England from the Hessian fly, seem to me to be *Merisus destructor* of Riley, &c." He thus fully confirms my opinion of last year, that the American parasite had occurred here. Early in the spring I bred several other parasites which, I am much inclined to think are *Platygaster herrickii* of Riley; and, if this is correct, it strengthens the opinion that part of the attack came from America.

The damp muggy weather appears to be decidedly favourable for the development of "the pest," the larvæ of which I found at the beginning of this week engaged in weakening the stems of barley; and on June 2 I observed a female Hessian fly ovi-positing. The number of eggs laid was 158! Truly a most prolific "pest," requiring both natural and artificial means to check its increase. F. E. S.

Fact and Fiction.

AS Mr. Grant Allen reads NATURE,—indeed this is evident from a sentence in his novel "This Mortal Coil," now in course of publication in *Chambers' Journal*—he will perhaps be good enough to satisfy my doubts upon the following practical points in electro- and thermo-physics. Firstly, in order to successfully attract a flash of lightning to a tree, is it necessary to bury beneath its roots a Rhumkorf coil? Secondly, do Rhumkorf coils exist which are *without* secondary wires? Thirdly, will an electric discharge ignite commercial petroleum oil?

While it is not undesirable that scientific fact should be imported into modern fiction, it is surely important that it should be fact: loose statements are apt to perpetuate themselves.

Mr. Allen is exceptionally well read and observant, and I am quite at a loss to understand why a simple solution of continuity in that part of his copper conducting wire which was immersed in the petroleum would not as well have served his purpose (if indeed, that purpose could have been effected in the way described), as the elaborate expedient of burying and destroying an expensive piece of apparatus.

Dublin, July. HARRY NAPIER DRAPER.

The Nephridia of Earthworms.

THE number of NATURE published on June 28 last contains (p. 197) an interesting paper by Prof. Baldwin Spencer, which deals with the excretory system of the gigantic Australian earthworm *Megascolides*. Prof. Spencer promises an extended memoir upon the anatomy of this earthworm, which has not hitherto received more attention than a superficial description. In the meantime the paper in NATURE contains an abstract of the results obtained by the author from his investigation of the nephridia.

This paper is particularly interesting to myself, as I am at present preparing an account of some further investigations into the anatomy of the excretory system of earthworms, which will supplement those already published by me in the *Quart. Journ. Micr. Sci.* (January 1888).

It appears from Prof. Spencer's paper that, as he himself points out, there is a considerable resemblance between the excretory organs of *Megascolides* and of *Perichæta aspergillum*, one of the species investigated by me; there are at the same time certain important differences between the two types.

In my paper upon *P. aspergillum* I described only the nephridia of the anterior segments of the body. I have since found that the nephridia of the posterior segments are in some respects different. In both cases, however, the external orifices are more numerous than I was at first inclined to suspect. They are not limited to the area of the segments which lie between the setæ, but are found all over the body, scattered irregularly; *they have, in fact, no relation whatever to the segmentation of the body.*

The tufts of tubules in the posterior segments of the body are not so abundantly developed as in the anterior segments, where they not only form a layer covering the body-wall and septa but occupy nearly the whole of the cœlomic space available.

Again, *they are furnished with numerous ciliated funnels*; I have not detected them in the nephridia of the anterior segments, but they have been possibly overlooked. These funnels are very abundant; for example, I counted five in one section on one side of the body. Some of them are distinctly larger than others; the larger ones were occasionally observed to be connected with a duct which perforated the septum and joined the nephridia of the segment behind.

In the posterior segments there is a distinct tendency for the nephridial system to become broken up into isolated clumps. It by no means always happened that this tendency to segregation was in relation to the metamerism of the body. On the contrary, the tufts are scattered irregularly in the segments; and the intersegmental septa do not always isolate the nephridial tufts which are connected by intraseptal tubules.

In fact the nephridial system of *Perichæta* and *Megascolides* forms a strong support for that view of the origin of the segmented from the unsegmented worms that has been so ably argued by Arnold Lang.

With regard to the ciliated funnels of *Perichæta*, it is right to mention that they have been already observed by Dr. Benham in a species from Luzon, though no description has been published. Prof. Spencer has made the observation that in the posterior region of the body of *Megascolides* there are a pair of much larger nephridia, which are furnished with a ciliated funnel opening into the segment in front of that containing the nephridium. He believes that these have arisen from the smaller nephridial tufts, and that from them are derived the paired nephridia of such earthworms as *Lumbricus*. I am quite disposed to agree with Prof. Spencer with regard to these points. I had already made some observations upon another earthworm which exhibits a closely analogous structure.

In *Perichæta aspergillum*, as I have mentioned above, some of the ciliated funnels are larger than the others, and are connected with a nephridial tuft lying in the segment behind that which contains the funnels. I could not, however, notice a very marked difference in the size of the nephridial tubules themselves.

In another species of *Perichæta*, viz. *P. armata*, which was characterized some years ago (*Ann. Mag. Nat. Hist*, 1883) by myself, the nephridial system is rather different from that of *P. aspergillum*. Mr. W. L. Sclater, of the Calcutta Museum, has kindly sent me some specimens of this worm which were well preserved. The worm has been lately re-described by Dr. D. Rosa (*Ann. Mus. Civ. Genova*, 1888), who states that each segment contains a pair of nephridia, opening internally by a funnel which lies in the segment anterior to that which contains the nephridium. So far Dr. Rosa's description is accurate, but there are also innumerable tufts of minute tubules which may or may not be provided with funnels. *These appear to be for the most part quite distinct from the large pair of nephridia.* The calibre of the tubules of the large nephridia is many times greater than that of the small tufts. The latter open by numerous orifices on the exterior.

In the present state of our knowledge it appears to me permissible to derive the paired nephridia of *Lumbricus*, &c., from the network of *Perichæta* in two ways, which may both have actually taken place:—

(1) By the gradual development of a pair of large nephridia, in the way suggested by Prof. Spencer, out of the minute nephridial network, and the gradual disappearance of the latter (which is in the process of disappearance in *Perichæta armata*).

(2) By the gradual breaking up of the nephridial network into tufts of tubules specially connected with the setæ, as in *Acanthodrilus multiporus*, and by the disappearance of all but two of these. Dr. Benham's interesting form, *Brachydrilus*, which has two pairs of nephridia in each segment, offers an intermediate condition in this reduction.

To assume that the ordinary condition of the nephridial system of earthworms has been derived in these two ways, renders the mutual affinities of certain earthworms easier to understand. For example, *Perionyx* (which is so nearly allied to *Perichæta* in most respects, but differs in having nephridia of the *Lumbricus* pattern) may have been derived from *Perichæta* directly *via* some such form as *P. armata* without having passed through an "*Acanthodrilus* stage"; again, *Deinodrilus*, which is intermediate in many characters between *Perichæta* and *Acanthodrilus*, is also, as I shall hope to show later, intermediate in the arrangement of its nephridia, and may therefore represent a stage in the evolution of *Acanthodrilus*.

Zoological Gardens, N.W. FRANK E. BEDDARD.

THE "AVOCET" ROCK.

THE circumstances attending the loss of the s.s. *Avocet* and *Teddington* towards the southern end of the Red Sea in the year 1887, and the subsequent finding of the small coral patch on which it is probable they both struck, are of interest, and deserving of record as showing the necessity for very close examination of seas where corals flourish, and the difficulties experienced in finding a small patch at a distance from land, when neither discoloration nor break of sea aid the searcher. It should be premised that the area between the Zebayir Islands and Jebel Zukur, in which this rock lies, had never been properly sounded, only a few scattered depths having been obtained. It is crossed yearly by hundreds of steam-ships—the majority of them British—and has always been accounted as deep, safe water.

On the 4th of March the *Avocet* was steaming southwards—with another steamer, the *St. Oswald*, with which she had kept company for some hours, not far from her—a strong head-wind and heavy short sea prevailing at the time. At about 8 a.m. a shock was felt, succeeded by two others, and shortly afterwards water was found to be coming in. It being evident that the ship would go down, the *St. Oswald* was signalled, and after a little time the crew of the *Avocet* were taken off by her, and the latter sank. A Court was held at Aden, and the evidence taken before it showed that the shock had been slight, one witness stating that he thought something had gone wrong in the engine-room; and another, that it was a heavy sea that had struck the ship. The verdict was that the ship had struck on an unknown rock in latitude 14° 21′ N., longitude 42° 38′ E., the position given by the master. No evidence was given to prove this position; but the fact of the *St. Oswald* being in company, and of other steam-vessels passing on either side of the two ships both just before and just after the accident, seemed to show that they must have been in the straight track, and that the position was not far wrong in longitude at any rate. H.M. surveying-ship *Flying Fish*, arriving at Aden shortly after the inquiry, spent some days on the suspected ground, and found nothing but deep water, over a hundred fathoms being found in the position given.

Those who have the responsibility of the issue of charts for the guidance of navigators may be pardoned if they are extremely sceptical and difficult to convince in the matter of new rocks in the great highways of traffic. So many instances occur of reports which on investigation prove to be erroneous—sometimes in the whole, sometimes in part (as of the position, for instance)—that very good evidence is required before a report, which seems in itself improbable, can be accepted, and one of Her Majesty's ships sent—perhaps from a long distance, and from other important duties—to spend many days in a search. In this case there was no doubt of the ship having foundered; but the cause of the disaster was somewhat doubtful, and her position was unsubstantiated. It was evident, however, that if she had struck bottom it must be a very small rock, as the presence of other vessels prevented the supposition of a wrong course.

The *Avocet* was partly laden with railway iron, she was pitching in a heavy sea, and the evidence of external injury was not convincing. Altogether it seemed more probable that some of this heavy material had fetched way and injured the ship from inside than that a rock could exist in the very track of the heavy trade of the Red Sea. The Admiralty therefore announced that they would order no further search until these points were cleared up, and the Board of Trade consented to order a further inquiry.

The witnesses were collected, and the Court sat on June 10, but before any further proceedings could take place a telegram was placed in the hands of the President announcing that the s.s. *Teddington* had foundered after striking an unknown rock 5 miles north-east of the *Avocet's* rock, or in latitude 14° 23′ N., longitude 42° 42′ 30″ E. This seemed sufficient, and the Court dissolved without any attempt to cross-examine the *Avocet's* officers on her position. The Admiralty telegraphed for a ship of war to proceed from Aden to examine the spot. The *Griffon*, therefore—whose captain had sat on the Court held there, and had concurred in the finding that the *Teddington* had struck on an unknown rock—spent over a week in traversing the area including both positions, sounding and dragging a chain cable suspended from her quarters, but found no sign of shallow water or rock. On her return to Aden, a fisherman announced that he knew the rock, and the *Griffon* returned with him, only to find that his rock was a well-known one 40 miles from the spot required.

Any further action was then suspended until the full report of the *Teddington* disaster was received. The official report of the Court held at Aden was long before it arrived in England, though the protest of the master was received before many weeks.

This stated that the *Teddington* was on her way north, and on June 9, at 6 a.m., she passed 5¼ miles eastward of Abu Ail, where she got a good position and the error of her compass, and thence steered to pass 5 miles east of the position given for the *Avocet* danger; calm, and weather fine. At 8.30 she struck heavily, nothing being seen under the stern, and no land in sight. Course was at once steered to the south-west, into the track of steamers, when the s.s. *Cairo* was met with, and the crew taken off, the *Teddington* foundering shortly afterwards. The master gave his position as in latitude 14° 24′ 30″ N., longitude 42° 42′ 30″ E., or 1½ mile north of the telegraphed position; but cause was afterwards seen to prefer the latter.

A statement was shortly after received from another ship that they passed the *Teddington*, abandoned and low in the water, at a time four hours later than that given for her foundering. This contradiction seemed to require explanation.

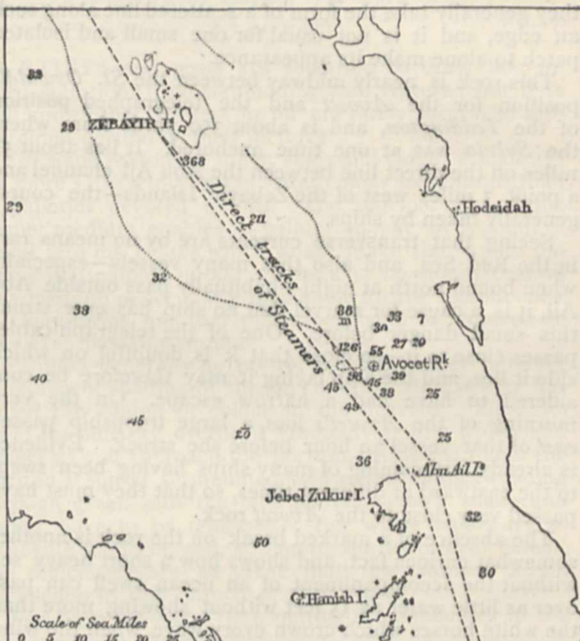
Before the official report arrived, the master of the *Teddington* called at the Admiralty by desire on August 4, and gave his account by word of mouth. His relation was so straightforward, and it was so evident on cross-examination that the ship had been navigated with great care, that it was clear that another and closer search must be made. Captain Free explained that the *Teddington* had been lost sight of in the haze, as the *Cairo* steamed away; and that it was believed she had then sunk.

The position now given, being 5 miles from the straight track that steamers usually endeavour to follow, gave much more probability to the existence of a rock than the *Avocet's* report, which placed it exactly in that direct route. Orders were therefore at once sent to H.M. surveying-vessel *Sylvia*—then in the Mediterranean—to proceed to the spot, and institute a minute search early in October, when the climatic conditions are most favourable to that work.

In September a reply was received to inquiries made of the master of the *St. Oswald* as to the position of his ship when signalled by the *Avocet*. This showed that the *St. Oswald* had found, when Jebel Zukur was sighted, that she was considerably to the eastward of the correct course, and that the position given by the *Avocet* was some four miles in error. The position now given was 14° 21′ N., 42° 41′ E., placing the *Avocet* within 1½ mile of the *Teddington's* danger. This greatly strengthened the evidence, and showed that a general strong cross-set must have existed on the morning that the *Avocet* was lost, sweeping the whole trade to the eastwards.

Unfortunate occurrences delayed the *Sylvia*, and when she arrived on the scene, the strong southerly winds had already set in. Nevertheless, a close search was accomplished, especially of the ground embracing the two best positions of the *Avocet* and *Teddington*, and extending far on either side. Six weeks were spent in this search, but no danger nor considerable shoaling of the water could be found. The heavy sea which caused her to part her cable, carry away anchor stocks, and do other damage, and also placed considerable difficulties in the way of marking the area with beacons, seemed also to afford a means of sighting the rock—had it existed—by the break that would probably be seen on it. When, however, the chart of the search was received, it was noticed that in one spot, nearly midway between the *Avocet* and *Teddington* positions, there was a slight shoaling of the water; a small area of 28 and 30 fathoms existing among the general depths of 35 fathoms. The *Sylvia* had anchored on this, and had commenced to search it carefully with the boats, but the freshening gale drove her from her anchors before the whole area was examined.

The indication afforded by this area, the slope of the sides of which was only a few degrees, was very slight,



but it was evidently necessary to re-examine it before it could be certainly stated that no small danger existed. H.M. surveying-vessel *Stork* was therefore directed to make a fourth search on her way to the East Indies.

Steering out from the mainland to the eastward, the *Stork* struck a depth of 28 fathoms at 8 a.m., April 25; but passing over it, the spot was not again found until late in the afternoon. The ship was then anchored with a light anchor in 26 fathoms of water, and the boats began to search. Just before dusk 6 fathoms was found. The night was luckily fine, and next morning the search was renewed, concluding in finding—not 100 yards from the ship—a small coral mound on which in one spot was a depth of only 15 feet at low-water summer level of the sea. Before, however, the examination was quite complete, the wind suddenly freshened, causing the ship's anchor to drag, and the ship to drift directly towards the rock. To clear this the cable had to be slipped, and the *Stork* thus narrowly escaped passing over the rock that she had just found.

