THURSDAY, DECEMBER 8, 1887.

TECHNICAL EDUCATION IN MANCHESTER.

PROFESSOR HUXLEY could scarcely have anticipated the ready response Manchester has given to the challenge he threw down at the close of his most able address at the Town Hall on the 29th ult. In speaking of one of the great problems of the day, that of meeting ever-increasing competition and yet maintaining the proper social condition of the workers, he said :—"I have ventured to put this before you in a bare and almost cynical fashion because it will justify the strong appeal which I make to all concerned in this work of promoting industrial education to have a care at the same time that the conditions of industrial life remain those in which the physical energies of the population may be maintained at a proper level, in which their moral state may be cared for, in which there may be some days of hope and pleasure in their lives, and in which the sole prospect of a life of labour may not be an old age of penury. . . . I therefore confidently appeal to you to let those impulses have full sway, and not to rest until you have done something better and greater than has yet been done in this country in the direction in which we are now going."

Only a few hours before the utterance of these words the trustees of the late Sir Joseph Whitworth—who during his life-time did so much to encourage and promote the higher education of working engineers—made a munificent offer to the city of Manchester ; an offer which was only made public by Mr. Darbishire after Prof. Huxley had finished his address, and which goes some way towards realizing what Prof. Huxley remarks may by some be looked upon as the Utopian dream of a student. The gift consists of a plot of land of about twenty-five acres in one of the best situations in the city, which the trustees have purchased for the sum of £47,000. They propose to offer the whole of this to the Corporation of Manchester upon trust, two-thirds to be maintained as a public park, and one-third as a site for the following institutions: (1) an appropriate Institute of Art, with galleries for paintings, for sculpture and moulded form, and for architectural illustration ; (2) a comprehensive Museum of Commercial Materials and Products ; (3) a Technical School on a complete scientific and practical scale. The necessary buildings are to be raised by the Corporation and by public-spirited inhabitants of the great district which owns Manchester as its metropolis ; and the Whitworth Trustees add that, if this work be heartily undertaken, their own further contributions may be looked for.

Such a result of the movement for the Extension of Technical Education and for the higher culture of our toiling thousands may indeed be welcomed, and the National Association, under whose auspices this meeting was held, may well be congratulated on this outcome of its autumn work. But this is not all, for it is not unlikely that the surplus, amounting, it is believed, to about £50,000, now placed at the disposal of the guarantors of the Jubilee Exhibition, may be applied to furthering this enterprise. Manchester has thus before it the prospect of showing England what can be done to promote educational progress in this direction, and to inaugurate a movement which ought to be followed by all the great cities in the country. Can we doubt that the sons of those whose energy and clear-sightedness have in times past placed Manchester in the van of the most important social movements of the day will prove themselves equal to the task which they have now a splendid opportunity of accomplishing? It is by caring thus for the well-being of our workers that the stable condition of society, referred to by Prof. Huxley, can be best secured ; for truer words were never spoken than those in which he stated his belief that, in order to succeed in the competition which is every day becoming more keen, it is not sufficient that our people shall have the knowledge and the skill which are required, but that they must also have the will and energy and the honesty without which neither knowledge nor skill can be of any permanent avail. Mere technical instruction in handicraft or science must, in short, be based on a sound preliminary education. We need to train our workers to be not only clever artisans, but honest men who take pride in the quality no less than in the quantity of their work. It is because these were the views upheld by Sir Joseph Whitworth, and acted upon by him during his lifetime, that his trustees have felt that in no better way could they carry out the important ends for which he laboured than by starting a movement having for its object not merely the technical training of the artisan, but his moral, intellectual, and physical advancement.

H. E. R.

TRIDIMENSIONAL FORMULÆ IN ORGANIC CHEMISTRY.

Dix Années dans l'Histoire d'une Théorie. Deuxième Édition de "La Chimie dans L'Espace." Par J. H. Van 't Hoff. (Rotterdam : P. M. Bazendijk, 1887.)

THIS interesting monograph gives an account, partly historical, partly expository, of what in our opinion is the most important theoretical contribution towards solving the problem of the constitution of organic compounds that has been made since the idea of a definite union of atoms within the molecule was first introduced into chemistry, of which idea, indeed, the new theory is an expansion. The work has the advantage of being written by one of the originators of the theory.

The linked-atom formulæ, which have so powerfully aided the development of organic chemistry, never professed to give any information as to the relative positions of the atoms in space. All that the "links" or "bonds" denoted was the existence of a closer relation of attraction (of a kind not further specified) between atoms represented as directly linked than between atoms represented as not directly linked. The question of the actual position of these atoms was left entirely open. If, therefore, anyone gathered from the graphic formula of methane,

$$\begin{array}{c} H \\ | \\ H-C-H, \\ | \\ H \end{array}$$

for example, that the five atoms of this compound were necessarily situated in one plane, that person was merely permitting the geometrical properties of paper (or blackboards) to influence his conceptions unduly.

In the great majority of cases the ordinary graphic formulæ fulfilled the purpose for which they were primarily devised: they enabled chemists to predict the number and constitution of the isomerides possible for any given combination of atoms. But there were cases, on the other hand, in which the number of isomerides discovered by experiment exceeded that predicted by the theory. This was especially noticeable in the case of those compounds which in the liquid form or in solution produce rotation of the plane of polarized light. Thus, of three compounds to which chemists, from a study of their modes of formation and decomposition, were obliged to ascribe identical atomic linkage, one would be found to cause rotation of the polarized ray to the right, another to the left, whilst a third was optically inactive. As this optical difference was frequently the only difference discoverable, the phenomenon was described as "physical" isomerism—a name which appeared to suggest that the investigation of it lay outside the province of chemistry. Wislicenus, however, in 1873, in discussing an isomerism of the foregoing type occurring in the case of fermentation-lactic acid and paralactic acid, suggested that this was really a "geometrical" isomerism; that, although the mode of linkage of the atoms was undoubtedly the same in the two compounds, the positions of the atoms in space were different.

The demand thus made for a system of tridimensional formulæ was speedily responded to. In the following year, Van 't Hoff, in Holland, and Le Bel, in France, independently, and almost simultaneously,[1] suggested a very simple hypothesis with regard to the distribution of the four affinities of the atom of carbon. From this hypothesis they developed a system of formulæ under which not only the old anomalies of isomerism disappeared, but new lines of experiment in the preparation of unknown isomerides were indicated.

Van 't Hoff and Le Bel called attention to the hitherto unnoticed fact that all organic compounds which in the liquid state or in solution exhibit optical activity, contain in their constitutional formulæ at least one carbon atom, the four affinities of which are satisfied by four *different* atoms or groups. Such a carbon atom they termed, for reasons to be explained presently, "asymmetric" (Van 't Hoff), or "dissymmetric" (Le Bel).

With regard to the distribution of the affinities of an atom of carbon, Van 't Hoff and Le Bel made the assumption that the four monad atoms or groups satisfying the four affinities of such a tetrad atom are situated at the solid angles of a tetrahedron, the centre of which is occupied by the carbon atom. If, now, the four monad atoms or groups are dissimilar, as in the case of optically active compounds, it is possible to arrange them about the angles of the tetrahedron in two different ways, so as to produce two *asymmetric* tetrahedra (considered with regard to the positions of these atoms or groups)—two non-superposable tetrahedra, one of which is the mirror-image of the other. A continuous curve, passing through the four atoms or groups in the same order, will in the one case describe a right-handed, in the other a left-handed, screw-line. Two compounds thus differing in atomic structure only as regards conditions of symmetry might be expected to possess the same chemical and physical properties, save where dissymmetry or polarity is concerned. As a fact, this is found to be the case with optically active compounds. When a compound contains an asymmetric carbon atom, this compound, provided that it has been adequately investigated, can always be shown to exist in two modifications, possessing the same chemical properties and displaying the same chemical reactions, and, as regards physical properties, agreeing in melting-point, boiling-point, solubility, specific gravity, and all other properties not involving the operation of polar forces. But let dissymmetry or polarity in any form intervene, and the non-identity of the two compounds is at once manifested. Thus, as regards the action of the compounds upon polarized light, the one compound turns the polarized ray through a given angle to the right, the other through the same angle to the left. Again, if the two compounds crystallize, although they do so in forms belonging to the same system and having the same angles, yet the crystals exhibit hemihedral faces which are situated to the right in the one case, and in the other to the left. The one crystal is thus the mirror-image of the other—a relation corresponding with that which is supposed to prevail between the asymmetric carbon atoms themselves within the molecule. These two hemihedral crystals also display opposite pyro-electricity. Even the otherwise identical chemical action of the two compounds may be modified by the dissymmetry of a third compound with which they combine; thus, for example, a dextro-rotatory and a lævo-rotatory acid differ in the degree of their affinity for a dextro-rotatory base, and the two resulting salts are generally quite distinct in their properties.

In all artificial syntheses of compounds containing an asymmetric carbon atom the substance obtained is optically inactive. This was to be expected. The chances in favour of the formation of each of the two modifications of opposite rotatory power are equal: both are therefore formed in equal quantity; and the resulting mixture is inactive. There are three known methods of separating the optically active constituents of such a mixture. These methods, due to M. Pasteur, were discovered, it should be mentioned, many years ago, before the Van 't Hoff-Le Bel hypothesis was put forward. The separation is effected: (1) by the greater ease with which one of the two modifications is attacked by some particular micro-organism, it being thus possible to destroy the whole of one modification leaving the other almost intact, and by properly selecting the organism even to destroy at will either the dextro-rotatory or the lævo-rotatory modification; (2) by the different degree of affinity which the two modifications exhibit towards some other optically active compound; and (3) by means of the factthat under certain conditions of temperature and concentration it is sometimes possible to separate the two modifications by ordinary crystallization. By these means Pasteur succeeded in breaking up racemic acid into dextro-tartaric and lævo-tartaric acids.