The position of the rock is in latitude 14° 22′ 8″ S., longitude 42° 41′ 32″ E., 18 miles from the island of Jebel Zukur, and the same from the eastern shore of the sea, and out of sight of land except in clear weather, when Jebel Zukur is visible. The dangerous portion of the rock is only about 40 yards in diameter, but the soundings round for about 100 yards give indications of its presence.

Its slope is not so very steep as in some other instances of coral banks in this sea. Assuming that coral after it attains within a certain distance of the surface grows mainly outwards, and that the almost perpendicular sides of some of the Red Sea reefs are mainly the result of such outward growth, the comparatively gentle slope of the *Avocet* rock may be taken to show that it is in an early stage of its development; a view which its small size also supports.

The rock lies on the bank of soundings on the eastern side of the deep-water gully up the centre of the Red Sea, near its edge, and close to the point where it comes to an end. It has frequently been noticed that coral patches most readily form on the edges of such steep submarine slopes—witness other parts of the Red Sea itself—but they generally take the form of a scattered line along such an edge, and it is not usual for one small and isolated patch to alone make its appearance.

This rock is nearly midway between the *St. Oswald's* position for the *Avocet* and the telegraphed position of the *Teddington*, and is about 350 yards from where the *Sylvia* was at one time anchored. It lies about 5½ miles off the direct line between the Abu Ail channel and a point 3 miles west of the Zebayir Islands—the course generally taken by ships.

Seeing that transverse currents are by no means rare in the Red Sea, and also that many vessels—especially when bound north at night—habitually pass outside Abu Ail, it is a cause for marvel that no ship has ever struck this small danger before. One of the telegraph cables passes close to it—so close that it is doubtful on which side it lies, and the ship laying it may therefore be considered to have had a narrow escape. On the very morning of the *Avocet's* loss, a large troopship passed *east* of that vessel an hour before she struck. Evidence is already forthcoming of many ships having been swept to the eastward at different times, so that they must have passed very close to the *Avocet* rock.

The absence of a marked break on the rock is another somewhat curious fact, and shows how a short heavy sea without the accompaniment of an ocean swell can pass over as little water as 15 feet without showing more than the white horses which crown every wave when the wind is strong.

MAGNETIC STRAINS.

It has long been known that when an iron rod is magnetized its length is in general slightly increased. This phenomenon was first studied by Joule about the year 1847, and most of his experimental results have been confirmed by other physicists, among whom may be mentioned the names of Tyndall, Mayer, and Barrett.

Joule enunciated the law that the elongation of a magnetized rod is proportional to the square of its magnetization, a law which seems to have been pretty clearly supported by his experiments so far as they went. Now, when iron is subjected to the action of continually increasing magnetizing force, a point is at length reached when further increase of the force produces comparatively little effect upon the magnetization. The iron is then, in popular language, said to be "saturated," and is (or until lately was) commonly supposed to have attained a condition of magnetic constancy, so that none of the properties of the metal connected in any way with its magnetism would be materially affected by any increase of magnetizing force, however great, beyond what was necessary to produce saturation.

Joule carried many of his observations up to the so-called "saturation point," and then, perhaps naturally, seems to have assumed that nothing would be gained by going any further, and accordingly discontinued his experiments. It is, however, a somewhat remarkable fact that although his interesting discovery was soon widely known, an account of it appearing in almost every text-book dealing with electricity, while an exhibition of the phenomenon in question became a familiar lecture illustration, yet for the thirty-seven years following the publication of Joule's paper it seems never to have occurred to any experimenter to try what would be the effect of subjecting an iron rod to stronger magnetizing forces than those applied by Joule himself. Perhaps I may be pardoned if I refer to the accidental circumstance which led me to do so.

In 1884, a reprint of Joule's scientific papers was issued by the Physical Society, and I then read, for the first time, his original memoir on the effects of magnetism upon the dimensions of iron and steel bars. I had recently been engaged in an investigation of the heat-expansion of sulphur, changes in the length of rods of that substance being indicated by their action upon a small movable mirror which reflected the focussed image of a wire upon a distant scale; and it struck me that a similar method would be well adapted for the exhibition of magnetic expansions. Wishing to have the satisfaction of witnessing some of these effects, I put together a rough apparatus, in which the mirror principle was applied. The battery employed consisted of five large bichromate cells, the zinc plates of which were immersed in the solution by the action of a treadle, and withdrawn by an opposing spring when the pressure on the treadle was removed. The circuit included the magnetizing coil, a galvanometer, and a contact-key.

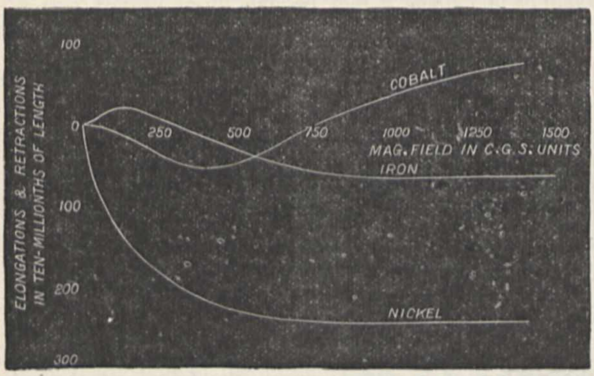
The first results of experiments made with this apparatus were disappointing. Everything appeared to be quite right: the mirror worked perfectly, as was shown by its deflection when the temperature of the iron rod was slightly varied; the iron was well annealed, and there could be no doubt that the magnetizing force used was more than sufficient to "saturate" it (in the popular sense). Yet the elongation indicated when the circuit was closed was only a small fraction of what had been expected, the movement of the focussed index upon the scale being, indeed, scarcely perceptible.

The arrangement was varied in several details, and further attempts were made, but without any better success. In these perplexing circumstances I happened to remove my foot from the battery treadle while the contact key was still depressed, and at the moment of doing so I noticed a curious "waggle" of the focussed image. A movement of the same kind was found upon trial to occur if the zincs were lowered into the liquid while the key was down. The operation was then performed very slowly, and the exact nature of the waggle became clearly revealed. As soon as the zinc plates touched the surface of the liquid the index immediately jumped into a position indicating a certain small elongation of the magnetized rod. As the zincs went in deeper, this elongation at first steadily increased, but only up to a certain point, after which it was *diminished;* and when they were completely immersed in the liquid, the focussed index had returned nearly to the zero position, showing that the elongation had almost entirely disappeared. When the zincs were again slowly raised, the same cycle of changes occurred in inverse order.

The conclusion obviously suggested by these observations was one that could not be readily accepted. It appeared as if the magnetizing force which had been used in the first instance was *too great* to produce Joule's effect, and that it was only when the current was diminished by increasing the resistance of the battery that the elongation of the iron became well developed. This view clearly involved the assumption that the common notions as to magnetic saturation must be at least in part erroneous, and I therefore endeavoured to find some other explanation of the apparent anomaly. In particular, I suspected that it might be due to electro-magnetic action of the kind known as "solenoidal suction" between the iron rod and the coil; but a few careful experiments convinced me that, although this might well have been the case, yet in fact it was not so. Nor did any other hypothesis present itself which would bear examination, and I accordingly fell back upon the first and natural interpretation of the facts, which implies that magnetizing force may exert an important molecular influence upon iron even when its magnetism is saturated.

A fuller investigation of the phenomenon was then made with very delicate apparatus and greater battery power, and the results were communicated during the next year to the Royal Society, the principal conclusion arrived at, so far as regards iron, being the following: When an iron rod is subjected to a continually increasing magnetizing force, its length at first increases to a maximum and then diminishes, ultimately becoming actually *less* than when the rod is unmagnetized.

I have since published accounts of further experiments, and amongst others of a series in which iron rings



surrounded by magnetizing coils were used instead of straight rods. The changes produced by magnetization in the diameter of the rings were of exactly the same nature, showing conclusively that the effects before observed could not have been due to any unexplained action of the ends of the rods.

By the kindness of Mr. W. H. Preece, F.R.S., who placed at my disposal the large secondary battery used in lighting his house at Wimbledon, I have recently been able to repeat some of my experiments with magnetic fields of exceedingly high intensity. Rods of iron, nickel, and cobalt were thus tested, and the results are clearly shown in the accompanying curves, where the abscissæ represent the magnetic fields due to the coil in C.G.S. units, and the ordinates the elongations and retractions of the rods in ten-millionths of their lengths.

The retraction of iron, it will be seen, becomes ultimately greater in amount than its maximum elongation, and reaches a limit in a field of 1000 or 1100 units, after which its curve becomes sensibly parallel to the horizontal axis. Nickel, unlike iron, retracts[1] from the very commencement, rapidly at first and afterwards more slowly, until in fields of 800 units and upwards its length becomes apparently constant. Cobalt behaves in a very remarkable manner. While the field is comparatively weak, no sensible change in either direction can be detected. After about 50 units of magnetizing force, the rod begins to contract, attaining its minimum length with 300 or 400 units. But instead of remaining unchanged in fields stronger than this, it again becomes longer. At 750 it regains its original length, and thence up to 1400, the highest field reached in the experiment, it continues to elongate steadily.

It should be understood that so far as mere details are concerned the curves in the diagram relate only to particular specimens of the metals in question. With different rods there will be certain small variations, dependent upon the purity of the metals and their physical condition. But I have always found that under increasing magnetizing force iron is at first extended and then contracted, nickel is contracted from the beginning, while cobalt is first contracted and afterwards extended.

My best thanks are due to Mr. Preece, not only for having given me the opportunity of carrying out the experiments described above, but also for the exceedingly kind and cordial manner in which he did so.

SHELFORD BIDWELL.

[1] The retraction of nickel under magnetization was first observed by Prof. Barrett (NATURE, xxvi. 585).

A METEOROLOGIST AT THE ROYAL ACADEMY.

ARTISTS and poets are supposed to draw their inspirations from communing with Nature; but it is well known that painters in oil are rarely successful with the cloud portion of their pictures.

For some reason or other, skies and clouds are always far more satisfactory in the water-colour exhibitions than in galleries devoted to oils. The transparency of the former medium enables a painter to put an amount of detail into his clouds which would make the sky far too heavy if attempted in oil; so there is no doubt that oil as a medium is peculiarly unsuitable for the reproduction of cloud-forms, and that the utmost skill is required to give even passable results.

Painters generally do pretty well when they only try to represent shading of the sky, or what Mr. Lockyer has called the zoning of colour in the heavens. They can paint the blue sky overhead gradually getting whiter and grayer as you approach the horizon, or the red round the horizon at sunset surmounted by a zone of orange shading through green into the blue above, as only shade and colour have to be rendered. But when artists try to delineate the form, and, still more, the texture, of clouds, the difficulties are so great that few painters attain excellence in this branch of their work.

Few have yet learnt that, putting the difficulties of the medium aside, the structure of a cloud has an anatomy as definite as that of a man; and that the perspective of cloud-forms obeys the same laws as that of bodies on the earth's surface. Everybody paints ordinary objects so as to show a characteristic texture or structure: the silk dress, the woollen carpet, the wooden floor, are all carefully distinguished; but how many realize the essentially different structure of cloud-forms—the hairy cirrus, the lovely fleecy sky, or the rocky masses of cumulus? Nobody would dare to draw a building, a road, or a tree out of its due perspective; but many seem to think that the forms and distances of the sky can be rendered by daubing white and blue and gray promiscuously over the canvas.

The chapters on clouds in Mr. Ruskin's "Modern Painters" sin against every canon of literature. They are disjointed, discursive, irrelevant, and wander into many by-paths; for one note brings in the causes of the failure of the Reformation in Germany, and the whole ends with a commentary on the nineteenth Psalm. But, in spite of all this, they preach in brilliant and poetic language the two great truths that clouds have distinctive characteristic structures, and that their perspective must be as carefully drawn as that of a building. In one of the illustrations—that of the tower of Beauvais Cathedral in front of a thundery sky—is the finest delineation of cloud in line that has yet been produced; and though Mr. Ruskin's writings have had a powerful influence on contemporary art in England, the following notes on the pictures now hanging on the walls of the Royal Academy will show that much still remains to be done before British artists have exhausted the possibilities of cloud-painting.

The great landscape of the year is undoubtedly Sir J. Millais' "Murthly Moss" (No. 292), and readers will naturally ask, Is the sky good? The answer is, unequivocally, Yes. Our great artist has selected a somewhat rare form of sky, but one which is most useful in giving distance and perspective to a picture. As a whole, the sky is covered with a sheet of thin flat cloud; but, while the top of the picture appears uniform, the sky lower down looks as if it were composed, or made up, of parallel bars, which get thinner and thinner as they approach the horizon.

If a series of disks stretched in a line from nearly overhead to the horizon, at a uniform height of about 10,000 feet, we should see the whole under-surface of those overhead; and progressively less and less, till on the horizon the thin edges of the disks only were visible, like straight bars. This is exactly what happens in Nature when a thin flat sheet of cloud is broken into irregular flakes. Above, there is only visible the flat, formless under-surface, while in the distance the thin edges of the flakes appear more and more like bars. Thus the picture of the sky alone gives instinctively the idea of retreating distance.

Turner, curiously enough, hardly ever painted cumulus, but almost always a coarser form of this flaky sky growing into thinner and thinner bars towards the horizon; and I have seen pictures by Mr. Leader, in which the same device was used for giving distance, with great effect. In Millais' picture the artist has painted the sky with consummate skill, true to Nature, and true to art in not destroying the balance of relative distance.

Another important landscape is No. 102, Mr. G. Boughton's "A Golden Afternoon." But in this the sky is scarcely satisfactory. The clouds are rather spotty, but yet not of the kind which come in flocks of little cloudlets; and it is difficult to make out either the precise form which it is intended to delineate, or the perspective of the whole sky. The reproduction of representative structure is simply nowhere, for at a distance neither form nor structure are discoverable; while close at hand the brush-marks are so apparent that the lower clouds appear to have a fibrous structure. This would be practically impossible, for though the summit of a rocky cumulus is often combed out into hairy cirrus, the rest of the cloud remains firm, and this would not occur on "a golden afternoon."

Mr. Leader can be complimented on sending three first-rate skies in the three pictures which he contributes to the exhibition. In No. 408 he not only paints "An Old English Homestead," but also a truly English sky. A wisp of cirrus floats over a well-painted cumulus, while the ideas of relative height and distance are well given. Cloud forms are essentially the same all over the world, but the details differ; and if the sky in this picture were alone, I could say that it was nowhere in the tropics, but somewhere in a temperate zone. In No. 638, "A Summer Day"—

"When the south wind congregates in crowds
The floating mountains of the silver clouds"—

Mr. Leader again paints the same kind of sky very beautifully; but in No. 421, over "The Sands of Aberdovey," he gives a totally different type of cloud. Here the clouds float as a thin white fleece on the sky, with some small raggy, evaporating cloud of a totally different structure at a lower level. The effect is very striking, and the accurate drawing of the forms gives height and distance to the picture.

Mr. V. Cole's "The Pool of London" (No. 350) has been purchased under the Chantrey bequest. This is a large, fine picture, in which the artist has employed a device for giving distance that was sometimes used by Turner. A dark mass of cumulus cloud on either side of the sky leaves a sort of bright vault running down the centre, in which high white clouds lead the eye to the dome of St. Paul's in the distance. The painting of all the clouds, and the effect of their floating at different levels, are very good; but somehow the scale of distance in the picture is scarcely satisfactory. Artists are conventionally allowed to diminish the size of objects in the foreground, and to increase that of distant objects so as to improve the effect; but the modern eye, which is trained to the accurate projection of objects at different distances given by photography, knows that in this picture the ships in the foreground should be bigger, and the Cathedral dome smaller than they are here delineated.

"Then came the Autumn, all in yellow clad," is the poetic title of Mr. G. Lucas's picture (No. 342). A beautiful, finely-painted shower-cloud, in the shape of a rising, driving cumulus, gives such an idea of space and height that it is a pleasure to look at such a truthful transcript of Nature. This is one of the best skies in the exhibition.