[1] Van 't Hoff's views were first published in a pamphlet in the Dutch language, in September 1874. Le Bel's original memoir appeared in the *Bulletin de la Société Chimique*, in November of the same year. In May 1875, Van 't Hoff published his pamphlet, "La Chimie dans l'Espace," which, however, did not attract much notice until the appearance of the German translation by Herrmann in 1877.

Optical inactivity may also be due to mutual compensation between two asymmetric carbon atoms, of equal and opposite asymmetry, within the molecule itself. This is the case with inactive tartaric acid.

At the present moment there is no case known which contradicts the foregoing hypothesis. A few substances, which, at the time when the hypothesis was first put forward, were believed to be optically active, and yet contained in their molecule no asymmetric carbon atom, have since been shown to owe their supposed optical activity to impurities. On the other hand, the presence of an asymmetric carbon atom in the formula of an apparently inactive compound has been an indication to chemists that the resolution of the compound into two isomerides of opposite optical activity might be profitably attempted; and in the long list of such attempts that have been made within the last few years there appears to be no record of failure.

We have already alluded to M. Pasteur's classical researches on the tartaric acids, in which he not only rendered the Van 't Hoff-Le Bel hypothesis possible by elucidating all the various modes of optical activity and inactivity which it contemplates, but also devised the methods which have so facilitated its experimental development. It only remains to show how near this great investigator came to anticipating the entire hypothesis. In a passage written in 1860, quoted by Prof. Van 't Hoff, M. Pasteur says, referring to the tartaric acids:—

"Les atomes de l'acide droit sont-ils groupés suivant les spires d'un hélice dextrorsum, ou *placés aux sommets d'un tétraèdre irrégulier*, ou disposés suivant tel ou tel assemblage dissymétrique déterminé? Nous ne saurions répondre à ces questions. Mais ce qui ne peut être l'objet d'un doute, c'est qu'il y a groupement des atomes suivant un ordre dissymétrique à l'image non-superposable. Ce qui n'est pas moins certain, c'est que les atomes de l'acide gauche réalisent précisément le groupement dissymétrique inverse de celui-ci."

This is divination indeed!

We must content ourselves with merely referring to another portion of the subject—the application of the carbon tetrahedron to the explanation of anomalous cases of isomerism occurring among unsaturated compounds; of which *allo-isomerism*, as Prof. Michael has termed it, fumaric and maleic acids may be taken as illustrations. This application, first made by Van 't Hoff in 1874, and accepted later by Le Bel, has undergone within the past year an extension of extraordinary importance at the hands of Prof. Wislicenus in his elaborate memoir "Ueber die räumliche Anordnung der Atome in organischen Molekulen und ihre Bestimmung in geometrisch-isomeren ungesättigten Verbindungen" (*Abhandl. der Königl. Sächs. Gesellsch.*, 1887), of which a very full and appreciative summary is given by Prof. Van 't Hoff in the present work.

The tridimensional formulæ of organic chemistry are thus an accomplished fact. The treatment of the subject is still, of course, only statical; but, taking care not to lose sight of the limitations thus imposed, the method is a perfectly legitimate one.

F. R. JAPP.

THE MAMMOTH AND THE FLOOD.

The Mammoth and the Flood: an Attempt to Confront the Theory of Uniformity with the Facts of Recent Geology. By Henry H. Howorth, M.P., F.S.A. (London: Sampson Low and Co., 1887.)

MR. HOWORTH'S book is not disproportionate to its subject. But even as the mammoth it had a small beginning. It saw light as letters in NATURE. It cast its swaddling-clothes at the British Association. Grown larger, it took passage on board the *Geological Magazine*, and, as some thought, threatened to swamp that useful but far from bulky periodical. Now, with body and tusks alike full-grown, it comes forth to champion cataclysm and scatter the uniformitarians.

The book consists partly of facts, partly of theories. The one part is separable from the other, though of course sometimes the facts are regarded in the light of the theories. We will endeavour in our notice to keep them apart. The first chapter of the work a little reminds us of the *hors d'œuvre* which sometimes precedes a banquet. Appetizing bits, dainty but miscellaneous—the etymology of mammoth, and its identity with behemoth; griffons and their claws; fossil unicorns; dragons' bones; Indian fabulous beasts; stories of giants, and their bones: with such subjects is the reader's palate stimulated. The next chapter gives a history of opinion on the subject of the remains of the mammoth and the woolly rhinoceros. The author then discusses the abode and range of the mammoth in Asia. He considers it to have been limited to the tundras, which must at that time have enjoyed a climate far more temperate than at the present. Then comes an account of the various discoveries of carcasses, either of the mammoth or of the woolly rhinoceros, in Siberia; followed by the history of the same animals and their associates in Europe. The climate of Europe, when frequented by them, is next discussed, and the facts bearing on the extinction of the mammoth are enumerated, particular stress being laid on the evidence of caves and fissures. Palæolithic man is next called into the witness-box, and cross-questioned as to the cause of his disappearance. That he was exterminated by Neolithic invaders does not, to the author, seem a satisfactory theory. That he was a victim of the Deluge is a simple explanation. The Old World is now quitted for the New—the two Americas are examined. In each, at no distant time, huge mammals flourished; their remains are found under circumstances not materially different from those of similar quadrupeds in the Old World. So they also must have perished in like manner: the Deluge was not limited to Siberia nor to the Old World; it swept alike over tundra and morass, over prairie and pampa; it inundated the New. Of course the West Indies could not escape; apparently no corner of the earth eluded the devastating waves, for Australia, Tasmania, and New Zealand tell the like tale of extinguished life, and sudden devastation. Lastly, there is the citation of historical evidence, in the form of brief summaries of the many variations of the widespread tradition of a universal deluge.

The facts, as indicated by the above statement—which is only a concise summary of the table of contents—cannot wholly be disentangled from the theories, in the light of which they are viewed and in proof of which they are ranged. Still, their value is independent of the theories: for the author has dealt with them in the spirit of an advocate, but of an honest advocate. If, indeed, Mr. Howorth can be accused of any forensic art, it is in this very pardonable respect—that the most is made of the opinions of geologists who have held views generally favourable to his own. Thus the unwary and but slightly scientific reader almost trembles before such a weight of authority, and is afraid to question an opinion favoured by so many lights of the heroic age of geology. But in citing authorities it must always be remembered that, unless it can be shown that all the important facts on which an induction is now founded were before them also, the value of their opinion is greatly affected, and it may even be comparatively small. Further, if satisfied on this point, we must inquire whether any, and, if so, what, alternative hypotheses had been presented to them. These preliminary considerations are often overlooked in quoting authorities, yet their importance cannot be disputed. The mind is greatly influenced by early impressions and by the hypotheses which it has accepted. In the multitude of facts we to some extent find what we seek, miss those of whose value we are ignorant, and without any conscious unfairness select those things which support the accepted view. Anyone who has had in the course of his life to reconsider and to modify an induction formerly maintained must be conscious that in this respect he has innocently erred. Probably, only a cantankerous-minded investigator wholly escapes this infirmity, and for him other snares are laid. Hence in this matter the testimony of even such men as Buckland, or Cuvier, or D'Archiac, is of small value, because not only has a vast store of new facts been acquired since their time, which have influenced or modified almost every branch of geology, but also because the widespread belief in a universal deluge and the virulent attacks made on geology by well-meaning but unthinking theologians had produced a natural readiness to welcome everything which seemed to harmonize with the Biblical narrative.

Mr. Howorth urges that a catastrophic occurrence is not excluded by a rational view of uniformitarianism—which position, we imagine, few would dispute in the abstract; but issue would often be joined as to which explanation were the more probable. He points out also that it is quite possible for a particular form of a tradition to be unhistorical, and yet for the tradition itself to have a true foundation, a remark which is certainly just, and which is sometimes forgotten. But, admitting these axioms, the asserted occurrence of any particular cataclysm is a question of evidence; and it is not enough for Mr. Howorth to show that his hypothesis explains some difficulties which exist in the other, unless he further prove that it is not only in accordance with a larger number of facts, but also does not create a new class of difficulties still more formidable.

Mr. Howorth's preface sounds no uncertain note, as the following extract will show:—

"The coral-insect (*sic*) raises the islands of the Pacific, and the fall of leaves in a tropical forest piles up deep black soil. These cases are no doubt cases of continuous change; but if we turn elsewhere we have to explain a very different state of things. The great gaping cliffs and sheer precipices of the Alps, the splintered pyramids of the Sierra Nevada, the cañons of Colorado, the huge dislocations of the strata, involving faults of hundreds of fathoms in extent, so near us as Durham. These have not the look of gradual changes."

We rub our eyes, and wonder whether the last fifty years have been all a dream. Here are dead and gone geological ideas in full vigour. We had thought that if there was one spot on earth in which catastrophe could not be invoked, where the uniformitarian could be in peace, it was the Colorado cañons; and we cannot help thinking that if Mr. Howorth were a member of the English Alpine Club he would by this time have convinced himself that, whatever signs of ruin the Alps may afford, there are none of any vast catastrophe. It is therefore evident that Mr. Howorth's method of interpretation differs from that of geologists in general, and this must throughout the book be borne in mind by the reader. But Mr. Howorth is always rather a special pleader, ingenious sometimes, but generally inconclusive. Granting that occasionally he contrives to give a smart rap to the irrational uniformitarian (for such a person does exist) and hits upon a defect in an hypothesis, he straightway goes on to propose a solution involving greater difficulties. In a brief notice it is impossible to deal with particular instances, but some general indications may be given The carcasses of mammoths are found embedded in ice in the north of Siberia. It is admitted that, from their state of preservation, they must have been frozen up very shortly after death, and have so remained ever since. There are no doubt considerable difficulties in attributing their transport to a river flood, as Mr. Howorth points out; nevertheless, when we remember the peculiarities of the Siberian rivers, and that in a cold region a carcass would be slow to decompose, for the flesh might freeze before it ceased to drift, these do not seem insuperable. Mr. Howorth, as an alternative, offers the hypothesis of a deluge, followed by a sudden change of temperature, but, apart from the difficulties attending the former part of this, by what physical or astronomical catastrophe does he account for the latter? Wisely, he makes no attempt to indicate this.

Again, in speaking of the contents of caves, Mr. Howorth constantly lays stress upon the indications of the action of running waters, and upon the absence of any such disturbing agent at the present time. But he forgets that even followers of Lyell would admit that at no very remote epoch the climate of England was different, the rainfall was heavier, the streams were all bigger, nay, that a cave itself is symptomatic of running water, which in most cases would gradually forsake its old course. The stream which made Clapham Cave still runs concealed, hard at hand, through the limestone rock, and not so long ago, after a downpour on Ingleborough, welled up into its ancient channel. We wonder whether Mr. Howorth has ever seen what the fall of 4 inches of rain in a single night—no unprecedented case—can do even in our English lowlands. Such a downfall would turn many a dry fissure, small as its drainage-area might be, into a running stream. Mr. Howorth, in combating uniformitarians, seems to overlook the variations and catastrophes on a small scale (compared with the bulk of the earth) which everyone who has sat at the feet of Lyell accepts as axiomatic.

It would have been more politic had Mr. Howorth contented himself with local deluges; but no, his destroying waves must pass over the whole earth. What is to generate these destructive waves, what multiplication of a Krakatão catastrophe is needed, how many cubic miles of mountain summit must fall into the sea, or of ocean bed leap up into the air, he forbears to tell us. Here, after a laborious scrutiny of facts, the reader is refreshed by a use of the imagination.

We leave a host of minor difficulties unnoticed for want of space, such as the occurrence of erratic blocks in positions of unstable equilibrium, the relation of drifts, supposed cataclysmal by the author, to the valleys in which they occur, the escape of apterous birds like the moa and the dodo, and the like. We must part from the book by saying that it exhibits great industry in the collection of materials—so that it will long be valuable as a work of reference—with a curious want of mental perspective, and a misapplied ingenuity of reasoning.

NEW ZEALAND SCALE INSECTS.

An Account of New Zealand Scale Insects. By W. M. Maskell, F.R.M.S. (Wellington: Geo. Didsbury, 1887.)

THIS book shows that the valuable work which is being done in South Australia by Mr. Frazer Crawford, Inspector under the Vine-Protection Act, is being done on a still greater scale in New Zealand. It affords an example of the great service which may be rendered by plain and sound publications on the subject of injurious insect attacks in the colonies. In the mother country the works which have been prepared for the Agricultural Department of the Privy Council by Mr. Whitehead, and Miss E. A. Ormerod's constant valuable publications on economic entomology, show what can be achieved in this field.

It is eminently satisfactory to find such an important subject taken up in New Zealand by an observer so well known as Mr. Maskell. The work extends to 116 pages, and includes exhaustive information on the Coccididæ affecting the crops of the island. The life-history of the Coccididæ (which are divided by the author as follows: I. Diaspidinæ; II. Lecanidinæ; III. Hemicoccidinæ; IV. Coccidinæ) is given in all its stages, a whole chapter being devoted to it, with descriptions of the male and female perfect insects in detail, and another to the natural checks to their increase, and parasites, &c.

The remedies against Coccididæ are fully treated of in Chapter V. The author gives a list of washes, of which he says: "Some of the substances here given are manifestly unsuitable for general use on account of their expense, at any rate in the open air; yet it is well to include them, as they are all suggested in some work or other, or in the replies of gardeners and fruit-growers to Parliamentary inquiries, and the objections to them ought to be known."

Chapter VI. is devoted to "A Catalogue of Insects"—that is, of the Coccididæ—and "A Diagnosis of Species," and will be found to be of great service to all students of entomology. Particular attention is paid to the cottony-cushion scale, the *Icerya purchasi*, whose ravages in South Africa have been so ably treated of in the pamphlet lately published by the Consulting Entomologist of the Royal Agricultural Society of England, also by the State Inspector of the Fruit Pests of California, and more recently by Prof. Riley, the well-known Entomologist of the Department of Agriculture of the United States. "Tree-growers should especially beware of this insect, and the best plan to adopt would be to burn at once any tree found infested with it."

This chapter, which occupies almost two-thirds of the book, is succeeded by an index of plants and the Coccididæ attacking them, with the useful reminder that in hot-houses and green-houses all sorts of plants are liable to attack.

The work also contains twenty-three well-drawn plates, which convey a good idea of the Coccididæ to those who have not the opportunity of studying them. Plates I., II., and III. deal with anatomical points or structural details; Plates IV. to XX. give a large selection of insects, with specimens of the various trees and plants they infest; Plate XXI. is especially valuable as giving the male insects *Cœlostoma zœlandicum* and *C. wairoense*, the antenna of the former and the head of the latter being especially well marked. Plate XXII. gives the honey-dew and resulting fungi, and Plate XXIII. parasites of Coccididæ. "Fig. 1, *a*, pupa of Hymenopterous parasites; *b*, the same pupa under the waxy test of *Ctenochiton perforatus*; *c*, imago. Fig. 2, *a*, brown and yellow fungi on *Ctenochiton viridis*; *b*, upper side of brown fungus; *c*, under side of the same, with attached fungoid sheet; *d*, *Ctenochiton viridis* (test removed), filled with yellow fungus, and with globular mass of the same above it."

From the above brief sketch of the contents of Mr. Maskell's book it will be seen that it is a welcome addition to entomological literature. It is written in plain and forcible language, and there is no padding or beating about the bush for the reviewer to find fault with. There is an excellent tabulated explanation of terms used, and students will be much pleased with the author's classification, or rather division or arrangement, of the Coccididæ, based upon a plan most useful for economic entomology:—

"Neglecting entomological distinctions, we may divide the Coccididæ roughly into

"(*a*) Insects attacking deciduous plants;
"(*b*) Insects attacking evergreen plants;

or again:

"(*c*) Insects living usually on the bark;
"(*d*) Insects living usually on the leaves;
"(*e*) Insects living on both bark and leaves;

or lastly:

"(*f*) Insects covered with hard shields or 'scales';
"(*g*) Insects covered with cotton;
"(*h*) Insects naked."

Among other salient points the importance of destroying the eggs is frequently urged upon those who wish to extirpate coccids, and attention is wisely drawn to the fact that "it is a fallacy to imagine that rule-of-thumb methods, not founded upon any knowledge of the nature, habits, and life-history of the insects, are likely to be really efficacious."

We agree with the author that an increase in works on economic entomology is always of good service in any country, and New Zealand may be congratulated on having Mr. Maskell at hand to supply a demand generated by the improved intelligence of the agricultural community.

OUR BOOK SHELF.

Pen and Pencil in Asia Minor; or, Notes from the Levant. By William Cochran. Illustrated with eighty-nine engravings, made chiefly from water-colour sketches by the Author. (London: Sampson Low and Co., 1887.)

THIS well-printed volume of over 450 pages is one of a class that we had thought had become extinct. The notes begin with the arrival of the author at the Alexandra Docks in Liverpool, and are continued almost daily, in some instances hourly, until the close of a five-months' tour through the Mediterranean to Smyrna, Constantinople, and then, with some slight journeys inland, back again by the same route to Liverpool.

No doubt the journey was pleasant, and we feel sure that the note-taking and the water-colour sketching were very agreeable occupations for the tourist; but probably even the author's friends would admit that as now laid before the world the text contains nothing either very novel or attractive, while of the many scenes sketched, omitting the sketches from photographs, we may say that it would be hardly fair to criticize them from an art point of view. The volume is not, however, without its merits. The author deserves credit for the earnest way in which he has called attention to the importance of encouraging the tea and silk industries, and we sincerely hope for the good of our colonies that his efforts in the direction of silk culture in Australia and New Zealand may eventually be as successful as tea-farming has been in Ceylon.

One chief object of the voyage to Smyrna was to see the result of Mr. John Griffitt's silk-farming in Asia Minor. At one time the silk industry was one of great importance in and about Smyrna, but owing to the silk-worm disease it became almost extinct, so that even the very mulberry-trees were used for firewood. Now, through the philanthropic zeal of Mr. Griffitts in supplying silkworm eggs not only free from disease but raised from carefully-selected varieties, the industry is being restored, and large numbers of mulberry-trees are being planted.

Several chapters in this volume are devoted to the subjects of the rearing of silkworms, and of the treatment of the mulberry-trees. From the hatching out of the larval forms to the reeling off of the silk, only some forty to forty-five days elapse, but though the labour be short, the care and attention required are very great, and the successful silk rearer learns various lessons of method and cleanliness which are of permanent value.

In chapter ix. we have a summary of Mr. Griffitt's valuable report on the silk trade, furnished to the Department of State, Washington. From it we learn that at one time in Smyrna there were three large silk-reeling factories, driven by steam, where hundreds of female hands were employed. When, on the failure of the indigenous worms, Japanese worms were introduced, it was found that it required double the number of cocoons to yield the same weight of silk. With Mr. Griffitt's improved native race of silkworms, the quality of the silk is better, and the produce much heavier than before. To those interested in silk culture we can recommend the perusal of this volume, which, indeed, would be better described as "Notes on Silk Culture in Smyrna."

A Catalogue of the Flora of Matheran and Mahableshwar. By the Hon. H. M. Birdwood, M.A., LL.M. With a Note by Dr. Theodore Cooke, LL.D., F.G.S. (1887.)