Close by, and in great contrast to the above, but fortunately well skied, hangs a small landscape which contains a sky of the worst possible description. White and blue and gray are patched about the canvas promiscuously, regardless of form or drawing or perspective; and the artist seems to consider that any mixture of these colours represents a cloud-covered sky.

Artists do not often break a lance with men of science, but Mr. J. Brett has run a tilt against the astronomers and geologists. One of his pictures of this year is an ambitious subject—"The Earth's Shadow on the Sky: the Rising of the Dusk." A short time after sunset in fine weather, the shadow of the earth appears to rise from the eastern horizon, like the segment of a leaden-gray arch; but there is little to suggest this on Mr. Brett's canvas, though the general effect of the picture is very pleasing. A bright green sea fills up the foreground, then comes a line of gray mist in shadow, with blue hills above; while the zoning of a gilded sunset sky from red through orange to blue is very skilfully handled. But the low mist is more characteristic of sunrise than sunset; and the sky appears to us very bright to be opposite the sun. This artist also shows a well-painted shower-cloud in "A Heavy Squall off the Start Lighthouse," and a confused cumulus in a slightly finished work entitled "The Bristol Channel."

In "Nearing the Needles—Return of Fine Weather after a Gale," Mr. H. Moore exhibits a pretty picture, with a lovely sea and sunlit chalk cliff; but the clouds are not very well defined; and are rather soft for the rear of a gale. The Needles appear to lie to the east of the observer, while the sea and ships appear to be running from south-east. If this is so, the sky has far more the character of a north-west than of a south-east wind. Another of Mr. Moore's pictures—"A Breezy Day in the Channel"—brings into evidence the great difficulty of painting clouds carefully, and yet of maintaining the balance of the picture. Here the clouds—irregular cumulus—are very good in form, and beautifully painted; but this careful work makes them so heavy that they appear rather too near. An artist's scale of distance is to a certain extent a scale of distinctness; so that when clouds are painted in minute detail, it is very difficult not to make them appear too near. The same criticism applies to this painter's "Westward," where another beautiful sky, correct both in form and perspective, is a good deal too heavy.

The low, ill-defined cumulus in Mr. Hook's "Low-Tide Gleanings" are not more finished than the rest of the picture, but are correct both in form and drawing; and the same remarks apply to his work, "A Day for the Lighthouse."

"Thanet Cliffs in the Time of Peace," by Mr. S. Cooper, shows a good cumulus with cirrus overhead; but in Mr. C. Hunter's "Fishers of the North Sea" the cumulus cloud is not satisfactory.

Mists on a mountain, with a gray sky, are very well painted in Mr. Faed's "And with the Burden of Many Years," and make an effective background to a striking work of art; while in "The Approach to Bealloch-na-ba" Mr. H. Davis has delineated mountain mist with equally good effect.

Mr. P. Graham's "A Norfolk River" contains a very good showery sky, but the brush-marks give an appearance of fibrous structure which would not be in Nature; while his "Driven by the Wind" contains an effective mass of gray nimbus or rain-cloud.

Mr. W. Shaw paints a good misty yellow-tinted sky in his "Tide Race"; but the great mass of cumulus behind Sir F. Leighton's central figure of the "Captive Andromache" is not very satisfactory.

The sky in "The Old Water-Way," by T. Liddell, is good so far as form is concerned, but is painted so heavily that the clouds look like clods. Philologists say that the word cloud is really derived from clod, but artists should not express that idea in their works. There is a rainbow in this picture, so ill defined that it is difficult to make out the succession of tints; though I think the red is meant to be outside, which is correct.

Mr. R. Rouse's "Pasture-land in Kent" would be much more pleasing if the clouds were more carefully painted, and not so like patches on the sky. In No. 553, Mr. H. Wells is to be complimented on having painted rays diverging from the sun from exactly the proper kind of sky. These rays are rarely seen except through a peculiar, flat, broken cloud; but they are usually associated with a firmer, harder sky than is here depicted.

Lastly, Mr. C. Johnson paints the "Plain of Arundel" under two well-drawn layers of cloud; and Mr. J. MacWhirter has hit off with great skill and accuracy a flat, broken cloud, lit from below by a setting sun, beside the picturesque castle of "Edinburgh."

Such are some of the more notable skies in our great national exhibition of pictures, and it will be seen at once that the best skies are painted as a rule by those who have achieved the greatest success in the other elements which make up a good picture. May we not therefore fairly conclude that part of their success is due to their faithful rendering of skies and clouds; and that it behoves those who wish to attain a high place among landscape painters to study the form, the structure, and the perspective of those clouds which give life, and height, and distance, to every picture? RALPH ABERCROMBY.

THE OXFORD UNIVERSITY OBSERVATORY.

THE following are the principal parts of the Thirteenth Annual Report of the Savilian Professor of Astronomy to the Board of Visitors of the University Observatory, read June 6, 1888:—

I. *Lectures.*—In addition to the requisite statutable lectures, Prof. Pritchard has offered some others of a more elementary and quasi public character on descriptive astronomy, and expressed as far as possible in untechnical language. He has been so much encouraged by the interest manifested in these lectures that he proposes to offer another and perhaps more extended series on the recent speculations as to the origin of the Cosmos from meteoric collision and on matters cognate therewith.

II. *Instruments.*—The De La Rue equatorial is in excellent order; its mechanical mounting is now equal to the delicate purposes of stellar parallax to which it has been uninterruptedly applied during the last twelve months. Although the mirror is perhaps somewhat dimmed with age, its figure, which has been recently tested by comparison with the presumed best productions of the day, retains its original very remarkable character.

The two mirrors mentioned in the last Report have been mounted temporarily on the large equatorial for the purpose of the comparison of their photographic action. An efficient electric control contrived by Sir H. Grubb has also been added with the view of securing the great accuracy necessary in the movement of the telescope. The work for which the mirrors were intended having been completed, they have now been dismounted.

Dr. De La Rue having provided the funds necessary for a photographic telescope of 13 inches aperture and of the pattern suggested at the Paris Conference of 1887, the large equatorial has been sent to Sir H. Grubb at Dublin, for the purpose of attaching thereto the instrument in question, and of carrying out the other considerable alterations necessary for the photographic charting of the heavens, as proposed at the aforesaid Conference.

The transit-circle is in perfect order.

III. *Buildings.* — Mr. Nasmyth has presented his magnificent picture map of the moon for the service of the Observatory. This very beautiful work of art (6 feet in diameter) was completed by Mr. Nasmyth from actual observation with a large telescope of his own construction in 1849.

IV. *Astronomical Work.*—During the past year this has been twofold. In the first place continuous attention has been devoted to the photography of small portions of the heavens with the view of determining the parallax of certain selected stars. In the first instance a careful trial of the method was made on the parallax of 61^1 and 61^2 Cygni, because the parallax of the point midway between the two stars had been determined, with presumedly great accuracy, by Bessel in 1838, whereby effective means of comparing the two methods were supplied. The general agreement of the result obtained from photography with that determined by this most able astronomer, together with the remarkable consistency of the individual photographic measurements, satisfied Prof. Pritchard not only of the great convenience, but also of the unimpeachable accuracy of the method. Dr. Pritchard has consequently much extended these operations for stellar parallax, and before the termination of the present year he hopes that the computation of the parallaxes of altogether some ten or twelve stars will be completed. The list will comprise 61^1 and 61^2 Cygni, μ Cassiopeiæ, and Polaris, which four stars may be regarded as already completed. Three more parallaxes have been *provisionally* determined from observations of *six months*,* viz. α, β, γ Cassiopeiæ; four others also are in a forward state. Experience has suggested that these stellar parallaxes will be most readily and efficiently determined by confining the photographic work on each star to those four periods of the year which, in respect of each parallactic ellipse, are the most effective for the purpose. It should be stated that for the purposes of accuracy four stars of comparison are selected, instead of the two with which astronomers have hitherto been generally contented. This photographic process enables Prof. Pritchard also, without much consumption of time, to measure from night to night the distance between the stars of comparison themselves, thus furnishing a check to the unavoidable variability of the scale of the focal field and of the photographic film. These operations are at present restricted to a systematic catalogue of stars of the second magnitude. It appears that astronomical work like this is well adapted to an Observatory connected with a great

University. It may be interesting to record the results of the computations so far obtained, viz.:—

61[1] Cygni .	0″·4289	±0″·0180	α Cassiopeiæ .	0″·072	±0″·042*
61[2] Cygni .	0·4353	±0·0152	β Cassiopeiæ .	0·187	±0·039*
μ Cassiopeiæ	0·0356	±0·0250	γ Cassiopeiæ	<0·05	±0·047*
Polaris . .	0·052	±0·0314			

The last result is peculiarly interesting, as it seems to furnish an instance where the resources of modern astronomy have arrived at the limits of their present possibility. The total number of plates taken for the purposes of the above investigation is approximately 700, and each plate has been measured with 120 bisections of the necessary stars, amounting altogether to about eighty-four thousand observations. Independently and concurrently with the preceding work Dr. Pritchard undertook for the Photographic Committee of the Royal Society the examination of two silver on glass mirrors of the same aperture but of very different focal lengths, with the view of ascertaining the practical effects of focal length on the photographic field. This work, owing to the temporary character of the mounting and the imperfection of the mechanical movement of the telescope, has been attended with great labour and personal endurance on the part of the observer, but at length it was brought to a successful conclusion, and the results have been communicated to and printed by the Royal Society. The expenses of the instrumental appliances connected with this investigation have been defrayed partly from a grant from the Royal Society, and partly by the generosity of Dr. De La Rue, to whom this Observatory owes so much, not only in the matter of pecuniary aid, but by his kindly encouragement and appreciation of our labours. The general result of the investigation alluded to above is the comparative unsuitability of any mirror for an extensive charting of the heavens, and particularly as regards mirrors of short focal length; but at the same time it leaves no doubt as to their capacity for the singularly accurate delineation of small portions of the heavens, and for such operations as those connected with stellar parallax, or the charting of the moon. Preparations were made for the necessary observations of the lunar eclipse of January 28 of this year; but, as was the unfortunate case with this and many other Observatories, they were rendered ineffectual by a clouded sky.

The above astronomical operations made under Dr. Pritchard's direction were skilfully and sedulously carried out by the two Observatory assistants, Mr. Plummer and Mr. Jenkins.

NOTES.

We learn that Dr. Guppy left England for Batavia on the 30th ult. with the intention of spending some time in the examination of the living and upraised coral reefs of the Indian Archipelago. Mr. John Murray has provided the necessary funds for the first six months of his sojourn in that region, and has directed Dr. Guppy in the first place to make as complete an examination as he can of the geological structure of Christmas Island. Judging from the important notes and collections made by Captain Aldrich and Mr. Lister during the recent visit of H.M.S. *Egeria*, this island would seem to be one of the oldest of the upraised coral islands, and as such it is likely to prove of considerable geological interest. At the last meeting of the Geographical Society, Captain Wharton, the Hydrographer, read a short paper on this subject.

Apparently we have missed our chance of solving the many interesting problems relating to the Antarctic regions. The matter has now been taken in hand by Germany, and we may be sure that she will not fail to carry out the enterprise in an energetic and thoroughly scientific spirit. The expedition is being organized by Dr. Neumayer, of the Hamburg Observatory.

Mr. Jesse Collings is to be congratulated on the result of his efforts to secure for the parish of West Lavington, Wiltshire, the full benefit of the Dauntsey Charity, a part of which the Charity Commissioners proposed to use for the establishment of a High School in some other place in Wiltshire. It is now proposed—with the approval of the Mercers' Company, the principal trustees and patrons of the Charity, who have agreed to undertake a liability of £60,000—not only that the children of the poorer inhabitants of West Lavington shall be provided with an ordinary elementary education, but that a fully-equipped Lower School for technical training in horticulture and agriculture shall be created for their benefit. It is intended that the latter school shall be adapted to the needs of persons who cannot afford to attend such institutions as those at Cirencester and Downton. If the scheme is carried out, land will be provided for the more thorough instruction of pupils, and classes will be formed for the teaching of the various sciences and arts which especially relate to agriculture.

On July 16, Prof. W. E. Ayrton will begin, at the City and Guilds of London Institute, a course of six lectures (to be delivered on Mondays, Wednesdays, and Fridays) on the construction, testing, and use of electrical measuring instruments. This course will include experimental lectures and special laboratory work. The lectures will comprise the principles and practice of the construction, calibration, and testing for faults of ammeters, voltmeters, ohmmeters, wattmeters, coulombmeters, and ergmeters as used for direct and alternating current systems. The students' practical work will be conducted in a laboratory specially fitted with accumulators, standard instruments, &c., for electrical instrument testing; and they will have the opportunity of examining and practically trying all the more important electrical meters at present in ordinary use.

An interesting Exhibition of hygiene and life-saving apparatus has been opened in the Park Léopold at Ostend. The exhibits are divided into the following sections:—Applications of geological, meteorological, and medical science to hygiene, industrial hygiene, maritime hygiene, domestic hygiene, hygiene of infancy, publications relating to hygiene, and life-saving apparatus.

At Messrs. Stevens' Sale Rooms on Monday, the 25th ult., a specimen of *Papilio caunus* from Assam was sold for £10. Mr. William Watkin, of Croydon, was the purchaser.

At the meeting of the Scientific Committee of the Royal Horticultural Society on June 26, Prof. Church contributed a summary of his highly interesting and important researches upon the presence of aluminium in the ashes of plants. This substance, instead of being peculiar to the species of Lycopodium, as once supposed, is found in minute traces in the ashes of very many others, a circumstance not to be wondered at, considering the abundant distribution of the element in many soils. It occurs in all the species of Lycopodium examined, except those which are of epiphytic habit, and which, consequently, do not directly derive their food from the soil. It does not occur in the allied genus Selaginella. It occurs in the ashes of some tree ferns in large proportions, sometimes forming as much as 20 per cent. of the ash, as in *Alsophila australis*, *Cyathea medullaris*; while from others it is all but absent. In the British species of ferns little or no alumina has been found.

At the same meeting Mr. McLachlan called attention to the notion that cold winters are injurious to insects—a notion he stated to be erroneous, although, no doubt, severe alternations of cold, heat, drought, or moisture, were prejudicial to insect life. During the present season it was noticed generally that great destruction of foliage occurred from caterpillars which destroyed the succulent portions of the leaf and tied the framework and fragments together by a web of fine threads comparable with spiders' webs. These caterpillars were different in different cases. In the oak they were species of Tortrix; in the apple the winter moth was destructive; while in other cases the larva of the Ermine moth was exceedingly hurtful to leaves.

THE *American Meteorological Journal*, desiring to attract the attention of students to tornadoes, in hopes that valuable results may be obtained, offers the following prizes:—For the best original essay on tornadoes or description of a tornado, 200 dollars will be given; for the second best, 50 dollars. Among those worthy of special mention 50 dollars will be divided. The essays must be sent to either of the editors, Prof. Harrington, Astronomical Observatory, Ann Arbor, Michigan, or A. Lawrence Rotch, Blue Hill Meteorological Observatory, Readville, Mass., U.S.A., before the first day of July, 1889. They must be signed by a *nom de plume*, and be accompanied by a sealed envelope addressed with the same *nom de plume* and inclosing the real name and address of the author. Three independent and capable judges will be selected to award the prizes; and the papers receiving them will be the property of the journal offering the prizes. A circular giving fuller details can be obtained by application to Prof. Harrington.

THE United States Congress has been discussing the question whether the Weather Bureau should be transferred to the proposed new Department of Agriculture. *Science* advocates the maintenance of the existing system. "The observations," it says, "upon which the Weather Bureau bases its calculations are now all made by enlisted men of the army, who have been specially instructed and trained for the work. No political influence whatever has been allowed to operate for their appointment, promotion, or retention in the service. It has been the aim of the Chief of the Signal Office to send to all important stations men who will be acceptable to the communities in which they are to live and do their work, but no member of Congress has been able to secure the transfer or removal of an observer sergeant in order that some favourite might be put in his place. The security which the observer sergeants have felt for the terms of their enlistment has certainly had a beneficial effect upon the character of the service they have rendered. It may seem an anomaly to the people that a duty that is in no respect of a military character should be done by soldiers rather than by civilians, but the military organization of the Weather Bureau has certainly resulted in keeping political influence from dictating in regard to the *personnel* of a class of men whose appointment and promotion it was very desirable to keep free from this influence."