THIS little botanical work is a reprint from the Journal of the Bombay Natural History Society. It will be useful to persons visiting the localities botanized; and the records of the upper limits of various plants are interesting to botanists at a distance.

Mahableshwar is in the Ghauts, about a hundred miles south of Bombay, and the highest part of this healthy resort is nearly 5000 feet above sea-level, so that there are considerable changes in the vegetation in the ascent. The present catalogue contains the names of less than 500 species of plants, a number which future investigations will doubtless double. As the Bombay Natural History Society is still in its infancy, some singular slips in the classification of the plants are perhaps excusable; and we hope the members will not feel discouraged at our pointing out that ferns are not "plants with cellular tissue only," nor are mosses "leafless plants."

The Bombay Natural History Society possesses a herbarium of Mahableshwar plants, presented to it by Dr. Cooke, and it may be hoped that this will form the nucleus of a collection adequately representing the whole flora of the entire Presidency. Up to the present time the Bombay Government has shown but little interest in botanical work, and possesses none of the appliances for its prosecution to be found at Calcutta, Saharunpore, Madras, or Peradeniya. Yet for the Forest Department alone some kind of herbarium and botanical library is indispensable, unless its officers are to grope in the dark as to a large proportion of the plants they come across in their duties.

However, this is by the way. It is a sign of the development of a healthier interest when a hard-worked official like a judge of the High Court is found to take the lead in so creditable a way in the study of the local flora.

L'Homme avant l'Histoire. Par Ch. Debierre. (Paris: J. B. Baillière et Fils, 1888.)

IN this book M. Debierre gives a clear and interesting account of some of the results of anthropological research. In dealing with disputed points, however, he is apt to arrive at conclusions somewhat hastily. The doctrine of the unity of the human race he rejects, but he contents himself with a very slight and inadequate consideration of the arguments which may be advanced on the other side. Again, he assumes that there can be no doubt whatever as to the Asiatic origin of the Aryan or Indo-European race. That the original home of the Aryans was in Europe cannot be held to have been proved, but the theory has been accepted by so many investigators, and so much may be said in favour of it, that in a work of this nature it ought at least to have been explained and discussed.

Philips' Handy Volume Atlas of the British Empire, with Statistical Notes and Index. (London: Philip and Son, 1887.)

THIS little book is among the first British work of its sort that we have seen. It is extremely neatly put together and is well edited throughout. It contains 64 plates and on them 110 maps, showing the British possessions in the various parts of the globe. After each map is a short analysis of position, extent, population, climate, industries, government, orography and hydrography, &c., &c. In addition to the maps there are plans of various towns. Just before the index are given "Comparative Diagrams of the British Empire," comparing area, population, trade, and revenue of the British possessions of the different quarters of the globe. This is followed by the index itself, with a list of abbreviations, consisting of twenty pages closely filled in with places in three columns. The colouring of the maps is excellent, and it is obvious that no attempt has been spared to make the book as complete as possible in every way. A. L.

The Young Collector's Hand-book of Ants, Bees, Dragon-Flies, Earwigs, Crickets, and Flies. By W. Harcourt Bath. (London: Swan Sonnenschein, 1888.)

ANY boy who may wish to form a collection of insects will find in this little hand-book all the information he will be likely to need at first for his guidance. The author does not pretend to go deeply into the subject, but he has brought together a sufficient number of facts to show beginners that the study of entomology will well reward any labour that may be devoted to it. His explanations are simple and clear, and the value of the manual is much increased by a large number of good illustrations.

LETTERS TO THE EDITOR.

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

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

An Earthquake in England.

As no account has been given in NATURE of a recent earthquake, perhaps room may be found for the following. I was standing near my garden door at 8.20 a.m. on Sunday, November 20, when the quiet was suddenly broken by a heavy smothered crash, followed by reverberations as in a clap of thunder of rather short duration. I felt no shaking of the ground, but many persons here felt it, and the shaking is stated to have been very marked near Dagnall, between here and Hemel Hempstead. The sound was like the falling in of an immense mass of rock—followed by echoes—in a cavern.

Some persons say they heard a second, but much less loud, crash later in the morning, but this was not heard by me.

At Ampthill, near Bedford, persons left the town to meet the first train from London to inquire of the passengers as to a possible explosion having occurred in London.

The crash was heard in Bucks, Beds, Herts, Suffolk, Essex, Cambridge, and possibly in other counties. I have seen reports from Newmarket, Hitchin, Cambridge, Wimpole, Heydon, Royston, and Saffron Walden, in addition to accounts from many positions close to this place.

It is curious that Stow records, under A.D. 1250, the thirty-fourth year of the reign of Henry III.:—"Upon St. Lucie's Day, there was a great earthquake in this town (St. Albans) and the parts thereabouts, with a noise underground as tho' it thundered, which was the more strange for that the ground is chalky and sound, nor hollow or loose as those are where earthquakes often happen; and this noise did so fright the daws, rooks, and other birds which sat upon houses or trees, that they flew to and fro, as if they had been frighted by a gosshawk." WORTHINGTON G. SMITH.

Dunstable.

On the Constant P in Observations of Terrestrial Magnetism.

THE formula for P given by Mr. Rücker (NATURE, vol. xxxvi. p. 508) has evidently been obtained by expanding the usual expression rigorously to terms of the second order; but as the usual expression differs from Gauss's theory by terms of the second order, Mr. Rücker's expansion is necessarily inexact to the same extent, and in fact his second order term has no existence in Gauss's theory.

Going only to terms involving r^{-5}, Gauss's equations may be written—

$$f(u) = Lr^{-3} + L^1r^{-5} \quad . \; . \; . \; . \; . \; . \quad (1)$$

$$f(u_1) = Lr_1^{-3} + L^1r_1^{-5} \quad . \; . \; . \; . \; . \; . \quad (2)$$

$$\frac{m}{H} = \tfrac{1}{2}L\left(1 + \frac{S}{F}\right) \quad . \; . \; . \; . \; . \; . \quad (3)$$

where $f(u)$ signifies either sin u or tan u according to the form of instrument employed.

By putting

$$A = \tfrac{1}{2}r^3f(u) \quad . \; . \; . \; . \; . \; . \; . \; . \quad (4)$$

$$A_1 = \tfrac{1}{2}r_1^3f(u_1). \quad . \; . \; . \; . \; . \; . \; . \quad (5)$$

$$B = \frac{r_1^2r^2}{r_1^2 - r^2} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (6)$$

we find from (1) and (2) respectively

$$\tfrac{1}{2}L = A\left\{1 - B\left(\frac{A - A_1}{A}\right)r^{-2}\right\} = A(1 - Pr^{-2}). \quad (7)$$

$$\tfrac{1}{2}L = A_1\left\{1 - B\left(\frac{A - A_1}{A_1}\right)r_1^{-2}\right\} = A_1(1 - P_1r_1^{-2}) \quad (8)$$

Whence, by inspection,

$$P = B\left(\frac{A - A_1}{A}\right) \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (9)$$

$$P_1 = B\left(\frac{A - A_1}{A_1}\right). \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (10)$$

To find $\tfrac{1}{2}L$ we may use either (4) and (9), or (5) and (10); and in either case the result will be as accurate as our fundamental expressions.

Expanding (10) to terms of the second order,

$$P_1 = B\left(\frac{A - A_1}{A}\right) + B\left(\frac{A - A_1}{A}\right)^2 \quad . \; . \; . \quad (11)$$

and therefore the mean of (9) and (10) is

$$P_0 = B\left\{\left(\frac{A - A_1}{A}\right) + \frac{1}{2}\left(\frac{A - A_1}{A}\right)^2\right\} \quad . \quad (12)$$

whence, by putting

$$C = \log A - \log A_1$$

and remembering that

$$\frac{A - A_1}{A} = \frac{C}{M} - \frac{C^2}{\lfloor 2 M^2} + \frac{C^3}{\lfloor 3 M^3}, \text{ \&c.} \quad . \; . \; . \quad (13)$$

in which M is the modulus of the common system of logarithms, we have to terms of the second order—

$$P_0 = \frac{r_1^2r^2}{r_1^2 - r^2}\left\{\frac{\log A - \log A_1}{M}\right\} \quad . \; . \; . \; . \quad (14)$$

Equation (9) is what I gave in my letter on p. 366 of the last volume of NATURE, where I was careful to say that it was derived from Gauss's original equations. When properly used it is as accurate as equations (1) and (2). Equation (14) was given by Mr. Ellis in his letter on p. 436. It is slightly easier to compute than (9), and differs from that expression by a term of the second order which is less than the accidental error of observation. The second order term added by Mr. Rücker renders his expression less accurate than either (9) or (14), if Gauss's theory is accepted as correct. WM. HARKNESS.

Washington, D.C., November 4.

I THINK that on reconsideration Prof. Harkness will admit that it is not I who have fallen into error. If only two observations are made, equations (7) and (8) are identical, and there is no need for the introduction of P_0. In like manner if numerous measurements were available in which the error of observation was *nil*, any pair would give the same value of L, and P_0 would again be unnecessary. If, however, the equations are affected by errors of observation, and it be agreed that in combining them we may replace the P's by a single quantity, P_0, it must not be arbitrarily defined. Prof. Harkness assumes that in the case of two observations it must be the mean of P and P_1, but he gives no reasons, and he does not state what value he would adopt if the measurements were numerous. The proper course is to determine it by the method of least squares.