THE Report of the Director of the Hong Kong Observatory for 1887 shows that the meteorological inquiries are being pushed on with vigour, and that the amount of information collected respecting the typhoons of the past year has been much greater than in previous years. Some of these results have been published in an appendix on the "Results of Further Researches concerning Typhoons"; and another work on the subject, with maps exhibiting the paths of the typhoons, is in preparation. This investigation will throw light on the cause of the frequency of these storms in the China Sea in September, and will enable masters of vessels to escape damage from them, and to make quicker voyages.

WE have received from Dr. Hellmann a very comprehensive and careful discussion of the rainfall of the Iberian Peninsula, being an excerpt paper from the Berlin *Zeitschrift der Gesellschaft für Erdkunde*, vol. xxiii. The principal results of the investigation were communicated to the Berlin Meteorological Society in January last (see NATURE, vol. xxxvii. p. 312). Dr. Hellmann, to whom we are indebted for many laborious inquiries, took advantage of his stay in Andalusia, in 1875–76, to collect all available materials, but found them insufficient for trustworthy results; the present discussion has therefore been delayed until the observations of ten more years could be added. The work deals with the monthly and yearly values for sixty-seven stations, for which a sufficiently long series could be got, and contains a map showing the yearly distribution of rainfall. The yearly and daily periods of rainfall, the monthly and yearly extremes, and the frequency, are also all fully and ably discussed. The annual fall is very various, being no less than 138 inches on the Serra da Estrella, and as little as 11 inches at Lérida, in Catalonia. In the yearly period the minimum fall at all stations occurs in July and August, and the maximum, generally speaking, about May or October, according to locality. Snow falls only in a few of the more elevated districts.

THE vapour-density of sulphur has been re-determined by Dr. Biltz in the laboratory of Prof. Victor Meyer, with unexpected results. It has hitherto been generally accepted that at a temperature (524° C.) not very far removed from its boiling-point (447° C.) the molecule of sulphur is built up of six atoms. This assumption is based upon vapour-density determinations by Dumas and Mitscherlich, who obtained values about this temperature pointing to a hexatomic molecule. However, the work of the last few years upon the chlorides of aluminium, tin, and iron, has opened the eyes of chemists to the fact that the double formulæ Al_2Cl_6, Sn_2Cl_4, and Fe_2Cl_6, resting as they did upon a few experiments performed within a very limited range of temperature, are erroneous, and have no foundation in fact. The older work upon the constitution of sulphur molecules was notably of this class. The experiments themselves were irreproachable, and completed with all the skill for which the experimenters were famous; but unfortunately the temperatures at which they worked were not sufficiently removed from each other, there being only a difference of 27° C. between their maxima and minima. It is now, moreover, a demonstrated law that the existence of molecules of fixed composition can only be assumed when the vapour-density remains constant within a notable interval of temperature. Hence a series of fresh determinations have been undertaken in the case of sulphur. Experiments conducted at 518° in a bath of vaporized pentasulphide of phosphorus by Dumas's method gave values averaging about 7·0, which are nearly coincident with Dumas's own. At the higher temperature of 606°, using a bath of stannous chloride vapour, the density had diminished to 4·7. At 860°, as is well known, sulphur vapour attains the normal constitution of two atoms to the molecule, and the density remains constant for about 200° higher still. Hence, in order to finally set the question at rest, a series of ten determinations were made at intervals of about 10°–15° from 468° to 606°, with the conclusive result that the density regularly diminished from 7·9 at the former to 4·7 at the latter temperature. Hence the notion of S_6 is completely dissipated; there is no more experimental reason for it than there is for the existence of molecules of the constitution S_5 or S_n. None but the value corresponding to the normal composition, S_2, stands the test of interval of temperature, therefore we must conclude that sulphur obeys the usual law, and that its molecules when completely vaporized are each composed of two atoms.

Science says that the logs from the great raft abandoned off the coast of New England a few months ago have drifted in a direction about east by south, and that the greater part of them are now in the region between the 33rd and 38th parallels and the 30th and 50th meridians. The reports lately received at the Hydrographic Office would seem to show that the general drift of the logs has been about east by south, and that most of them are now west-south-west from the Azores. Very few, if any, have drifted north of the 40th parallel. A great deal of timber has been reported further north, to the westward of the 20th meridian, but, from the descriptions given, it does not seem to be a part of the great raft.

In the twenty-first Annual Report of the Provost to the Trustees of the Peabody Institute, Baltimore, it is stated that whereas the number of readers during the past year declined, the number of books used increased. Thus the library "is being gradually converted into that real reference library for scholars which its founder intended to establish." A table included in the Report gives some interesting and suggestive information as to the subjects studied. Antiquities, philology, and theology seem to be the most popular subjects. On the first of these subjects 2894 volumes were read; on the second, 2336; on the third, 2212. Biography comes next; but there were readers for only 1,964 volumes under this heading.

The Register, for 1887-88, of the Johns Hopkins University of Baltimore has been sent to us. In an introductory statement it is explained that this University was opened in 1876; that thus far the Faculty of Philosophy has alone been fully organized; and that the formation of a Medical Faculty has been begun, and will soon receive further development. In the Faculty of Philosophy, instruction is carried on by University methods and by Collegiate methods corresponding with the requirements of students at different stages of their advancement. University instruction is offered to those who have already taken an academic degree, or who have otherwise fitted themselves to pursue advanced courses of study.

From the Report, just issued, of the trustees of the South African Museum for the year ended December 31, 1887, we learn that the condition of the collection generally has been satisfactorily maintained by dint of regular and frequent inspection. The donations during the year numbered 3125 specimens, presented by 78 donors, as compared with 1298 specimens, presented by 58 donors, in 1886. The trustees make an urgent appeal for the extension of the Museum buildings. "Each year," they point out, "has of necessity increased the overcrowding of the very limited available space, and this has now become a most serious hindrance to the usefulness of the Museum, and indeed an absolute barrier to its due development. The trustees have been disappointed to find that their repeated written representations on this important matter failed to meet with the favourable consideration of the Government, as they have thus been placed in the highly unsatisfactory position of inability to promote the normal growth of the institution, or even to insure the proper preservation of much of the valuable public property for which they are trustees."

The annual reports of the Aëronautical Society of Great Britain for the years 1885-86 have been issued in one small volume. Among the contents are the following papers, read at the annual meeting of the Society on December 11, 1886:—Gravity and wind-pressure on auxiliary powers in flight, by Sidney Hollands; balloon-signalling in war, by Eric Bruce; experimental ballooning, by F. W. Breary; an aërial boat, by Mr. Green; and jet-propulsion for aëronautical purposes, by Captain Griffiths.

We have received No. 5 of the first volume, fourth series, of the Memoirs and Proceedings of the Manchester Literary and Philosophical Society. It contains the following memoirs:—Descriptions of twenty-three new species of Hymenoptera, by P. Cameron; a survey of the genus Cypræa (Linn.), its nomenclature, geographical distribution, and distinctive affinities, with descriptions of two new species and several varieties (with two plates), by James Cosmo Melvill; a catalogue of the species and varieties of Cypræa, arranged on a new circular system, in accordance with true sequence of affinity, by James Cosmo Melvill; memoir of the late Prof. Balfour Stewart, F.R.S., by Prof. A. Schuster, F.R.S. To the last of these memoirs a list of the titles of papers by Prof. Balfour Stewart is appended.

A sixth edition of Mr. William Ford Stanley's "Mathematical Drawing and Measuring Instruments" (E. and F. N. Spon) has just been issued. It contains descriptions of twenty-five new instruments mounted or brought out since the publication of the fifth edition ten years ago. Among the instruments invented by the author himself is the oograph, designed for the purpose of enabling oologists to draw eggs of birds in their natural sizes and proportions.

A useful little volume on "Landscape Photography," by Mr. H. P. Robinson, has been issued as one of the series of "Photographic Handy-Books" (Piper and Carter). It consists of letters written to a friend "whose study of photography enabled him to produce a technically perfect negative, but who did not know how to put his knowledge to pictorial use." "They were not intended," the author explains, "to point out a royal road to art, but rather to act as a stimulus to activity in the search for subjects for the camera, and to teach how readiness of resource may help good fortune in turning them into agreeable pictures."

An interesting pamphlet on Pallas's sand grouse, by Mr. W. B. Tegetmeier, has just been issued (Horace Cox). It is illustrated with a coloured plate and woodcuts. "It is greatly to be regretted," says the author, "that a bird so beautiful in its form, harmless in its habits, valuable as an article of food, interesting to the sportsman as a game bird, and to the naturalist as the type of a most singular genus, should not be protected. The present pamphlet has been compiled as an endeavour to make the bird better known, to interest the public at large in the species, and thus, if possible, to aid in its preservation and naturalization as a British game bird."

Science states that Mr. William Walter Phelps has introduced into Congress a Bill to purchase from Stephen Vail, of Morristown, N J., the original telegraphic instrument, or recording receiver, invented by his father, Alfred Vail, and used upon the first telegraphic line ever constructed,—that between Washington and Baltimore,—and to transmit the first message ever sent: "What hath God wrought?" The purchase of this instrument is strongly recommended by the officers of the Smithsonian Institution. The price is ten thousand dollars.

According to an official notification of the Trustees of the Schwestern Fröhlich Stiftung at Vienna, certain donations and pensions will be granted from the funds of this charity this year, in accordance with the will of the testator, Miss Anna Fröhlich, to deserving persons of talent who have distinguished themselves in any of the branches of science, art, or literature, and who may be in want of pecuniary support, either through accident, illness, or infirmity consequent upon old age. The grant of such temporary or permanent assistance in the form of donations or pensions is, according to the terms of the foundation deed, primarily intended for natives of the Austrian Empire, but foreigners of every nationality—English and others—may likewise participate, provided they are resident in Austria. Information as to the terms and conditions of the foundation deeds, &c., may be obtained from the Austro-Hungarian Embassy in London.

The additions to the Zoological Society's Gardens during the past week include two Tasmanian Wolves (*Thylacinus cynocephalus*), two Bennett's Wallabys (*Halmaturus bennetti*), a Black and Yellow Cyclodus (*Cyclodus nigro-luteus*) from Tasmania, nine Silky Bower Birds (*Philonorhynchus violaceus*) from New South Wales, ten Laughing Kingfishers (*Dacelo gigantea*), ten Blue-cheeked Parrakeets (*Platycercus cyanogenys*), two Cereopsis Geese (*Cereopsis novæ-hollandiæ*), seven Maned Geese *Bernicla jubata*), two Black-backed Piping Crows (*Gymnorhina tibicen*), two Lace Monitors (*Varanus varius*), two Gould's Monitors (*Varanus gouldi*), a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi*) from Australia, deposited; a Smooth

Snake (*Coronella lævis*), European, presented by Mr. Walter C. Blaker; a Dark-Green Snake (*Zamenis atrovirens*) from Dalmatia, an Æsculapian Snake (*Coluber æsculapii*), European, purchased; two Triangular-spotted Pigeons (*Columba guinea*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

AMERICAN OBSERVATORIES.—The Trustees of the Lick bequest formally made over the Lick Observatory to the University of California on June 1. The staff of the Observatory consists of Prof. Holden, Director; Messrs. Barnard, Burnham, Keeler, and Schaeberle, astronomers; and Mr. Chas. B. Hill, librarian and assistant-astronomer.

The Lick Observatory is not to be the most elevated of American Observatories. Mr. H. B. Chamberlin, of Denver, Colorado, is providing the University of that city with a new equatorial refractor of 20 inches aperture. The site chosen for the erection of this telescope is 5000 feet above sea-level, some 800 feet higher than the Lick Observatory.

Mr. W. R. Brooks, so well known for his cometary discoveries, has removed to the Observatory provided for him by the generosity of Mr. William Smith, of Geneva, New York. His present address is therefore "Smith Observatory, Geneva, N.Y."

The instruments of the Dearborn Observatory, Chicago, have been dismounted, and the old site abandoned, and a new building is to be erected at Evanston, about 16 miles north and 3 miles west of the old site, and some 250 feet from the shore of Lake Michigan, on grounds belonging to the North-Western University, with which institution the Observatory is in future to be connected, but without affecting its relationship to the Chicago Astronomical Society. The new building, which is to cost about £5000, and which will include a dome and tower for the 18½-inch refractor, a transit-room, library, and about eight other rooms, is the gift of Mr. James Hobbs.

Rochester, New York, has no fewer than seven Observatories, of which the Warner Observatory is the most important.

MINOR PLANETS.—The object discovered by M. Borelly on May 12 has proved to be Sironia, No. 116; the difference between the observed and predicted places being due to the omission of perturbations in the computation of the ephemeris. Herr Palisa's discovery of May 16 thus remains No. 278 as given in NATURE, vol. xxxviii. p. 89, at first. No. 272 has been named Antonia; No. 274 Philagoria.

THE RINGS OF SATURN.—Dom M. Lamey, Director of the Observatory of the Priory of St. John, Grignon, claims to have discovered four new rings around Saturn, outside those previously known. The first of these rings is said to commence at the extreme edge of that now known as the outer ring; the next reaches to the orbit of Enceladus; the third, which is the brightest, touches the orbit of Tethys; whilst the fourth and faintest lies between Dione and Rhea.

The distances from Saturn of the known rings have been measured by M. Perrotin, at Nice, with the following results:—

	Outer limit.	Cassinian division.	Dark ring. Outer limit.	Dark ring. Inner limit.
	″	″	″	″
E. Ansa	11·22	8·50	4·08	1·46
W. Ansa	11·12	8·43	4·07	1·41

with an average probable error for each determination of ± 0″·02. These results agree well with those of Profs. O. Struve and Meyer, except in the case of those in the last column. The distances in the E. ansa appeared almost always greater than those in the W. ansa for the two outer points measured, but the measures of the dark ring are sometimes greater on one side, sometimes on the other. This is probably due to the revolution of the perisaturnium of the dark ring, which would appear to revolve round the planet in an elliptic orbit. The dark line known as Encke's division has not been seen in 1888, though seen in previous years; but on the other hand the inner part of the ring B has shown three faint divisions separating it into three nearly equal parts. The dark ring has appeared of a uniform tint, and no division has been detected in it.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *JULY* 8–14.

(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 July 8

Sun rises, 3h. 56m.; souths, 12h. 4m. 51·1s.; sets, 20h. 14m.: right asc. on meridian, 7h. 12·3m.; decl. 22° 25′ N. Sidereal Time at Sunset, 15h. 23m.

Moon (New on July 9, 6h.) rises, 3h. 16m.; souths, 11h. 25m.; sets, 19h. 36m.: right asc. on meridian, 6h. 32·5m.; decl. 21° 11′ N.

Planet.	Rises.		Souths.		Sets.		Right asc. and declination on meridian.	
	h. m.		h. m.		h. m.		h. m.	° ′
Mercury..	4 30	...	12 7	...	19 44	...	7 14·7	... 17 35 N.
Venus.....	3 46	...	12 1	...	20 16	...	7 8·8	... 23 12 N.
Mars......	13 5	...	18 18	...	23 31	...	13 26·5	... 9 58 S.
Jupiter....	16 6	...	20 30	...	0 54*	...	15 39·0	... 18 38 S.
Saturn....	5 42	...	13 30	...	21 18	...	8 38·2	... 19 9 N.
Uranus...	12 1	...	17 41	...	23 21	...	12 49·8	... 4 39 S.
Neptune..	1 6	...	8 52	..	16 38	...	3 58·7	... 18 51 N.

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

Comet Sawerthal.

July.	h.	Right Ascension. h. m.	Declination. ° ′
8	... 0	... 1 5·2	... 49 22 N.
12	... 0	... 1 6·7	... 50 10

July.	h.	
9	... 5	... Mercury in conjunction with and 3° 34′ south of the Moon.
9	... 5	... Venus in conjunction with and 1° 57′ north of the Moon.
9	... 5	... Mercury in inferior conjunction with the Sun.
9	... 6	... Mercury in conjunction with and 5° 32′ south of Venus.
9	... —	... Partial eclipse of the Sun: not visible in Europe.
10	... 20	... Saturn in conjunction with and 0° 1′ north of the Moon.
11	... 19	... Venus in superior conjunction with the Sun.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·4	... 81 16 N.	... July 10,	21 52 *m*
Algol	3 0·9	... 40 31 N.	... ,, 11,	0 42 *m*
U Monocerotis ...	7 25·5	... 9 33 S.	... ,, 13,	*m*
R Crateris	10 55·1	... 17 43 S.	... ,, 11,	*M*
δ Libræ	14 55·0	... 8 4 S.	... ,, 13,	1 10 *m*
U Coronæ	15 13·6	... 32 3 N.	... ,, 9,	0 1 *m*
U Ophiuchi... ...	17 10·9	... 1 20 N.	... ,, 14,	1 18 *m*
Z Sagittarii... ...	18 14·8	... 18 55 S.	... ,, 12,	1 0 *M*
R Scuti	18 41·5	... 5 50 S.	... ,, 10,	*M*
S Sagittæ	19 50·9	... 16 20 N.	... ,, 9,	1 0 *M*
X Cygni	20 39·0	... 35 11 N.	... ,, 10,	23 0 *M*
T Vulpeculæ ...	20 46·7	... 27 50 N.	... ,, 10,	22 0 *M*
			,, 11,	23 0 *m*
W Cygni	21 31·8	... 44 53 N.	... ,, 8,	*m*
δ Cephei	22 25·0	... 57 51 N.	... ,, 7,	0 0 *m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near 102 Herculis ...	271°	... 21° N.	... Very slow.
	283	... 14 S.	... ,,
,, π Cygni	330	... 35 N.	... Swift. Red streaks.
	352	... 38 N.	... Swift.

ELECTRICAL NOTES.

PROF. NICHOLS, of the Cornell University, has suggested the use of carbon and copper combined to form a compensated resistance standard. The resistance of metals increases with temperature, but that of carbon diminishes. The movement of copper is + 0·384, that of carbon − 0·0235 per cent. per degree Centigrade. For every ohm of carbon, 11·544 ohms of copper are needed to secure complete compensation for temperature.

Prof. Nichols electroplates a strip 1 millimetre wide of the carbon rod parallel to the axis with copper to the required thickness. The influence of temperature up to 100° C. is then entirely imperceptible.

MESSRS. GLAZEBROOK AND FITZPATRICK have once more utilized the resources of the Cavendish Laboratory to determine the specific resistance of mercury, and therefore the value of the ohm (10^9 C.G.S. units of resistance). The result, together with the most recent determinations, is given in the following table:—

Observer.	Date.	Value of Siemens unit in B.A. units.	Value of ohm in centimetres of mercury at 0°.
Lord Rayleigh and Mrs. Sidgwick ...	1883	0·95412	106·23
Mascart, Nerville, and Benoit... ...	1884	0·95374	106·33
Strecker	1885	0·95334	106·32
L. Lorentz	1885	0·95388	105·93
Rowland	1887	0·95349	106·32
Kohlrausch	1888	0·95331	106·32
Glazebrook and Fitzpatrick	1888	0·95352	106·29
Wuilleumier	1888	0·95355	106·27

The specific resistance of mercury at 0° C. is therefore 95352 C.G.S. units.

THE mean of the values in centimetres of mercury—106·3—omitting Lorentz's, must be considered a very close approximation to the true ohm. We thus have

B.A. unit	104·808 cm.
Legal ohm	106
Ohm	106·3

The B.A. unit is thus 1·347 per cent. wrong.

WHAT is the specific resistance of pure copper? is a curious question to ask in 1888, but Mr. G. P. Prescott asks it in the *Electrical Engineer* of New York. He points out that Ayrton gives it as 1·599, and Stewart and Gee 1·616, legal microhms, at the same temperature, 0° C. He also shows that Matthiessen and Jenkin did not agree; they differed 2·3 per cent. Messrs. Glazebrook and Fitzpatrick, who have done such good work with mercury, might well turn their attention to copper. It is well known that Matthiessen's standard for pure copper is wrong. It was one English standard mile of pure annealed copper wire 1/16 inch in diameter at 15°·5 C., having a resistance equal to 13·59 B.A. units. It is a common thing to get copper giving better results than this.

THE magnetic elements for 1887 as determined at Greenwich were—

Mean declination	17° 47′ W.
Mean horizontal force	181·75
Mean dip	67° 26′ 20″

Why does the Astronomer-Royal retain British and metric units when nearly all the world uses C.G.S. units?

THE MICRO-ORGANISMS OF AIR AND WATER.

EVER since the great importance of micro-organisms in the economy of Nature was pointed out by Pasteur now some twenty-five years ago, the presence of these minute living forms in the two great fluid media—air and water—with which we are surrounded, has formed the subject of elaborate investigations. As these investigations are thus co-extensive with the period during which micro-organisms have been made the subject of careful study, a review of them becomes particularly instructive as illustrating the gradual development of the methods of bacteriology from the earliest times up to the high degree of perfection to which they have attained at the present day.

It was Pasteur himself who first instituted a systematic inquiry into the presence and distribution of micro-organisms in the atmosphere in connection with his well-known researches disproving the spontaneous generation of life. The experiments which he undertook for this purpose are as remarkable for their extreme simplicity as for the striking results which they yielded. Thus the apparatus with which Pasteur set about exploring the distribution of microbes in the air consisted simply of a number of small flasks, each partially filled with a putrescible liquid such as broth; the necks of these flasks were drawn out and sealed before the blow-pipe whilst the fluid contents were in active ebullition. The flasks thus prepared were both vacuous and sterile, and could be preserved for an indefinite length of time without the contained liquid undergoing change. A number of these flasks were then momentarily opened in various places—in Paris, in the open country, at various altitudes in the Jura Mountains, and at an elevation of 6000 feet at the Montanvert, near Chamonix. Each flask on being opened became instantly filled with the air of the place in question, whilst, by sealing the flask directly afterwards, the further access of air was prevented. On preserving these flasks which had been thus opened, the liquid of some was found to become turbid and lose its transparency owing to the development of bacterial life within it, whilst in others it remained perfectly clear and translucent. It was further observed that the proportion of flasks becoming so affected varied greatly according to the places where they had been exposed. Thus, of twenty flasks exposed in the open country near Arbois, eight developed living organisms; of twenty opened on the lower heights of the Jura Mountains, five became affected; whilst of the twenty opened at the Montanvert, close to the Mer de Glace, only one broke down. The proportion of flasks which became affected on being similarly exposed in Paris, was considerably greater than in the case of the experiment made at Arbois.

The results of these simple experiments thus convey a most vivid picture of the great density of microbial life in the air of towns, and of its attenuation in the higher regions of the atmosphere, although they can give no account of the *actual* numbers present in the air under examination.

Miquel and Freudenreich[1] made the first step in the quantitative estimation of aërial microbes by aspirating air through plugs of glass-wool, thus taking advantage of a fact long known—that it is impossible for micro-organisms to pass through sufficiently tightly constructed plugs of such materials.

Without entering into a detailed account of this method, the merits and demerits of which have been fully discussed by German investigators, it is sufficient to state that a very large number of experiments have been carried out by the authors which can lay claim to a fair degree of accuracy. However, since solid nourishing media for the cultivation of micro-organisms were introduced by Koch, the importance of substituting the latter for the liquid media hitherto exclusively employed has led experimenters to devise processes which shall render their use possible in the examination of air.

The advantages possessed by solid over fluid media are very great, for whereas in fluid media, such as broth, the organisms are in no way restricted in their movements, and their multiplication can take place indiscriminately throughout the entire liquid, on the other hand, if they are introduced into gelatine-peptone which has been first melted, they can be evenly dispersed throughout the culture-material by gentle agitation, and by subsequently allowing it to solidify they are not only isolated, but rigidly confined to one spot. Thus each individual organism becomes a centre round which extensive multiplication takes place, and in a few days definite points of growth are visible to the naked eye, which are appropriately described as "colonies," and which can be easily counted with the aid of a low magnifying glass. Although each colony consists of many thousands or even millions of individual microbes, yet as in the first instance they owe their origin to a single organism or indivisible group of organisms, it is correct to regard the number of colonies as representing the number of micro-organisms. These colonies have often very beautiful and characteristic appearances,[2] and it is exceedingly remarkable how constant and distinct for one and the same organism these appearances are. In many cases they give rise to magnificent patches of colour—deep orange, chrome yellow, brown, various shades of red, green, black, &c. Often under a low magnifying power they are seen to spread over the surface of the gelatine, producing tangled networks of threads, sometimes they resemble the petals of a flower, sometimes the roots of a tree or its branches; in fact, one is constantly startled by the novelty and beauty of their modes of growth.

Koch[3] and, later, Hesse[4] have devised methods by which the organisms in the air become deposited on a solid surface of gelatine-peptone, and by there producing colonies render their estimation possible. A large number of experiments have been

[1] "Annuaire de l'Observatoire de Montsouris," 1879–86.

[2] "Studies on some New Micro-organisms obtained from Air," Phil. Trans., vol. clxxviii. p. 257.

[3] *Mittheilungen aus dem kaiserlichen Gesundheitsamte*, 1881, Bd. i.

[4] *Ibid.*, 1883, Bd. ii.

made with Hesse's method, which consists in aspirating air through glass tubes about 3 feet in length, coated internally with a film of gelatine-peptone. The organisms, owing to the property they possess of rapidly subsiding in the absence of disturbing influences, fall on the surface of the gelatine, and give rise to colonies.

The following series of observations was made by this method in 1886[1] on the roof of the Science Schools, South Kensington Museum, in order to trace the seasonal variations in the number of micro-organisms present in the air of one and the same place. The following are the averages obtained for each month during which these observations were made :—

Number of Micro-organisms found in Ten Litres (Two Gallons) of Air.

January	4	August	105
March	26	September	43
May	31	October	35
June	54	November	13
July	63	December	20

From these figures it will be seen that it is during the summer that the largest number of micro-organisms are found in the air, whilst the smallest average number was recorded in the month of January.

The air at sea, the air at higher altitudes, and the air in sewers, have all been explored by means of Hesse's method.

Thus Dr. Fischer,[2] in experiments carried on at sea, found that beyond a distance of 120 sea miles from land micro-organisms were invariably absent. And, inasmuch as micro-organisms are abundantly present in sea-water, it thus appears that no micro-organisms are communicated to the air from the water even when the latter is much disturbed. Moreover, as might have been anticipated, this complete freedom from micro-organisms was attained even in close proximity to land, provided the wind had passed over the above-mentioned distance of sea.

As regards the air at higher altitudes, experiments have been made on the dome of St. Paul's, in London, and on the spire of Norwich Cathedral, which show that even in ascending to such modest elevations in densely-populated centres, the number of micro-organisms suspended in the air undergoes very marked diminution.

Thus, on the top of Norwich Cathedral spire, at a height of about 300 feet, I found in ten litres (two gallons) of air only seven micro-organisms, and on the tower, about 180 feet high, I found nine, whilst at the base of the Cathedral, in the Close, eighteen were found. These results are fully confirmed by another series of experiments made at St. Paul's Cathedral. In this case the air examined from the Golden Gallery yielded in the same volume eleven, that from the Stone Gallery thirty-four, whilst in the churchyard there were seventy micro-organisms present.

The contrast between town and country air, and even between the air of the London parks and streets is also exceedingly sharp. In Hyde Park—the place selected for the experiment being as far removed from roads and traffic as possible—I found eighteen, whilst on the same day, June 7, the air in the Exhibition Road, South Kensington, yielded as many as ninety-four. On the following day, however, when the traffic was very great, and the air was consequently heavily laden with dust, the number rose to 554. This is in marked contrast to the microbial condition of country air, for on the Surrey Downs in the same volume only two micro-organisms were found; and in the case of an extensive heath near Norwich only seven.

Within doors we find that the number of micro-organisms suspended in the air depends, as we should have expected, upon the number of people present, and the amount of disturbance of the air which is taking place. Thus, on examining the air in the large entrance hall of the Natural History Museum in Cromwell Road it was found to yield under ordinary conditions from fifty to seventy organisms in the same volume (two gallons), but on Whit Monday, when an immense number of visitors were present in the building, I found as many as 280. Again, on a paying day at the South Kensington Museum, about eighteen micro-organisms were found, but on the Saturday, when no entrance fee is charged, there were as many as seventy-three in the same volume of air.

[1] "The Distribution of Micro-organisms in Air," Proc. Roy. Soc., No. 245, 1885; "Further Experiments on the Distribution of Micro-organisms in Air," Proc. Roy. Soc., vol. xlii. p. 267, 1886.

[2] "Bacteriologische Untersuchungen auf einer Reise nach Westindien," *Zeitschrift für Hygiene*, Bd. i. Heft 3.

The air of sewers has been shown by Carnelley in this country, and by Petri in Berlin, to be remarkably free from micro-organisms, the number being almost invariably less than in outside air. That this should be the case is only natural when the moist nature of the walls and the absence of dust in these subterranean channels is borne in mind, and although their liquid contents is teeming with bacterial life, there is no reason why the latter should be carried into the air provided no effervescence or splashing takes place. On the other hand, if the contents of a sewer enter into fermentation and bubbles of gas become disengaged, minute particles of liquid with the living matter present may be carried to great distances, and it must not, therefore, be too hastily concluded that because sewer air is generally remarkably free from micro-organisms, that, therefore, a visit to the sewers should be attended with such beneficial results as a trip to sea or the ascent of a mountain summit!

During the use of Hesse's method I became acquainted with several serious defects which it possessed, and in order to overcome these disadvantages I was led to devise a new process[1] for the examination of air. This consists essentially in aspirating a given volume of air through a small glass tube, not more than 4 inches long and ¼ inch in width, which is provided with two filter-plugs, the first of which is more pervious than the second, and consists of glass-wool coated with sugar, whilst the second contains, in addition, a layer, ⅛ inch in thickness, of fine sugar-powder. On these plugs the microbes suspended in the aspirated air are deposited, and each of these plugs is then introduced into a separate flask containing a small quantity of melted gelatine-peptone; with this the plug is agitated until it becomes completely disintegrated, and since the sugar-coating of the glass-wool dissolves in the liquid gelatine, the microbes become immediately detached. The contents of the flask are then made to congeal in the form of a thin film over its inner surface. The flasks are then preserved at a suitable temperature, and in the course of a few days the colonies derived from the organisms, which were collected by the plug, make their appearance and can be counted and further studied. Now, if the plug has been properly constructed, the flask into which the second or more impervious plug has been introduced will be found to remain quite sterile, clearly showing that the first plug has arrested all the microbes suspended in the aspirated air. This method yields results which agree not only very closely amongst themselves, but also with those obtained by Hesse's method, if the experiments are made in still air, which is the condition necessary for an accurate result being obtained with a Hesse tube. As this new method is equally applicable in disturbed air, it possesses great advantages over Hesse's, and is, moreover, considerably more convenient, as it renders possible the examination of a far larger volume of air in a very much shorter space of time, the apparatus required being also exceedingly portable.

Of the presence of pathogenic or disease-producing micro-organisms in air, there is little or no direct evidence so far; it must, however, be remembered that it is just in the case of those extremely infectious diseases, such as measles, whooping-cough, &c., in which the virus might be expected to be carried through the air, that the exciting organized poisons have not yet been discovered and identified.

The investigations on aërial microbia, so far as they have as yet been carried, are of service in indicating how we may escape from all micro-organisms, whether harmful or harmless; and secondly, how we may avoid the conveyance of micro-organisms into the atmosphere from places where pathogenic forms are known or likely to be present. This acquaintance with the distribution of micro-organisms in general, and the power of controlling their dissemination which it confers, is really of far wider practical importance than discovering whether some particular pathogenic form is present in some particular sample of air. It is this knowledge which has led to the vast improvements in the construction and arrangement of hospital wards and of sick-rooms generally, and which has directed attention to the importance of avoiding all circumstances tending to disturb and distribute dust. It is, moreover, this knowledge of the distribution of micro-organisms in our surroundings which has formed one of the foundations for the antiseptic treatment of wounds—that great step in surgery with which the name of Sir Joseph Lister is associated.