Writing f for $f(u)$ and omitting $1 + \frac{S}{F}$, (3) may by the aid of (7) be written in the form—

$$\frac{1}{f} = \frac{H}{2m}(r^3 - P_0 r).$$

This is exactly analogous to the equations used by Maxwell in the determination of the quantity A_2, which in his notation and method of development corresponds to P_0 ("Electricity and Magnetism," second edition, vol. ii. p. 100). It is unnecessary to occupy the pages of NATURE with a reproduction *mutatis mutandis* of his formulæ. We can get, as he does, a general expression for P_0 when we have n equations at our disposal, and when $n = 2$ this reduces (in the notation of Prof. Harkness) to—

$$(\alpha) \qquad P_0 = (A - A_1)/(A/r^2 - A_1/r_1^2).$$

If then in a magnetic survey observations are made at two distances at a number of stations, we should take as the final value of P_0 the mean of the most probable values found at each station. As this would be unduly laborious, we approximate. By an obvious transformation (α) becomes—

$$\log\left(1 - \frac{P_0}{r_1^2}\right) - \log\left(1 - \frac{P_0}{r^2}\right) = \log A - \log A_1$$

$$\therefore P_0(r^{-2} - r_1^{-2}) + \frac{P_0^2}{2}(r^{-4} - r_1^{-4}) + \&c. = \frac{\log A - \log A_1}{M}.$$

Thus to a first approximation—

$$(\beta) \qquad P_0 = \frac{r^2 r_1^2}{r_1^2 - r^2} \frac{\log A - \log A_1}{M}.$$

And if we substitute this value in the small term—

$$(\gamma) \qquad P_0 = \frac{r^2 r_1^2}{r_1^2 - r^2} \frac{\log A - \log A_1}{M}$$

$$- \frac{r_1^2 r^2}{2} \frac{r_1^2 + r^2}{(r_1^2 - r^2)^2} \left(\frac{\log A - \log A_1}{M}^2\right).$$

This is the expression I gave. The effect of the small term in (γ) is, as I pointed out, less than the error of experiment, but it diminishes the difference between the rigorous and approximate values of P_0 given in (α) and (β), and it is useful in indicating the magnitude of the difference between them.

Fortunately all methods lead to (β) as a first approximation which we are agreed is close enough for practical purposes. If, however, we regard the observations as fallible, (α) gives a better value of P_0 than (14), and equation (γ) gives a closer approximation to it than (β) does. ARTHUR W. RÜCKER.

Science Schools, South Kensington, November 24.

P.S.—It may be well to add that, although the formula for A_2 is correctly given by Maxwell in line 17, p. 101, the value of A_2 deduced below is incorrect, being really that of $2MA_2/H$. There is another misprint immediately below, δD being substituted for δQ in the second edition.

Instability of Freshly Magnetized Needles.

I SHOULD like to be permitted to support Prof. Rücker in his reply to Prof. Nipher (NATURE, vol. xxxvii. p. 77), with a few remarks on the subject of observations of magnetic dip.

The question of the degree of accuracy of dip observations is one that has been repeatedly raised and discussed. In 1864 in his report to the Board of Visitors, the Astronomer-Royal, Sir G. B. Airy, referred to the matter, and a correspondance between him and the Chairman of the Kew Committee (Mr. L. P. Gassiot) ensued, which is printed *in extenso* in the Report of the British Association for 1864, pp. xxxiv.-xlvii.

In reply to an inquiry by Mr. Gassiot as to whether the paragraph in the Report was intended to apply to dip observations made at the Kew Observatory, Sir G. B. Airy quoted the following statement by Sir E. Sabine :—"The probable error of a *single observation of the dip* with reliable instruments of easy procurement is known to be ± 1'·5. It has been shown to be so by a series of 282 observations made at Kew, employing twelve circles and twenty-four needles, all of the pattern which has been in use at Kew for several years past. The observations were made by seven different observers; the results are published in the Proceedings of the Royal Society, March 1861, vol. xi. p. 156, from entries in the Kew Observatory books, not a single observation having been omitted. The probable error ± 1'·5 may be regarded as including *constant* errors, considering the number of different circles and needles which were employed, as well as the peculiarities of different observers, of whom there were seven" (the italics are General Sabine's). The Astronomer-Royal then concluded by stating "these are the probable errors which I cannot accept as accurate."

As a result of the correspondence, a series of observations was made at both the Greenwich and Kew Observatories by the observers of both institutions, with the same Kew pattern instruments, and then Sir G. Airy wrote, in a letter dated November 15, as follows: "As regards the results of observations, those made with the Kew instruments are consistent to a degree which I never saw before; and the results for dip obtainable with the Kew dip instruments are undoubtedly more consistent and more certain than I had supposed them to be."

A similar inquiry was set on foot by Dr. H. Wild, of St. Petersburg, and in 1886 we made a large number of observations with different needles for him, the resulting error of an observation being in this case ± 1'·3. The most severe test, so far as we are aware, which has been applied to dip observation, is that recently described by M. E. Leyst, of St. Petersburg, in a quarto volume of 133 pages, published in the *Repertorium für Meteorologie*, entitled "Untersuchung über Nadel Inclinatorien."

The author discusses some 6576 observations of dip made with different instruments and needles, and determines their probable errors, which he always find small, so much so that he deduces the corrections to hundredths of a minute of arc. To quote particular cases, he determines from thirty series of comparisons between observations and the simultaneous readings of the magnetographs and the induction inclinometer, that the difference amounts to only 1'·06; and again, by comparing at Pawlowsk the fifteen needles of the three dip instruments of the Pawlowsk, Irkutsk, and Ekaterinburg Observatories (all of English make, obtained through this Observatory), he finds their mean correction to be nil.

Judging from the experience gained at Kew by the examination of probably 150 circles and 500 needles by various makers and different observers, I can thoroughly indorse Prof. Rücker's opinion that Prof. Nipher's instruments are scarcely capable of satisfying modern requirements as to accuracy, and are such that were they submitted to us for examination they would be promptly returned to their makers for adjustment.

G. M. WHIPPLE.

Kew Observatory, November 26.

Gore's Railway.

As I have had several letters concerning my use of Dr. Gore's arrangement, depicted on p. 107 of your last week's issue, perhaps I may as well say that I am aware it is commonly regarded as a Trevelyan rocker, and that I doubt not its function in that connection. This point of view is so familiar to every one, through Tyndall's "Heat," that I thought it unnecessary to mention it. But I have occasionally heard the motion of the ball attributed to the electro-magnetic action of the current on itself—which is impossible—and I thought it useful to point out that it could nevertheless be used as an illustration of electromagnetic force, provided a vertical magnetic field is applied as well as a current. I should imagine the earth not too weak to have an effect under favourable conditions; but of course such an effect would be strictly definite in direction, and reversible.

OLIVER J. LODGE.

The Highclere Bagshots.

THE notice in NATURE for December 1 (p. 104), by my friend Mr. R. S. Herries, of casts of shells in the Bagshot Beds at Highclere tends strongly to confirm the results of my own work in that district. On the strength of physical and stratigraphical evidence, I have shown the development in that neighbourhood of *all the three stages* of the Bagshot formation as we know it in the London Basin. This will be seen on the publication of a paper which was sent in to the Secretary of the Geological Society on October 10 last, but has not yet been put down by the Council for reading. A. IRVING.

Wellington College, Berks, December 2.

The Ffynnon Beuno and Cae Gwyn Caves.

MR. WORTHINGTON G. SMITH'S letter in NATURE of December 1 (p. 105), is so misleading that I hope I may be allowed to reply to it. As is usual with highly prejudiced observers, he has attempted to prove too much for his case, as he might have seen had he taken the trouble to refer to my papers. The scraper which he mentions was submitted to Dr. John Evans for his opinion, and his conclusion as given in my paper in the Proceedings of the Geologists' Association, vol. ix. p. 17, is as follows. The scraper "is not of a river-drift form, so far as at present known, but is precisely like many from the French caves of the reindeer periods, such, for instance, as La Madelaine." Mr. Worthington Smith's contention therefore that it agrees exactly with "the Neolithic scrapers of Icklingham and Mildenhall" can only prove that there is no chronological value in the classification of such implements. I must explain, however, that we have based no argument on the scraper referred to, since it was found, before the explorations were properly commenced, in an open part of the cavern, and, as stated by me in the paper referred to, "it would be improper to dogmatize on this evidence." I may say at once that I entirely demur to any classification based on the form of the implements rather than on the fauna associated with them, and I see no reason whatever to suppose that the worn, roughly-trimmed implements usually found in river gravels are older than the better-preserved flakes and trimmed implements found in caverns, which would be used for a different purpose from the rougher ones. The implements discovered subsequently belong to the so-called oldest types found in caverns, and were associated with Mammalian remains, equally characteristic of the oldest river gravels as of the caverns. Mr. Smith's statements in regard to the drift "in front of the Denbighshire caves" are of so extraordinary a character that I am tempted to ask him, before I criticize those statements, whether he ever visited the Ffynnon Beuno Caves during the course of the explorations, whether he ever saw the section of the drift exposed at the Cae Gwyn Cave, and what evidence he can bring forward to support his statements that the drift "is not in its original position, but distinctly and obviously relaid," and that he doubts "whether before it was relaid it was a true Glacial gravel at all?" I think the members of the British Association Committee, who have carefully conducted the explorations, and have the strongest evidence in support of their conclusion that the caverns, which are now about 400 feet above sea-level, were occupied by man and the animals before the marine drift and boulder-clay covered them over, have a right to ask for the data upon which such statements as those above referred to are based. These relate to facts, and must be dealt with in a different manner from those statements which are made clearly from a bias against the idea of Glacial and pre-Glacial man. Mr. Smith says that he has not been able to read up the literature of the subject, therefore he is probably unaware of the fact that Prof. Prestwich has recently (Quart. Journ. Geol. Soc. for August last) stated that he has arrived at the conclusion that the high-level gravels, with implements, in the valleys of the Somme, Seine, Thames, and Avon date back to Glacial or pre-Glacial times; and that "the great masses of gravel in the neighbourhood of Mildenhall and Lakenheath, also containing flint implements, are certainly not of fluviatile origin"; and that they seem to him "to be part of the phenomena connected with the passage of the great ice-sheet over the eastern counties, and in that sense pre-Glacial." HENRY HICKS.