[1] "A New Method for the Quantitative Estimation of the Micro-organisms present in the Atmosphere," *Phil. Trans.*, vol. clxxviii. p. 113.

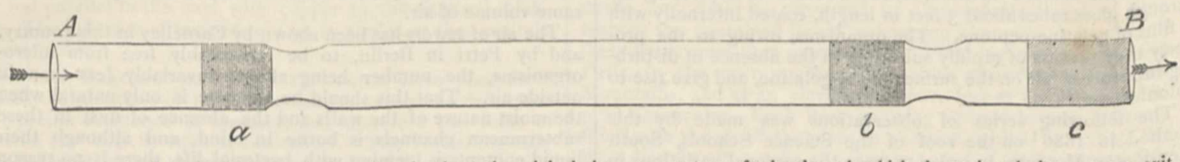


FIG. 1.—Glass tube through which the air is aspirated: about the original size. A, aperture of tube through which the aspirated air enters; B, exit of aspirated air; *a*, first filter-plug, consisting of glass-wool; *b*, second filter-plug, consisting of glass-wool and powdered glass or sugar; *c*, cotton-wool plug to protect plug *b*.

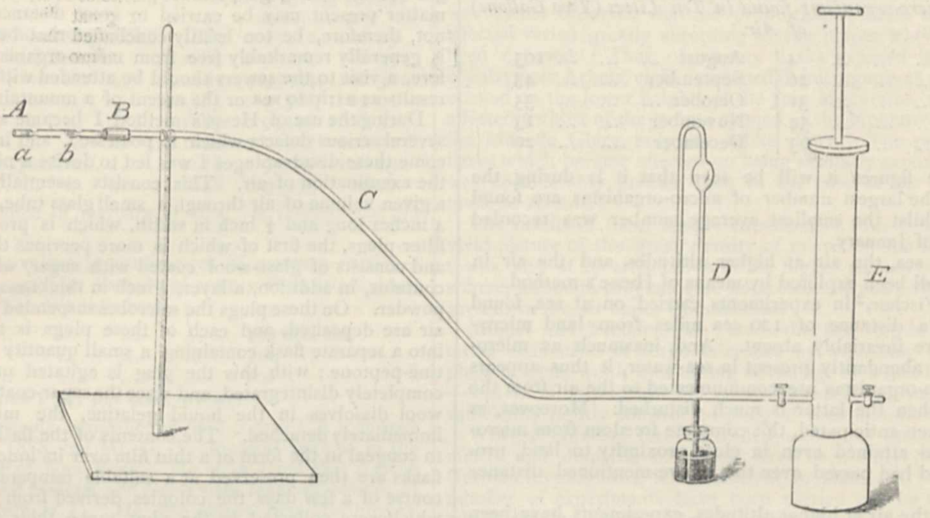


FIG. 2.—Arrangement of the apparatus for taking a sample of air. A, B, the filter tube; C, lead tubing, about 10 feet in length; D, mercury pressure-gauge; E, air-pump.

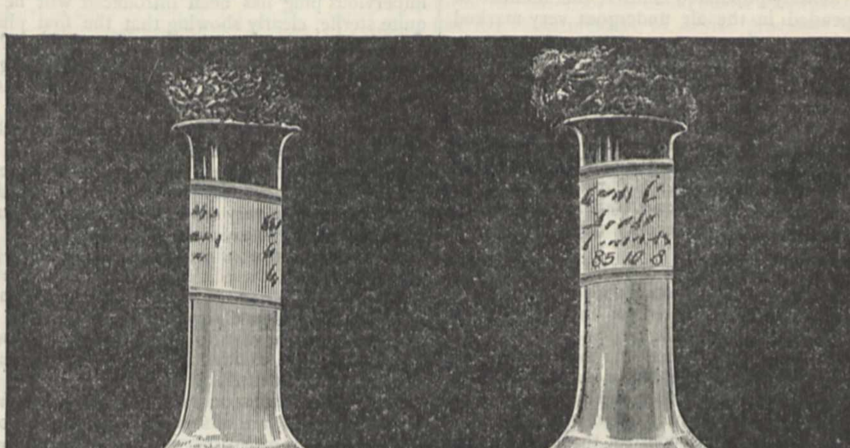


FIG. 3.—Flasks after incubation, showing colonies on film of gelatine with which the inner surface is coated.

Micro-organisms in Water.

The micro-organisms present in water have long been studied by direct observation with the microscope. Such observations can, however, only be made in the case of foul waters in which bacterial life is very abundant, and even in such cases the information gained by the microscope alone has but little value. It is to the modern methods of cultivation, more especially those in which solid media are employed, that our increased knowledge concerning these primitive inhabitants of water is due. Thus the beautiful process of plate-cultivation introduced by Koch,[1] and to which more than to anything else the recent advances in bacteriology are due, has been of the greatest service in the investigation of a number of questions bearing on the micro-organisms in water. The method of plate-cultivation consists, as is well known, in taking some of the liquid or other substance under examination for micro-organisms and mixing it with melted gelatine-peptone in a test-tube, the mixture being then poured out on a horizontal plate of glass and allowed to congeal, the plate being then preserved in a damp chamber at a suitable temperature. In the course of a few days colonies make their appearance in the gelatine film, and can be counted and further studied as required. This process is of extremely wide application, for by this means pure cultivations of the various organisms in a mixture can be readily obtained. If a definite volume of water be submitted to this method of plate-cultivation, the resulting colonies on the plate clearly indicate both the number and the character of the organisms present in it.

From numerous investigations made by means of gelatine plate-cultivations, it appears that whilst surface waters, such as rivers, contain an abundance of microbial life, waters, which like those from springs and deep wells have undergone filtration through porous strata, contain but very few micro-organisms. Now since such underground waters have at some time or other been surface waters, it is obvious that in passing through the porous strata of the earth they have been deprived of those microbes which they contained whilst at the surface. This removal of micro-organisms from water[2] also takes place in a very marked manner when it is submitted to some kinds of artificial filtration, such as that through very finely divided coke or charcoal, as well as in the filtration of water on the large scale through sand. The process of filtration, however, which absolutely removes microbes with the greatest degree of certainty is that introduced by Pasteur, in which the water is forced through porous porcelain. It is especially noticeable that the efficiency exhibited by these various materials in removing micro-organisms stands in no sort of relationship to their chemical activity, *i.e.* power of removing organic matter from water. Thus the porous porcelain produces practically no change whatever in the chemical composition of the water, whilst it deprives it entirely of micro-organisms.

The relative abundance of bacterial life in surface water, in deep well water, as well as in surface water after filtration through sand on the large scale, is well illustrated by the following results.

Thus the average number of micro-organisms obtained during the past year from a cubic centimetre (about twenty drops) of the raw water as abstracted from the Rivers Thames and Lea by the metropolitan water companies was 21,500 and 13,200 respectively. The same water, however, after having undergone storage and filtration contained on an average respectively 500 and 450 micro-organisms in 1 cubic centimetre. It is at once apparent, therefore, what striking results can be obtained by sand filtration as at present carried out, and there is no doubt that with the introduction of fresh improvements and increased care an even greater reduction will be effected.

In deep well water obtained from the chalk, which has undergone no artificial filtration, we find the remarkably low number of eighteen as the average for the year. Thus the artificial filtration through sand is far surpassed by the exhaustive filtration through vast thicknesses of porous strata.

Another point which has been brought to light through investigating the micro-organisms of water by means of the improved methods which we now possess is that many of the microbes found in natural waters are capable of the most abundant multiplication[3] in the absence of practically any organic matter whatever. Thus, if the deep well water referred to above is preserved for several days thoroughly protected from contamination through the air, and is then examined for micro-organisms, it will be found that these have undergone an enormous increase, 1 cubic centimetre containing many thousands instead of the ten or twenty usually present in the water at the time of pumping. It has been found, moreover, that some of the water-organisms are even capable of such abundant multiplication in water which has been several times redistilled, and which is, therefore, almost absolutely pure. From what source such organisms obtain their necessary nourishment under these circumstances has not yet been determined. The following figures serve to illustrate the extent to which multiplication of this kind may take place:—

Number of Micro-organisms obtained from 1 *cubic centimetre of water.*

	Day of Collection.		Standing 1 day at 20° C.		Standing 3 days at 20° C.
Sample of water from Kent Co.'s deep well in chalk	7	...	21	...	495,000

It is often urged that the bacteriological examination of water is of little practical importance, inasmuch as the micro-organisms found are not necessarily prejudicial to health, and that the method of examination does not aim at the detection of harmful forms. A little more mature consideration, however, will show that the actual detection of harmful or pathogenic forms is a matter of very little importance, and that if methods of water purification are successful in removing micro-organisms in general, and more especially those which find a suitable home in natural waters, there can be no serious doubt that they will be equally successful in removing harmful forms, which are not specially adapted for life in water. Could it be, for instance, reasonably contested that a method of purification which is capable of removing the *Bacillus aquatilis* from water, would be incapable of disposing of the *Bacillus anthracis* when suspended in the same medium? The supposition is, on the face of it, absurd, and not a particle of experimental evidence can be adduced in its favour. It is, therefore only rational to conclude that those methods of water purification, both natural and artificial, which succeed in most reducing the total number of micro-organisms, will also succeed in most reducing the number of harmful forms should they be present.

As a matter of fact, however, pathogenic forms can and have been discovered in waters by the process of plate-cultivation; thus the "comma-bacillus," which is by many authorities regarded as the cause of Asiatic cholera, was found by Koch in some tank-water in India, and the bacillus which with more or less probability is identified with typhoid fever has by Chantemesse and Widal been discovered in the drinking-water which had been consumed by persons suffering from that disease.

On the other hand, the examination of water for the number of micro-organisms present can have no value if the multiplication referred to above has taken place. Thus, if the number of micro-organisms present in a water is to throw light on the natural purification it has undergone, the sample for examination must be taken as near as possible to the point where it issues from the water-bearing stratum, and, in the case of artificially purified water, as soon as possible after it has left the purifying apparatus.

Of much more importance than the discovery of pathogenic organisms in particular waters is the problem of ascertaining the fate of pathogenic forms, when these are introduced into waters of different kinds. A considerable amount of work has been done in this direction with a number of typical pathogenic forms,[1] and some very remarkable results have been obtained. Thus it has been found that the bacilli of anthrax do not survive many hours on being introduced into ordinary drinking-water; their spores, however, are not in any way affected by such immersion, and even in distilled water the latter retain their vitality for practically an indefinite length of time. In polluted water, such as sewage, on the other hand, not only do the bacilli not succumb, but they undergo extensive multiplication. Similarly Koch's "comma-bacillus" was found to flourish in sewage, being still present in very large numbers after eleven months' residence in this medium. In deep-well and filtered Thames water, on the other hand, although the "comma-bacilli" were

[1] *Mittheilungen aus dem kaiserlichen Gesundheitsamte*, Bd. i., 1881.

[2] "The Removal of Micro-organisms from Water," Proc. Roy. Soc. No. 238, 1885.

[3] "On the Multiplication of Micro-organisms," Proc. Roy. Soc., No. 245, 1886. "Ueber das Verhalten verschied. Bacterienarten im Trinkwasser," Meade Bolton, *Zeitschrift für Hygiene*, Bd. i. Heft 1.

[1] "Die Vermehrung der Bacterien im Wasser" Wolffhügel und Riedel, *Arbeiten a. d. kaiserlichen Gesundheitsamte.* "Ueber das Verhalten, &c.," Meade Bolton. "On the Multiplication of Micro-organisms," Proc. Roy. Soc.; also "Recent Bacteriological Research in connection with Water Supply," Soc. Chem. Ind., vol. vi. No. 5.

still demonstrable after nine days, they were only present in small numbers. Much less vitality is exhibited by the micrococcus of erysipelas when introduced into waters of various kinds, for even in sewage this organism was not demonstrable on the fifth day. In fact, all the pathogenic micrococci which have been experimented with in this manner exhibit but little vitality under similar circumstances.

From these experiments it appears, therefore, that whilst ordinary drinking-water does not form a suitable medium for the extensive growth and multiplication of those pathogenic forms which have hitherto been made the subject of investigation in this respect, yet, that in the condition of spores, they are extremely permanent in any kind of water, however pure, and that even those of which no spores are known may often be preserved for days or even weeks.

Thus the investigations which have hitherto been made on the micro-organisms both of air and water, by the light which they throw on the behaviour of micro-organisms in general in these media, the manner in which they may be preserved and the manner in which they may be removed, are of great service in indicating how the spread of zymotic diseases through these media is to be avoided.

Until we are fully acquainted with all pathogenic forms of microbes, a consummation which is certainly not likely to be attained in the near future, it is obvious that in endeavouring to exclude dangerous organisms we must attempt to exclude *all* organisms, *e.g.* in the purification of water which has been exposed to possibly noxious pollution, that process of purification which insures the removal or destruction of the greatest proportion of micro-organisms must be regarded as the most efficient. In just the same way as in the antiseptic treatment of wounds, the preventive measures employed by surgeons are of such a nature as to destroy or preclude the possibility of growth of *any* microbes whatever, and not only of those known to be capable of causing mischief.

PERCY F. FRANKLAND.

THE OPENING OF THE MARINE BIOLOGICAL LABORATORY AT PLYMOUTH.

THE Laboratory erected at Plymouth by the Marine Biological Association of the United Kingdom, of which a full account was given last week in NATURE, was opened on Saturday, June 30. The weather was fine, and at ten o'clock a large and distinguished company were present. Having viewed the tanks, the company assembled in the Laboratory, where Prof. W. H. Flower, C.B., F.R.S., Director of the Natural History Department of the British Museum, delivered an address, in the course of which he said :—"The necessity for such institutions as this has been felt almost simultaneously throughout the cultivated nations of the world. The British Isles, with their extensive and varied seaboard, offering marvellous facilities for the investigation of marine life, with their vast economical interests in the denizens of the waters that lave their shores, have been rather behind some other countries in adopting this line of research. Let us hope, however, that being so, we may profit by example and the experience of others, and ultimately, as in so many other similar cases, may outstrip our neighbours in a department of work for which our maritime and insular position seems so specially to fit us. That our country should be alone in neglecting this branch of scientific inquiry was impossible. Stations for the investigation of the phenomena of marine life have been founded at several places on the northern coasts of our island, but all on a very limited scale. An institution commensurate with the importance of the subject and of the nation had to be established sooner or later ; the only questions to be solved were when it was to be founded and where it was to be placed. Much of the success of an enterprise must depend upon the particular time selected for embarking upon it. If delayed too long, the world is a loser by the non-existence of the knowledge that is to be gained from it. On the other hand, premature attempts before sufficient interest in the subject is awakened, or before sufficient information as to the best means of carrying it out has been gained, often end in failure. I think that in this respect we have taken the right medium." After a reference to the Fisheries Exhibition, Prof. Flower continued:—"The question as to the place at which our head-quarters were to be established was at first one of considerable difficulty. Many were the rival claimants, but Plymouth was finally chosen as best approaching the requisite physical and geographical surroundings for such an institution ; and the cordiality with which the Association was welcomed by its leading citizens was in itself a ground of justification for the choice. Though a portion of the old military defences of the town has been given up to our peaceful enterprise, we trust the safety of the inhabitants will not suffer. The Laboratory now stands beneath the Plymouth Citadel and the sea, and an enemy entering the town by the most direct route would have to march over the ruins of the building. That consideration alone should be enough to secure your safety in a war with many of the enlightened science-loving nations of Europe, should such an event unhappily arise. As to the institution itself, few words are needed to show how excellent is its adaptation to the purpose for which it is founded. Although still not in all respects in full working order, we have been all enabled to see to-day how carefully it has been planned, and how well the design has been carried out. We have secured a capable and energetic working staff, students are already taking their places at our laboratory tables, and already a commencement has been made in their original investigations and contributions to knowledge, which we hope will be of such a character and of such abundance as to give this Laboratory a high place among the scientific institutions of the world. Our present financial position and our future needs are fully set forth in the report of the Council, just issued. This shows that of our capital already subscribed the greater part has been expended on the building and the necessary apparatus for its equipment. We still want a steam-vessel for the use of the staff in exploring the fishing-grounds of the neighbourhood and for collecting materials to stock our tanks ; and for the means of providing this, and for the annual maintenance of our establishment in a state of efficiency, we shall require further pecuniary assistance. But as the report is, or shortly will be in your hands, I need not detain you longer by enlarging upon its contents. I will therefore, in the name of the President and Council of the Marine Biological Association of the United Kingdom, thank all those who have, by their generous contribution of money or by expenditure of their time, labour, and thought, brought us so far on our way, and declare the Laboratory of the Association open for work. May we all join in the earnest hope that the expectations which have been raised of its future usefulness may never be disappointed."

The company, after being photographed, adjourned to the Grand Hotel on the Hoe, where they sat down to a *déjeûner* given by the Fishmongers' Company. Sir James Lawrence, Prime Warden of the Fishmongers' Company, presided, and was supported by the Earl of Morley, Prof. Flower, Sir H. W. Acland, K.C.B., F.R.S, the Mayor of Plymouth (Mr. H. J. Waring), the Mayor of Devonport (Mr. J. W. W. Ryder), the Chairman of the Stonehouse Local Board (Mr. E. A. Lyons), Prof. E. Ray Lankester, LL.D., F.R.S., Sir Edwin Saunders, Sir George Paget, K.C.B., F.R.S., the Ven. Archdeacon Wilkinson, Prof. A. Milnes Marshall, F.R.S., Prof. Charles Stewart, Mr. J. Evans, P.S.A., F.R.S., Captain Wharton, R.N., F.R.S., the Vice-Chancellor of Cambridge, Sir Edward Watkin, M.P., Prof. J. W. Groves, Rear-Admiral H. D. Grant, C.B., Major-General T. C. Lyons, C.B., Mr. Thiselton Dyer, C.M.G., F.R.S., Mr. A. Sedgwick, F.R.S., Mr. W. Pengelly, F.R.S., Mr. F. Crisp, F.R.S., Colonel Hewet, R.E., Rev. J. Hall Parlby, Dr. A. Günther, F.R.S., Major-General Barton, R.E., Captain Inskep, R.M., Mr. Robert Bayly, Prof. F. Jeffery Bell, Prof. D'Arcy Thompson, Prof. G. B. Howes, Mr. C. Spence Bate, F.R.S., Prof. M. Foster, Mr. W. Lant Carpenter, Mr. E. W. N. Holdsworth, Mr. E. L. Beckwith, Fishmongers' Company, Mr. Gilbert C. Bourne, and Mr. J. Solly Foster and Mr. John Hall, Wardens, Fishmongers' Company.

The health of "The Queen" having been given by the Chairman, Lord Morley proposed "The Marine Biological Association of the United Kingdom." He said he was sure that his friends the Mayors of Plymouth and Devonport would join with him in wishing a hearty welcome to the Association, and in sincerely hoping that the Laboratory would prove a success. Any doubt as to the practical value of the Laboratory was dissipated by the fact that the Chairman was one of its main founders, and also that many well-known gentlemen, including the Chairman of the National Association at Kensington and Kew, anticipated good results therefrom. Since there was such a consensus of opinion as to the importance of the scheme from a practical and scientific point of view, the thing which surprised him was why it was not done before. We reaped the richest harvest from the sea, and yet we had never inquired scientifically into the source of this great industry. We had [illegible] behind other nations in this respect. France had [illegible] less than four institutions of a similar kind; Austria, with its small coast, had one at Trieste; and the German Government endowed their Laboratory at Naples [illegible] was the most complete in existence, with £1500 a year. From certain statistics recently given to Parliament by the Board of Trade, they learned that the production of fish in the United Kingdom of Great Britain and Ireland last year amounted in value to six and a quarter millions, and if they took the retail value and not the wholesale value, as put in the statistics, it would amount to not less than thirteen millions per year. The east coast was by far the most fruitful of all our coasts as regards the fishing industry, Grimsby, Hull, Lowestoft, and Yarmouth producing £2,800,000 worth of fish. Plymouth with its £96,000 worth of fish per year, Brixham with its £56,000, and Penzance with its £41,000, gave some idea of what the sea produced in the shape of food. Comparing these figures with other countries, it would be found that Canada did not produce four millions worth of fish, and France even less. Then they ought to consider the immense amount of traffic our fishing industry gave to our railways. From Plymouth alone there were sent on two lines of railway 50,000 tons of fish annually. It seemed to him an extraordinary thing that so many years should have elapsed before scientific methods were adopted for learning the conditions under which fish live. If they read the interesting Reports of the Trawling and Fishing Commission, they would be surprised at the ignorance of fishermen as to the habits of fish, their modes of existence, their food, and the climatic and other effects which influenced their existence and modes of living, and he was afraid that ignorance was not confined to fishermen. The great want was, he hoped, about to be supplied in the establishment of this Laboratory. In heartily wishing success to the Marine Biological Association of the United Kingdom, he had the greatest possible pleasure in coupling with it the name of Prof. Ray Lankester.

Prof. Ray Lankester said it was with feelings of pride that he rose to return thanks. It was the great Fisheries Exhibition which suggested the movement for the formation of a laboratory where fishery studies could be carried on. The idea they had in view at that time, or rather the institution existing elsewhere which they wished to copy, was that established by Dr. Dohrn at Naples, with which they were all familiar. The question was, How could such a laboratory be put up on the British coast? And it was to his friend Dr. Günther, of the British Museum, that they owed the suggestion of the formation of an Association. It was to the officers of the Royal Society that they owed the opportunity of starting the Association. A meeting was called in the rooms of that Society, and presided over by the illustrious President of the great scientific institution, which was also the first public body to support the funds of the Association with a large and handsome subscription, and was very largely attended by men of science and gentlemen interested in fisheries, while the late Earl of Dalhousie, one of their most ardent supporters, the Duke of Argyll, and other public men took part in it. The newspaper Press had all along helped them in a most admirable and cheering manner. The *Times* had been their warmest friend, and he hoped it would continue to be so for years to come. No sooner had the first start been made at the meeting in the rooms of the Royal Society and the subscription list put forward than many other big societies came in and individuals throughout the country put down their money, as did also the Universities of Oxford and Cambridge. Subscriptions had been received from purely scientific bodies and individuals to the amount of £3000, and from various sources a total sum of £16,000 to £17,000 had been obtained. The most important item of support given to the Association was the grant from Her Majesty's Government of £5000 and £500 a year. The remaining £10,000 they owed to the great civic Companies and to munificent individuals, among whom he must not omit to mention with hearty gratitude their friends Mr. John Bayley and Mr. Robert Bayley, of Plymouth. No sooner had the enterprise been set on foot than His Royal Highness the Prince of Wales expressed his desire to become the patron of the institution, and support came in from every side. The Inspector-General of Fortifications and the Earl of Morley were instrumental—were, in fact, the actual causes of their receiving the grant of the splendid site on which the building had been erected; and the co-operation and consent of the Town Council of Plymouth, who had certain rights over the area, were cheerfully given. They had now arrived at a definite stage in their work: the building was completed, the laboratory was equipped, the naturalists were on the spot, and they had thus, as he had said, accomplished what he considered to be the first step in the work of the Association. But it was only the first step. Beyond the mere existence of the laboratory building, they had still to justify themselves in the eyes of their supporters by the work that was done within it. He thought they might rely upon the staff they had been fortunate enough to obtain. He had the greatest confidence in the work that would be done in the institution, and in the direction which would be given to that work by his friend Mr. Gilbert Bourne, assisted by the experience of his friend Mr. J. T. Cunningham, who had come to them fresh from his work in Scotland, and students of all ages. He would mention once more a subject which had been already alluded to. They wanted a yacht of their own—not a pleasure-yacht, but a steam sea-going vessel which could accompany the trawlers on their expeditions, and should be a thoroughly seaworthy boat. He hoped that those who were able to place additional funds at their disposal, and who had been pleased and gratified with the way in which they had expended the money already intrusted to them, would not delay to add to the resources of the Association so as to enable them to purchase this steamer.

The Prime Warden then proposed "Prosperity to Plymouth," and the Mayor of Plymouth replied.

Sir George Paget, K.C.B., proposed the health of the Prime Warden, who responded, and three cheers having been given for the Fishmongers' Company, the guests dispersed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following have been placed in the first class in the Natural Sciences Tripos, Part I. (the names are in alphabetical order):—Baily, Joh.; Daniel, Trin.; Falkener, King's; Hankin, Joh.; Horton-Smith, Joh.; Jones, King's; R. Langdon-Down, Trin.; Locke, Joh.; Long, Caius; Morrell, Caius; Newstead, Christ's; Perkins, Emman.; Phear, Trin.; Schott, Trin.; H. Simpson, Joh.; H. Smith, Trin.; W. A. L. Smith, Trin.; Thornton, B.A., Christ's; Whetham, Trin.; G. Wilkinson, jun., Emman.

Women.—Class I.—L. Ackroyd, Newnham; D. Alford, Girton; A. G. Earp, Newnham; L. R. Howell, Girton; M. Kennedy, Girton.

The following have been placed in the first class in the Natural Sciences Tripos, Part II.:—Ds. Anderson, Caius (physiology); Barber, Christ's (botany); Ds. D'Arcy, Caius (physics); Ds. Francis, King's (human anat. and physiology); Fry, King's (botany); Hardy, Caius (zoology); Hutchinson, Christ's (chemistry); E. R. Saunders, Newnham (physiology).

Mr. A. C. Seward, B.A., Scholar of St. John's College, has been elected Harkness Scholar in geology and palæontology.

Mr. W. W. Watts, M.A., has been elected to a Fellowship at Sidney-Sussex College. Mr. Watts graduated in the Natural Sciences Tripos, 1881, and was placed in the first class for proficiency in geology.

At Downing College the following have been elected to minor Scholarships of £50 each open to the competition of persons not yet in residence: H. Brownsword, for physics, Manchester Grammar School; C. Swift, for chemistry, University College, Liverpool; and H. Widdicombe, private tuition, for botany. G. Dodson has been elected Foundation Scholar for Natural Science.

At Christ's College the following undergraduates have been elected to Natural Science Scholarships: A. H. L. Newstead, £60; C. Krishnau, £50; R. H. Luce, £30; H. M. Stewart, £30.

At King's College, R. C. Fry has been elected Natural Science Scholar, and G. L. Rolleston to an Exhibition of £40, and L. Falkener to £30.

At Gonville and Caius College, H. B. Brunner, Berkhampstead School, has been elected to an Entrance Scholarship of £50 for natural science.

The following Natural Science Scholars have been elected at St. John's College: H. Simpson, Hankin, Horton-Smith, Locke, Baily, Blackman, Schmitz. Turpin, B.A., has been elected Hutchinson Student for organic chemistry.

SCIENTIFIC SERIALS.

THE *Journal of Botany* continues, in its numbers for April, May, and June, Mr. J. G. Baker's Synopsis of the Tillandsieæ, and MM. Britten and Boulger's valuable biographical index of British and Irish botanists (deceased).—Students of diatoms will be interested in Mr. J. Rattray's paper on *Aulacodiscus*, in which the many and singular abnormalities of this genus of fossil diatoms are described and illustrated by a plate.—Mr. G. Massee contributes a revision of the genus *Bovista*, in which several new species of this genus of Fungi are described, also illustrated by a plate.—We have also biographies of Prof. Asa Gray, and Mr. John Smith, of Kew (the portrait of the former is not a pleasing one), and several papers on local or descriptive botany.

IN the *Botanical Gazette* for February, March, and April, we have no important papers of original research or observation such as sometimes reach us in this record of the doings of botanists in the Far West (published at Crawfordsville, Indiana). The original papers in these numbers relate almost entirely to the distribution of plants in the Western States of America, and to the description of American species.

THE number of the *Nuovo Giornale Botanico Italiano* for April contains the conclusion of Prof. A. N. Berlese's monograph of the genera of Fungi *Pleospora*, *Clathrospora*, and *Pyrenophora*, with the ten coloured plates which serve to illustrate the whole paper; and a description by Sig. C. Massalongo of a number of instances of teratology, chiefly relating to the flower. It serves further as the medium of publication of the proceedings of the Italian Botanical Society, reports being appended of a number of smaller contributions in various departments of botany.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"Muscular Movements in Man, and their Evolution in the Infant: a Study of Movement in Man, and its Evolution, together with Inferences as to the Properties of Nerve-centres and their Modes of Action in expressing Thought." By Francis Warner, M.D., F.R.C.P., Physician to the London Hospital, and Lecturer on Botany in the London Hospital Medical College. Communicated by Prof. J. Hutchinson, F.R.S.

Before proceeding to give an account of the visible evolution of voluntary movement in man, it is necessary to define the different classes of movements seen, indicating the criteria by which the observer may be guided in the examples before him.

The new-born infant presents constant movement in all its parts while it is awake, and this is not controlled by impressions from without. Graphic tracings of such movements are given This spontaneous movement in the infant appears to be of great physiological importance, and is here termed "microkinesis." It is argued that the mode of brain action which produces microkinesis is analogous to the action producing spontaneous movements in all young animals, and to the modes of cell-growth which produce circumnutation in young seedling plants. It is argued that as circumnutation becomes modified by external forces to the modes of movement termed heliotropism, geotropism, &c, so microkinesis in the infant is replaced by the more complicated modes of brain action as evolution proceeds.

The conditions of movement are then described, as seen at successive stages of development of the child, and it is shown that they become less spontaneous, and more under control of stimuli acting upon the child from without, while the phenomena termed memory and imitation are evolved.

From observations made, two hypotheses are put forward. It is suggested that when a well co-ordinated movement follows a slight stimulus, the impression produces temporary unions among the centres, preparing them for the special combinations and series of actions which are seen to follow. Such unions among nerve-centres appear to be formed when a period of cerebral inhibition, produced by a word of command, is seen to be followed by a co-ordinated series of acts. A graphic tracing indicating suspension of microkinesis to the stimulus of sight and sound is given. It is further suggested that the brain action corresponding to thought is the formation of functional unions among cells, whose outcome is seen in the movements which express the thought, or its physical representation. Properties similar to those described in brain-centres may be illustrated in modes of growth.

"Evaporation and Dissociation. Part VIII. A Study of the Thermal Properties of Propyl Alcohol." By William Ramsay, Ph.D., F.R.S., and Sydney Young, D.Sc.

In continuation of our investigations of the thermal properties of pure liquids, we have now determined the vapour-pressures, vapour-densities, and expansion in the liquid and gaseous states of propyl alcohol, and from these results we have calculated the heats of vaporization at definite temperatures. The compressibility of the liquid has also been measured. The range of temperature is from 5° to 280° C., and the range of pressure from 5 mm. to 56,000 mm.

The memoir contains an account of the purification of the propyl alcohol; determinations of its specific gravity at 0°, and at 10°·72; and of the constants mentioned above.

The approximate critical temperature of propyl alcohol is 263°·7; the approximate critical pressure is 38,120 mm., and the approximate volume of 1 gramme is 3·6 c.c. The first two of these constants must be very nearly correct; the third cannot be determined with the same degree of precision.

The memoir is accompanied by plates, showing the relations of volume, temperature, and pressure in a graphic form.