Hendon, December 2.

Cloud Movements in the Tropics, and Cloud Classification.

A FEW months ago I called attention to the fact that the general movement of the upper clouds in the tropical regions of the Atlantic was from a westerly point; since then I have worked up all my observations (which extend over a period of 331 days spent in these regions in all months of the year except June) with the following results:—

Between latitudes	Upper layer of cloud comes from	Middle layer of cloud comes from
N. 23° and 17°	S. 67° W.	S. 45° W.
N. 16° ,, 11°	S. 56½° W.	S. 83° W.
N. 10° ,, 6°	S. 1° W.	S. 17° W.
N. 5° ,, 0°	N. 41° W.	N. 35° E.
S. 1° ,, 5°	N. 32° W.	N. 78° E.
S. 6° ,, 10°	N. 45° W.	S. 58° W.
S. 11° ,, 15°	N. 53° W.	N. 16° W.
S. 16° ,, 23°	S. 86° W.	N. 55° W.

Taking a general mean for the whole region, this gives for the upper layer of clouds N. 86½° W., and for the middle layer of clouds S. 73° W. These results are from observations taken by myself, and no observation was registered if there was the slightest doubt as to the cloud movement. The ordinary ship register of upper cloud movements is worse than useless, a propagatory movement of the upper clouds being constantly mistaken for their real movement, and the names being hopelessly mixed, the cirro-cumulus being the source of most mistakes.

The cirro-cumulus exceeds all other forms of cloud in extent, ranging from the delicate fine mottles at a great elevation to the large flaky masses quite low down, and until it is considered a middle layer cloud we are certain to have some confusion.

It is quite time that cloud classification was placed on a more satisfactory basis. Now one observer will call a certain form of cirro-cumulus, a cumulo-cirrus; a moderately high (middle layer) stratus of uniform texture, a cirro-stratus; again, one form of low stratus, a pallio-stratus. Another observer will even call a detached fragmentary stratus, cirro-cumulus; and lots of observations will be useless from one observer failing to understand the particular form of cloud A calls pallio-stratus or B calls cirro-cumulus. Far better to keep to Luke Howard's simple nomenculature till some classification is definitely fixed to which all can agree.

To be satisfactory the classification must be founded on the physical and morphological (if I may use the word here) structure of clouds. I find no difficulty in making observers understand the difference between a stratiform and a cumuliform cloud; this is the first step, and once the distinction is thoroughly grasped the rest is comparatively easy. I propose something of this sort. Two orders, the "Straiforms" and the "Cumuliforms," these to be subdivided into types, and these again into species; *e.g.* taking the ordinary dull-looking stratus commonly seen in anticyclonic areas, it would be described as—

Order	...	Stratus.
Type	...	Low-stratus.
Species	...	Pallio-stratus.

Or take that form of cirrus which appears as lines or threads right across the sky; it would be destribed thus—

Order	...	Stratus.
Type	...	Cirrus.
Species	...	Cirro-filum.

By using this system an observer would be gradually brought to recognize first the broad distinctions and then the minute distinctions in clouds. DAVID WILSON-BARKER.

THE FORMS OF CLOUDS.

SO much attention has been given of late years to the study of clouds, and so many names have been suggested by different writers for the same form of cloud, that the whole question of cloud forms and cloud names must soon be referred to an International Congress. A few remarks on certain broad facts connected with the shapes of clouds, and on the fundamental principles by which weather forecasts are deduced from these forms, may therefore be acceptable to those who have not given special attention to the subject.

The two most important facts which must never be forgotten are: (1) that cloud forms are essentially the same all over the world; and (2) that there are only five or six distinct structures of clouds.

The identity of cloud forms all over the world has recently been demonstrated both before the Royal Society and the Royal Meteorological Society of London by the exhibition of about fifty photographs of clouds taken by the writer in various longitudes, and in latitudes ranging from 72° N. to 55° S. Some of these are reproduced in the illustrations of this article, and the conclusion of identity is irresistible. The cirrifying cloud over an irregular cumulus, in Fig. 3, might be seen over any summer thunderstorm in England, though this example is from tropical Borneo; while the fleecy cirro-cumulus in Fig. 4, which was taken near the Falkland Islands, about 51° S., differs in no respect from the similar cloud we so often see at home. Fig. 6 is a strato-cumulus from near Teneriffe, in the heart of the North-east Trade; but the writer has seen an absolutely identical sky from the summit of North Cape, far within the Arctic Circle.

Fig. 1.—Cirrus wisp over cumulus. Folkestone.

Fig. 2.—Stratus. London

Fig. 3.—Cumulo-nimbus, cirrifying above. Borneo.

The different structures of clouds can certainly be reduced essentially to five or six types. A great deal must of course depend on the definition we adopt of a kind or species of cloud. We believe that one German meteorologist in Rhineland says that he has discovered 30,000 different kinds of cloud, and that he has not yet finished his classification. This is absurd; for though no two clouds are ever exactly the same, any more than any two faces, still certain broad types of cloud structure can readily be recognized.

The first primary type of structure is the cirriform or hairy. The thin fibres of white silvery cloud which constitute a cirrus may assume an almost infinite variety of forms. The commonest is the simple wisp of white threads such as is shown in Fig. 1, floating at a high level over a heavy mass of cumulus cloud. Sometimes the cirrus lies in long straight stripes, which Ley has shown have a great value in forecasting weather; or at other times assumes the "penniform" or plume-like appearance which, according to Vines, precedes a hurricane in the Antilles.

Cirrus as a rule is formed at very high levels—20,000 to 25,000 feet—and the constituent particles are undoubtedly frozen, but we occasionally find a fibrous structure at low levels, where the constituent particles are certainly in a fluid form. Both the cirrus and cumulus in Fig. 1 are composed of icy particles, for the picture was taken on a cold winter day in England when snow showers were flying about. But in Fig. 3 we see a fibrous combed-out structure at quite a low level in Borneo, where the temperature both of the air and the rain makes it certain that the whole cloud mass was made up of liquid particles.

The true cumuloform structure of cloud can never be mistaken. The rising mass of condensed vapour assumes a rocky, lumpy appearance, which is well delineated in the lower portion of Fig. 1. The varieties of form are infinite. Sometimes beautiful little isolated cloudlets, each with its own flat base, float all over the sky, while at other times we only see mountainous masses rising above a gloomy cloud bank on the horizon, as in Fig. 3.

Essentially different from the above is the stratiform structure which is depicted in Fig. 2. Here we have a thin layer of flat cloud, at low level, more or less broken, but showing no trace of either a fibrous, rolled, or lumpy structure. When the sky is broken, this form of cloud is unmistakable, but when overcast it is impossible to distinguish pure stratus from the flat under surface of some kinds of cumulus or nimbus.

The term nimbus is applied to any cloud which is precipitating rain. In practice we find two rather distinct types—a strato-nimbus or flat cloud, and a cumulo-nimbus or rocky rain-cloud. The former is characteristic of the rainfall in front of an extra-tropical cyclone, the latter of the precipitation from squalls and thunderstorms all over the world. Our illustration (Fig. 3) represents a distant view of the clouds over a thunderstorm in Borneo. Below we see the rocky summits of a mass of cumulo-nimbus, while apparently above, but really at about the same level, we find the characteristic fibrous structure that is called "goat's hair" by some, or "false cirrus" by others.

Another typical structure is that which has been called in all times by all nations fleecy, woolly, or some cognate name. In this, clouds assume the appearance of a fleece of wool. Each little mass of condensed vapour has a peculiar fibrous structure, quite different from true cirrus. The density and level of formation vary a good deal. When the cloud is thin at up to about 25,000 feet, most meteorologists call it cirro-cumulus; but when denser, and down at about 18,000 feet, the name of cumulo-cirrus has been proposed to distinguish this low variety. Fig. 4 is an excellent specimen of cirro-cumulus, from a photograph taken near the Falkland Islands

There is a form of cloud intermediate between pure cirrus and pure stratus which is so common and so characteristic of bad weather that it has universally been classified as cirro-stratus. We apply the term to a sky which is covered with a thin layer of cirrus fibres, more or less mixed up with a formless haze or veil of scattered ice-particles. Sometimes the cirrus threads are thin and white as the finest gossamer, and float 25,000 to 27,000 feet above the earth, but at other times the structure is coarser, and the level of formation not more than 18,000 feet. The first kind is called cirro-stratus, the second strato-cirrus. Fig. 5 is an example of a rather heavy cirro-stratus, taken near Dover. It will be observed that there are two distinct lines of structure about which the cloud masses are grouped, and that the lines intersect one another at a certain angle, so that the whole has a certain reticulated appearance. This is most characteristic of cirro-stratus.

Cirro-stratus with its hairy structure, and cirro-cumulus with its fleecy appearance, might at first sight appear to be radically different from one another; but they are not so really. It is by no means uncommon to see a patch of fibrous cirro-stratus suddenly become fleecy for a few minutes, and then return again to its former state. We cannot give the reason for this, as the origin of both structures is at present unknown.

There is a form of cloud, intermediate between stratus and cumulus, to which the word strato-cumulus is appropriately applied. In this the cloud layer is too lumpy to be called pure stratus, and not rocky enough to be called cumulus. Fig. 6 is an excellent specimen of this type, taken near Teneriffe; and here we see the lumpy masses of cloud getting apparently thinner and thinner as they approach the horizon, till they look at last like a series of stripes or rolls parallel to the horizon. This of course is the result of perspective.


FIG. 4.—Cirro-cumulus, or fleecy structure. Falkland Islands.

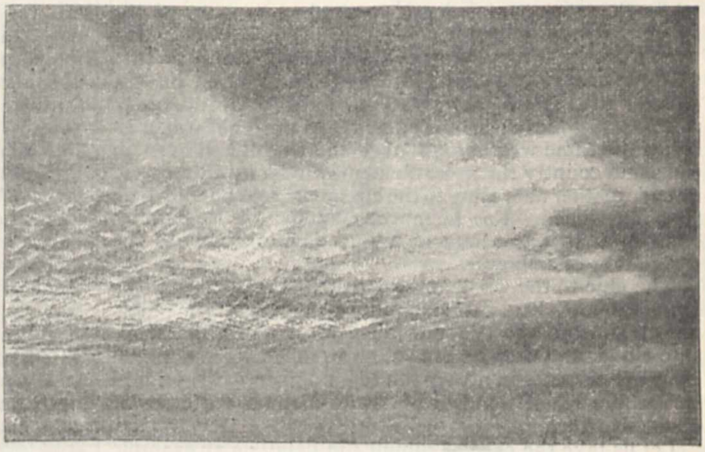
FIG. 5.—Cirro-stratus. Folkestone.


FIG. 6.—Strato-cumulus. Near Teneriffe.

The ten varieties of cloud which we have now described

—cirrus, cumulus, stratus, nimbus and cumulo-nimbus, cirro-cumulus and cumulo-cirrus, cirro-stratus and strato-cirrus, together with strato-cumulus—comprise all the important kinds of clouds; and there are really only five distinct types of structure—cirrus, stratus, cumulus, nimbus, and cirro-cumulus. Prof. Hildebrandsson and myself consider that the ten words above mentioned, compounded out of only four Latin words, are practically sufficient for all ordinary purposes.

Specialists in clouds will of course want more minute varieties, such as different names for some of the kinds of cirrus, and for the low broken clouds, such as scud, wrack, &c. There are also a whole class of pendulous clouds, such as festooned stratus, pocky cloud, or mammato-cumulus; and the long black wreaths of cloud in front of certain types of thunderstorm, but these are all very local, and also very short-lived, so that they need only be mentioned here.

So far for the mere external forms of clouds as they would strike a savage or an artist; but to the meteorologist there is a philosophy behind them. In England some forms presage wind and rain, others indicate the advent of fine weather; while recently it has been shown that different kinds of clouds are developed in different parts of cyclones and anticyclones. For instance, cirro-stratus forms in front, cumulus in rear, of a cyclone; while fleecy cirro-cumulus is very characteristic of the western side of the anticyclones.

But then we are met by the apparent paradox that precisely the same forms of cloud are found on the equator where neither cyclone nor anticyclone was ever developed. Moreover, the same cloud does not prognosticate the same weather all over the world, and even in the same country the same cloud may indicate either good or bad weather according to the circumstances under which it is developed. For instance, cumulus in England is sometimes the associate of a fine day, other times the forerunner of a shower.

The clue to the whole puzzle lies in the fact that the same form of cloud can be produced under totally different circumstances. Vapour-laden air can only condense into cloud, and then be drawn out or rolled about between different currents in a very limited number of ways, and hence the small number of really distinct varieties of cloud structure.

Let us take the case of cumulus in detail as an example of general principles. Cumulus is always the condensed capital of an ascensional column of air, but the source of the uptake need not always be the same. For instance, air may rise either (1) from ordinary evaporation on a fine day; (2) from the uptake of a cyclonic vortex; (3) from the collision between two opposite currents.

The first—evaporation—is the source of fine-weather cumulus in England and all over the world; while the uptake of a cyclone is the cause of rainy cumulus wherever such eddies are formed. The rainy cumulus of the equator is the product of squalls and thunderstorms whose nature at present is unknown in most cases; but one very common cause is the collision between the land and sea breezes of the tropics. The two opposing currents meet, one is forced upwards, and then mountainous cumulus is the result. The cumulo-nimbus in Fig. 3 is over a thunderstorm in Borneo, due to the collision of the land and sea breezes.

All, therefore, that we can say for certain when we see a cumulus cloud is that an ascensional current of air has risen to the level of condensation. What future weather the cloud prognosticates depends on circumstances, and must be judged by our experience and knowledge of the climate in which we may happen to be. Clouds always tell a true story, but one which is hard to read; and the language of England is not the language of Borneo. The form alone only shows that a certain form of condensation is taking place; the true import must be judged by the surroundings, just as the sense of many words can only be judged by the context.

RALPH ABERCROMBY.

FIFTH ANNUAL REPORT OF THE FISHERY BOARD FOR SCOTLAND.

THE Report for 1886 contains so much of general interest that it deserves the attention of many who look upon a Blue-book as the driest of reading, only attractive to those whom it may immediately concern. It is desirable that the scope and practical aims of the Board should be more generally known, and the public should appreciate the excellent work done by it, instead of regarding this as the mere outcome of scientific leanings to certain lines of investigation. The fisheries of Scotland continue to be very productive, and nothing is more striking about them than the great and increasing yield of the herring fishery. Though this increase and the low price at which the herrings have been sold have proved a great boon to the community, especially to the poorer classes, it is deeply to be regretted that the crews sustained very heavy losses from the glutting of the market consequent on the large takes and low prices. A striking feature of the summer herring fishery of 1885 was that many in-shore grounds where herrings had been found in great abundance in previous years but which had been recently all but deserted were restored to their former fertility. This was even more marked in the season of 1886, as all along the east coast from Montrose to the Pentland Firth there seemed to be one immense unbroken shoal of herrings, lying from one to ten miles off land. At no former period in the history of this fishery were the catches so heavy. The winter herring fishery on the east coast was the most productive ever known, yielding a total catch of 128,441 crans. The gross total value of the sea and salmon fisheries of Scotland for 1886 was £2,550,778 8*s*. 3*d*.

During the past year the scientific work consisted chiefly in carrying on the trawling experiments required by the recent Act of Parliament (Sea Fisheries (Scotland) Amendment Act, 1885), but in addition investigations were made as to the development, artificial hatching, structure, and habits of the more important useful fishes. An important part of the inquiry as to the influence of trawling consisted in arranging to obtain statistics showing the quantities of fish landed from the restricted areas, and the conditions under which they were captured—an extremely difficult matter to arrange.

The Board's marine station at St. Andrews has again been under the direction of Prof. McIntosh, whose Report shows that important work on the life-histories and development of the food-fishes has been done at this station by him and Mr. E. E. Prince, by Dr. Scharff on the intra-ovarian eggs of food-fishes, and by Mr. Wilson on the development of the common mussel. The memoir first mentioned, viz. that on the development and life-histories of the food-fishes, is now ready for publication, and is illustrated by thirty-one quarto plates. Its size and the nature of the illustrations of course render it unsuitable for a Parliamentary Blue-book.

The "Report on the Trawling Experiments on the East Coast, Part I. Preliminary," by Prof. Ewart and Sir J. Ramsay Gibson-Maitland, gives the results of an important item in last year's work. The Act already referred to having empowered the Scotch Fishery Board to frame by-laws for the better regulation of sea-fishing, and one such law having been framed, passed, and confirmed, it was necessary to make arrangements to discover, if possible, what influence the prohibition of trawling under the by-law would have in leading to an increase of fish in the protected waters. At the outset it was evident that it would be necessary to make systematic observations on the various areas by trawling along the same lines, and as nearly as possible under the same conditions, as the ordinary steam trawlers; and further, that it would be equally necessary to obtain as far as possible a record of the fish captured day by day from the various grounds in the Firth of Forth, St. Andrews and Aberdeen Bays.

Representations having been made that a small steam-vessel properly fitted out was indispensable, and a sum for the buying and maintenance of such a vessel having been granted, the *Garland*, an iron fishing yacht, was purchased and duly equipped. She was provided with a steam winch, trawling gear, dredges, &c., and later it was found desirable to add a small bridge to admit of a better "look-out" being kept when at work during the night in the vicinity of small fishing-boats, often imperfectly protected by lights. The beam of the trawl provided is twenty-five feet in length, *i.e.* about half the length of those used by the ordinary steam trawlers. This size was selected partly to suit the weight of the ship, and partly to cause as little disturbance as possible to the fishing-grounds when under periodical inspection. Special forms were prepared to admit of a complete record being kept of the fish taken by the trawl, dredge, and tow-net, and of the temperature, state of the weather, &c. The *Garland* was supplied with charts, showing the extent and direction in which the trawl was to be carried in working over the various trawling stations, and with several books of reference, bottles, tanks, &c., for the preservation of spawn, young fish, crustacea, and other objects which required to be afterwards examined or identified. Recently a complete set of thermometers and other instruments for making physical observations have been provided, and the necessary instructions given for their use.