Royal Meteorological Society, June 20.—Dr. W. Marcet, F.R.S., President, in the chair.—The following papers were read:—First Report of the Thunderstorm Committee. This Report deals with the photographs of lightning-flashes, some sixty in number, which have been received by the Society. From the evidence now obtained it appears that lightning assumes various typical forms, under conditions which are at present unknown. The Committee consider that the lightning-flashes may be arranged under the following types: (1) stream, (2) sinuous, (3) ramified, (4) meandering, (5) beaded or chapletted, and (6) ribbon lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes, but the Committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the Committee propose to publish their Report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.—The cold period from September 1887 to May 1888, by Mr. C. Harding. The mean temperature for each of the nine months from September 1887 to May 1888 was below the average, whilst in the case of October there has been no corresponding month as cold during the last half century, and only three colder Aprils. In London the mean temperature for the period was only 42°·4, and there has been no similarly low mean for the corresponding period since 1854-55, which will be remembered as the time of the Crimean War, and only three equally cold periods during the last 50 years. The temperature of the soil at Greenwich at 3 feet below the surface was below the average in each month from October to April; in October and April the temperature at this depth was the coldest on record, observations being available for the last 42 years, and in November it was the coldest for 37 years.—Observations on cloud movements near the equator; and on the general character of the weather in the "Doldrums," by Hon. R. Abercromby. The author gives the results of observations made during four voyages across the equator and the "Doldrums," with special reference to the motion of clouds at various levels. Two voyages were across the Indian Ocean during the season of the north-west monsoon, and two across the Atlantic in the months of July and December. The nature of the general circulation of the atmosphere near the "Doldrums" is discussed as regards the theory that the Trades, after meeting, rise and fall back on themselves; or, according to the suggestion of Maury, that the Trades interlace and cross the equator; or, as following the analogy of Dr. Vettin's experiments on smoke. It is shown that the materials at present available are insufficient to form a definite conclusion, but details are given of the general character of the weather and of the squalls in the "Doldrums," with a view of showing what kind of observations are required to solve this important problem. The old idea of a deep Trade—with a high opposite current flowing overhead—is certainly erroneous; for there is always a regular vertical succession of the upper currents as we ascend, according to the hemisphere.

Zoological Society, June 19.—Prof. Flower, F.R.S., President, in the chair.—A letter was read addressed to the President by Dr. Emin Pasha, dated Tunguru Island (Lake Albert), October 31, 1887, announcing the despatch of further collections of natural history objects, and promising for the

Society some notes on European migratory birds observed in that country.—An extract was read from a letter addressed by Mr. E. L. Layard to Mr. John Ponsonby concerning the occurrence of a West Indian Land-Shell (*Stenogyra octona*) in New Caledonia.—Mr. Tegetmeier exhibited and made remarks on the feet of an Australian Rabbit, supposed to have acquired arboreal habits.—Prof. Bell exhibited and made remarks on a specimen of a tube-forming Actonian (*Cerianthus membranaceus*) in its tube; obtained by Mr. John Murray at a depth of 70 fathoms in Loch Etive.—A communication was read from Prof. W. Newton Parker, on the poison-glands of the fishes of the genus *Trachinus*. This paper showed the existence of glands in connection with the grooved dorsal and opercular spines of the two British species of Weever. The glands were stated to be composed of large granular nucleated cells, which are continuous with those of the epidermis. An account of the observations of previous authors, both as regards the structure and physiology of the poison-organs of these fishes, was also given.—A communication was read from Mr. H. W. Bates, F.R.S., containing the description of a collection of Coleoptera made by Mr. J. H. Leech, during a recent visit to the eastern side of the Corean Peninsula.—A second communication from Mr. Bates treated of some new species of Coleoptera of the families Cicindelidæ and Carabidæ from the valley of the Yang-tsze-Kiang, China.—Mr. J. B. Sutton read a paper on some abnormalities occurring among animals recently living in the Society's Gardens.—Prof. Bell read an account of a collection of Echinoderms made at Tuticorin, Madras, by Mr. Edgar Thurston, Superintendent of the Government Central Museum, Madras.—A communication was read from Mr. F. Moore, containing the second portion of a list of the Lepidoptera collected by the Rev. J. H. Hocking, chiefly in the Kangra District of the North-Western Himalayas. The present paper contained the descriptions of seven new genera and of forty-eight new species. An account of the transformations of a number of these species was also given from Mr. Hocking's notes.

Geological Society, June 20.—Dr. W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—On the occurrence of marine fossils in the Coal-measures of Fife, by Jas. W. Kirkby; communicated by Prof. T. Rupert Jones, F.R.S.—Directions of ice-flow in the North of Ireland, as determined by the observations of the Geological Survey, by J. R. Kilroe; communicated by Prof. E. Hull, F.R.S.—Evidence of ice-action in Carboniferous times, by John Spencer.—The Greensand bed at the base of the Thanet sand, by Miss Margaret I. Gardiner, Bathurst Student, Newnham College, Cambridge; communicated by J. J. H. Teall.—On the occurrence of *Elephas meridionalis* at Dewlish, Dorset, by the Rev. O. Fisher.—On perlitic felsites, probably of Archæan age, from the flanks of the Herefordshire Beacon, and on the possible origin of some epidosites, by Frank Rutley. The author has previously described a rock from this locality in which faint indications of a perlitic structure were discernible. In the present paper additional instances were enumerated and a description was given. The perlitic structnre is difficult to recognize, owing to subsequent alteration of the rock. Decomposition-products, apparently chiefly epidote, with possibly a little kaolin, have been found in great part within the minute fissures and perlitic cracks. The author suggested, from his observations, that felsites, resulting from the devitrification of obsidian, quartz-felsites, aplites, &c., may, by the decomposition of the felspathic constituents, pass, in the first instance, into rocks composed essentially of quartz and kaolin; and that by subsequent alteration of the kaolin by the action of water charged with bicarbonate of lime and more or less carbonate of iron in solution, these may eventually be converted into epidosites. He regarded it as probable that the rocks are of later Archæan or Cambrian age.—The ejected blocks of Monte Somma, Part I., stratified limestones, by Dr. H. J. Johnston-Lavis.

Palæontographical Society, June 22.—Annual Meeting.—Dr. H. Woodward, F.R.S., Vice-President, in the chair.—The Report of the Council, presented by the Secretary, Prof. Wiltshire, stated that since the date of the last annual meeting the volume for 1887 had been issued, and that the volume for the present year was in progress. It would contain the following parts of monographs: the Stromatoporoids, Part II., by Prof. Alleyne Nicholson; the Cretaceous Echinodermata, Part I., by Mr. W. P. Sladen; the Jurassic Gasteropoda, Part III., by Mr. W. H. Hudleston; the Inferior Oolite Ammonites, Part II., by Mr. S. S. Buckman. It was stated that the arrangement by which members had been enabled to procure parts of finished monographs as well as the complete monographs, distinct from the annual volumes, had been found to work very efficiently. It was further stated that the financial position of the Society was much better than on the previous occasion. This was due in part to a grant of £50 made by the General Committee of the British Association at the Manchester meeting, and in part to the very considerable increase in the number of subscribers, which had resulted from the efforts made during the past and preceding year to bring before geologists, palæontologists, and all interested in science, the work which was carried on by the Society. If the present improvement could be maintained, there need be no fears for the future.—Sir R. Owen was re-elected President; Mr. Etheridge, Treasurer; and Prof. Wiltshire Secretary. Messrs. W. E. Balston, C. J. A. Meyer, G. H. Morton, and W. P. Sladen were elected members of the Council, in the place of Messrs. S. S. Buckman, J. Evans, C. H. Gatty, and W. C. Lucy, who retire by rotation.

PARIS.

Academy of Sciences, June 25.—M. Janssen, President, in the chair.—On the canals of the planet Mars, by M. Fizeau. The various circumstances connected with these appearances, as lately described by MM. Perrotin and Schiaparelli, suggest a strong analogy with certain phenomena of glaciation—parallel ridges, crevasses, rectilinear fissures often of great length and at various angles—observed in the regions of large glaciers in Switzerland and especially in Greenland. This leads to the hypothesis of a vast development of glaciation on the surface of Mars, where, the seasons being relatively longer and the temperature much lower, the conditions must also be more favourable than on the earth for these manifestations. The reading of the paper was followed by some remarks by M. J. Janssen, who gave a guarded assent to M. Fizeau's "very ingenious and very beautiful" theory.—On the vapour-density of the chloride of aluminium, and on the molecular weight of this body, by MM C. Friedel and J. M. Crafts. The recent experiments of MM. Nilson and Pettersson tended to show that this substance should receive the formula $AlCl_3$ rather than the double formula Al_2Cl_6 proposed by MM. Sainte-Claire and Troost. The fresh researches of MM. Friedel and Crafts, undertaken to settle the point, lead to the conclusion that the density corresponds to Al_2Cl_6, which would accordingly represent the molecular weight of the chloride of aluminium. The experiments of MM. Louïse and Roux on methyl and ethyl aluminium are in harmony with this inference.—Progress of the Roscoff and Arago Laboratories, by M. de Lacaze-Duthiers. Both of these important biological stations have lately been inspected by the author, who is able to speak most favourably of their present state. Zoologists will find concentrated at Banyuls during the winter and at Roscoff in summer all the conditions best adapted for the study of the lower forms of animal life.—Some remarks relative to the representation of irrational numbers by means of continuous fractions, by M. Hugo Gyldén. From the points here discussed flows a thesis of great importance connected with the convergence of certain trigonometric series employed in the calculation of perturbations. The thesis is thus worded: The probability of finding a value for a beyond a given limit is in inverse ratio to the number expressing this limit.—On the degrees of oxidation observed in the efflorescing compounds of chromium and manganese, by M. Lecoq de Boisbaudran. In this first paper on the subject the author deals mainly with the carbonate of lime in combination with an oxide of chromium (or chromate of ammonia), and highly calcined in the air. He shows that chromium produces with lime a fluorescence which seems to present no analogy with those yielded by it in combination with alumina, gallina, or magnesia.—On orthogonal substitutions and the regular divisions of space, by M. E. Goursat. The divisions here determined may be connected with the regular figures of space of four dimensions. Thus may readily be found the six regular figures discovered by Stringham. But the question may be pushed further, and, by following Poinsot's method, in space of four dimensions the existence may be shown of regular figures analogous to the regular starred polyhedrons of space of three dimensions. These results, here merely indicated, will be fully developed in a memoir which will shortly be published.—On a theorem of Kummer, by M. E. Cesaro. This is in connection with a recent paper by M. Jensen, who is stated to defend himself from inaccuracies of which he was not accused. In the author's communication of April 16, nothing was questioned except the *novelty* of M. Jensen's theorem, which does not differ essentially from that of Kummer, as modified and completed by Dini in 1867.—On the hydrochlorates of trichloride of antimony, of trichloride of bismuth, and of pentachloride of antimony, by M. Engel. The researches here described fully confirm the existence of these bodies, which are described as well-defined salts that may be easily isolated. Like all the other hydrochlorates of chloride hitherto prepared, they all contain water of crystallization, and there are in each case at least two molecules of water for each molecule of hydrochloric acid fixed by the chloride.—On the reproduction of phenacite and the emerald, by MM. P. Hautefeuille and A. Perrey. The conditions are described under which the authors have effected the synthesis of two substances whose properties are identical with those of natural phenacite and the emerald. The analysis of the artificial emerald yielded silica 67·7, alumina 19·6, and glucine 13·4, which are nearer to the calculated proportions than those given for the composition of most natural emeralds. The analyzed crystals, whose density was 2·67, were colourless; but greenish-yellow and green crystals were easily obtained—the former by the oxide of iron, the latter by the oxide of chromium.

BERLIN.

Physiological Society, June 8.—Prof. du Bois-Reymond, President, in the chair.—Prof. Kossel spoke on a new constituent of tea. Inasmuch as the presence of caffein in tea does not suffice to explain its physiological action, he had examined it for other bases, and found in the leaves of tea, in addition to adenin, a new well-characterized base whose composition is $C_7H_8N_4O_2$, to which he has given the name of theophyllin. Theobromin and paraxanthin have the same chemical composition as theophyllin, but the latter differs from the former by a series of well-marked chemical reactions. One question of special interest was as to the constitution of the new base, which belongs to that class of substances known as the xanthin-bodies. Fischer has shown that xanthin yields alloxan and urea when oxidized; and, similarly, it is known that theobromin is dimethylxanthin, yielding, by oxidation, methylalloxan and methylurea; as also that caffein is trimethylxanthin, yielding, by oxidation, dimethylalloxan and monomethylurea. The question hence arose as to the constitution of the new base, which, since it is isomeric with theobromin, is also presumably a dimethylxanthin. Since the speaker was in possession of so limited a quantity of the substance that he could not proceed to oxidize it, he proceeded by a different method, and introduced a methyl group into the molecule of theophyllin: on performing this experiment he obtained caffein, from which it must be concluded that theophyllin contains one methyl group united to a residue of urea, and one to a residue of alloxan, and has therefore a constitution identical with that of theobromin. It still remains to investigate the physiological action of the new base.—Dr. Will spoke on the alkaloids of the Solanaceæ, of which at present only atropin, hyoscyamin, and hyoscin are known as distinct substances with reference to their mydriatic action. The first two of the above are of special interest, as possessing the same chemical composition ($C_{17}H_{23}NO_3$), but differing as regards their melting-point, the salts which they form with gold, and their specific rotatory powers. It had been noticed long ago that sometimes much atropin and but little hyoscyamin, and, *vice versâ*, much hyoscyamin and but little atropin, is obtained from the roots of Belladonna. This difference in the relative amounts of the two substances obtained was noticed when portions of the same sample of roots were treated in the same way; as the result of which the chemical factory of Schering had requested the speaker to investigate the cause of this difference in the relative amounts of the several products. The first fact which he determined was, that when hyoscyamin is heated to 109° C.—that is to say, to a temperature slightly above its melting-point—it changes into atropin. This is, however, of no significance in the preparation of the alkaloids, as carried on in a factory, inasmuch as no such temperatures are employed. Dr. Will further found that, when a few drops of alkali are added to a solution of hyoscyamin which possesses strong rotatory powers, in a few hours the rotatory power is lost, and the solution no longer contains hyoscyamin, but atropin. According to this, during the extraction of Belladonna roots in the factory, the amount of hyoscyamin which may have become converted into atropin is dependent upon the time of action and the concentration of the alkaline solution employed in the process: by treatment with alkali, the whole of the hyoscyamin can always be converted into atropin. The fact that, by the extraction of the roots of Hyoscyamus, only hyoscyamin and no atropin is obtained, was explained by the speaker as being due to the employment of ammonia in the process, which has only a feeble power of converting the one alkaloid into the other. The speaker intends to employ this conversion of hyoscyamin into atropin, which is measurable by means of change in rotatory power, to the determination of the combining affinities of the alkalies. Dr. Will is inclined to believe that relations similar to the above exist in the case of quinine and cinchonine, which are also obtained in varying relative amounts from the bark.—Dr. Koenig gave an account of some experiments, undertaken at his suggestion by Isaacksen, with a view to testing Holmgren's statement that very small coloured dots can only be seen as one of the primary colours of the Young-Helmholtz theory—namely, red, green, or violet. This statement was not, however, confirmed when the necessary precautions were taken, and it was found that small dots of any colour, even yellow and blue, were perceived as possessing their own objective colour; this had also been observed by Hering. Isaacksen had, further, investigated the power which the eye possesses of distinguishing between minute dot-like lights which are so small that their image on the retina only falls on one cone, and found that it was as fully developed as for the colours of large surfaces.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Chemical Problems: Grabfield and Burns (Heath, Boston).—The Movements of Respiration and their Innervation in the Rabbit: Dr. M. Marckwald, translated (Blackie).—Natural History and Epidemiology of Cholera: Sir J. Fayrer (Churchill).—The Photographer's Note-book and Index: Sir D. Salomons (Marion).—Short Lectures to Electrical Artisans: J. A. Fleming, second edition (Spon).—Whence comes Man; From Nature or from God?: A. J. Bell (Isbister).—*Challenger* Expedition Report, vols. xxiii., xxiv. 2 Parts, and xxv., Zoology (Eyre and Spottiswoode).—Annual Report of the Geological and Natural History Survey of Canada, vol. ii. 1886 (Dawson, Montreal).—Another World, or the Fourth Dimension: A. T. Schofield (Sonnenschein).—Changes of Level of the Great Lakes: J. K. Gilbert (Washington).—The Construction and Maintenance of School Infirmaries and Sanatoria (Churchill).—Electricity *versus* Gas: J. Stent (Sonnenschein).—Annalen der Physik und Chemie, 1888, No. 8*a* (Leipzig).

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