In the present Report it is pointed out that the Firth of Forth is well adapted either as a feeding-ground or a nursery for the most important of our food-fishes and also for shell-fish. As a matter of fact, there is not, it is stated, on the east coast of England or anywhere else on the coast of Scotland, a stretch of water with so many natural advantages from the fishermen's point of view as the Firth of Forth. The fresh water carries with it food for mussels and other shell-fish. The sea brings in food for herring and other round fish. The water varies considerably in depth and salinity, and the bottom at one part consists of sand or mud, at another of gravel or shingle, and at another of rocks, sometimes bare, sometimes covered with sea-weed, and the temperature throughout the year is fairly constant, there never being great heat in summer or very great cold in winter. The physical conditions of St. Andrews Bay are entirely unlike those of the Forth, and this being the case the fauna may naturally be expected to differ considerably. There has not been time to prepare a complete account of the fauna of St. Andrews Bay during the different months of the year, but it is hoped that with the help of Prof. McIntosh a first list will be ready for the next Report. It is, however, known already that the rocky ground on the south shore is rich in mollusks, crustacea, marine worms, cœlenterates, &c.; and that starfish and other echinoderms, edible, swimming, and hermit crabs and other crustacea are scattered in abundance over the sandy bottom of the bay, and especially that mussels abound near the mouth of the Eden. Further, swimming or pelagic forms (including at certain seasons of the year schools of young fish, crustacea, and mollusks) teem in the surface and deeper waters. As is to be expected from the nature of the bottom, flat fish far out-number round fish all over the bay. The flat fish are chiefly represented by several kinds of dabs, by plaice, flounders, skate, and brill, and at times turbot; and in addition the bay is visited by haddock, whiting, cod, and other round fish. Aberdeen Bay corresponds in some respects with St. Andrews Bay, but the closed area includes not the bay proper so much as a narrow portion of the territorial waters (some eighteen miles in length) which extends from Girdle Ness to the Cruden Scars. This area, very narrow at certain points, never reaches a width of three miles. The Dee, Don, and Ythan flow into the bay, but the fresh water flows over the salt without mingling with it as in the Forth to form a true estuary. The bottom consists chiefly of sand, but towards the north and south sand gives place to rock. The fauna resembles that found at St. Andrews, but although flat fish are relatively plentiful, whiting are far more abundant. It is to be observed that, in comparing the prominent features of the three districts investigated, the Firth of Forth is characterized by an abundance of haddocks, St. Andrews Bay by the predominance of flat fish, and Aberdeen Bay by the large number of gurnards and whitings. As regards the practical working of the by-law, it is only necessary to add that although only a year has elapsed since it was passed, providing for a limited form of protection for the waters referred to, there are already some signs of improvement both in the number and size of the less migratory flat fish, and in the number of young round fish which visit the territorial waters for long or short periods. The fishermen of the Forth and St. Andrews Bay state they are already obtaining better takes of flat fish, and that they believe in a few years the in-shore grounds will have recovered to a considerable extent their former richness.

Prof. Ewart gives an interesting paper on "The Artificial Hatching and Rearing of Sea Fish." The publication last year of "The History of Howietoun" (Sir J. Ramsay Gibson-Maitland) marks an epoch in the history of fish-culture. It affords proof that the Salmonidæ at least can be bred and reared in confinement as successfully as any of the smaller domestic animals, and that fish-culture, notwithstanding all the reverses it has suffered through the misplaced zeal and energy of its many would-be advocates, has a great future before it, not only in re-stocking our own rivers and lakes, but also in peopling the waters of all countries where the conditions are favourable to the development and growth of the Salmonidæ and other valuable food-fishes. Fish-culture at Howietoun has been reduced to a science. Every step in the process, from the impregnation of the eggs to the rearing of the mature fish, has been thoroughly mastered and systematized. So careful have the observations been from first to last, that it is now possible to produce, within certain limits, considerable modifications in the time at which the eggs mature and hatch, and in the rate of growth of both the fry and the older fish; and, further, many hybrids have been bred, the genealogy of which is not a little hard without the aid of an ancestral tree to fully comprehend.

The reasons for putting such knowledge acquired to a practical application are that the demand for salmon is greater than formerly, and the nature of the spawning-grounds has been altered. Nature provides for all natural losses, but she does not, and cannot be expected to cope with those created by the necessities of civilization. It is for science to step in and help to solve the problem of supply and demand.

Unlike the higher animals, fish are not protected in the early stages, and the food-fishes even less than others. A very limited acquaintance with the life-history of sea-fish enables one to readily understand that, though the culture of salmon and trout may be highly advantageous, and often all but imperative, it does not follow that this is the case with the herring and cod and their allies. The most sanguine pisciculturist would scarce dare propose to increase the number of the more migratory fish that live in the open sea. It has been suggested that, by hatching fish in-shore, local races might be formed; but this is taking for granted that during the process of incubation the fish are brought under some remarkable spell which arrests their strongly inherited instincts, and leads them to settle down for life in the vicinity of their birthplace, instead of roaming about to see the world like their free born cousins. It seems, therefore, too much to expect cod and haddock and other wanderers to remain always about our doors because they happened to see the light under artificial instead of natural conditions. But though fish-hatching may not be able to influence much, if at all, the number of fish in the open sea, and though it may not be able to establish local races or shoals, it may still be of great service. In the first place, it may be the means of introducing fish, which have the migratory instinct fairly well developed, into waters where they practically did not previously exist. For example, by instituting hatcheries in the upper reaches of some of the long fjords in Norway, a large school of haddocks or other round fish might be readily created which might find all the conditions necessary to their existence without wandering into the open sea; and, in fact, the same results might follow the hatching on a large scale of round fish in some of our own firths and bays. Again, as in America, it might be possible to produce shoals of fish, such as the shad, which, by wandering along the coast or living in the estuaries, would be the means of attracting large and more valuable forms to the in-shore grounds; fish, in fact, which would act the part of the herring, but be a more constant source of attraction—remaining in the firths for several months at a time. Lastly, fish-culture may have a great future before it in hatching flat fish, which have the double advantage of being extremely valuable, while they are often very limited in their migrations. The artificial hatching of sea-fish has not yet had time to obtain a firm footing; for the first trustworthy experiments made were those of the German Commissioners (Meyer, Möbius, and others), who hatched numerous herring in 1874 in the Bay of Kiel. As is well known, Norway has a Society for Promoting the Norwegian Fisheries, with branches at the principal fishing centres. In 1882 an experimental station under Captain G. M. Dannevig was started at Flödevig, near Arendal, where millions of sea-fish have been hatched, and a number of cod and herring reared in a pond near the hatching station. The question of hatching sea-fish is under consideration at the present moment at Grimsby. It is proposed to found a hatchery at Cleethorpes to propagate round and flat fish, with a view of replenishing the exhausted in-shore waters of the North Sea. Even should this experiment prove unsuccessful, it will be of importance in furnishing and spreading the technical education and information so much required among those engaged in the fishing industry.

To successfully hatch sea-fish in large numbers, the first and last requisite is an abundant supply of pure sea-water. This necessitates a small sea-pond and a number of large tanks, from which a constant supply of pure filtered water can be readily obtained. In addition to having at command an abundant supply of sea-water, it is, of course, necessary to have the hatching-station in the vicinity of some rich fishing-ground, where plenty ripe fish may be obtained when wanted.

Given plenty pure sea-water and a number of ripe fish, the next desideratum is a hatching apparatus, the form of which must depend on the nature of the eggs to be manipulated. While herring eggs are heavy, and not only fall to the bottom, but adhere to whatever they touch, the eggs of most of the food-fishes are non-adhesive and lighter than sea-water, and hence they float at or near the surface. Prof. Ewart describes and figures a promisingly practical hatching jar for adhesive eggs lately designed and used by himself, also the apparatus used at Arendal for floating eggs, the most successful hitherto devised. With such apparatus it would be possible, at a very small outlay, to hatch millions of floating food-fish eggs, and thus to restore and maintain the original productiveness of the in-shore fisheries. The conclusion is that we ought to establish hatching stations at one or more centres. One might be for round fish, the other for lobsters and other shell fish. The Firth of Forth and the Cromarty Firth seem admirably adapted for the purpose, one great point being that minute pelagic forms, such as the young fry feed on, are remarkably abundant in both. A hatching station could be provided for about £1000, and it is hoped the Board may soon obtain a vote for the purpose. The hatching operations at Flödevig, of the report of which Prof. Ewart gives an interesting abstract, shows that many important practical questions have been settled, and the conclusions reached at Howietoun and elsewhere as to the influence of extreme temperatures, sudden changes in the surroundings, and also on the eggs and young spawn on full-grown fish, have been well confirmed.

Mr. Duncan Matthews gives (Part I.) a long paper, excellently done, on "The Structure of the Herring and other Clupeoids," with a series of capital plates; also Part II. of the "Report as to variety among the Herrings of the Scotch Coast"; notes on "The Food of the Whiting," and on the "Ova, Fry, and Nest of the Ballan Wrasse." Mr. R. D. Clarkson's paper "On the Nutritive Value and Relative Digestibility of White Fish" is as interesting from the dietetic point of view as Mr. C. E Fryer's suggestions for "The Preparation of Sprats and other Fish as Sardines" is from the economic. Prof. McIntosh reports on the work done last year at the St. Andrews Marine Laboratory. The other scientific investigations include notes on "The Food of Young Gadidæ," and on "The Spawning of the Pike," by Mr. George Brook; on "Entomostraca," by Mr. G. S. Brady; a paper on the "Development of the Common Mussel," by Mr. John Wilson; one on "The Physical Conditions of the Water of the Firth of Forth," by Dr. H. R. Mill; and a "Further Report on the Examinations of River-waters for Micro-organisms," by Prof. Greenfield and Mr. John Gibson. There are a number of tables and plates which add greatly to the interest and usefulness of the work.

PROFESSOR A. WEISMANN'S THEORY OF POLAR BODIES.

ONE of the most noticeable features at the recent meeting of the British Association at Manchester was the manner in which naturalists of all nationalities agreed to do honour to Prof. Weismann, who has contributed to theoretic biology in the last few years with as lavish a hand as that with which he formerly enriched the practical side of the science through detailed observation and far-reaching induction.

Of his later speculations upon the significance of obscure reproductive phenomena, the first [1] was abridged by Prof. H. N. Moseley (NATURE, vol. xxxiii. p. 154); while perhaps the most important contribution to biological science at the Manchester meeting was an abstract of the newer pamphlet [2] recently reprinted in this journal (vol. xxxvi. p. 607). The necessary limits of such an abstract precluded any account of the observations which appeared to support Prof. Weismann's views, as also of the details of the process by which, as he supposes, the plasmata are removed in the polar bodies. As neither the original pamphlet nor the still later account of his observations upon parthenogenetic eggs are generally accessible, it has been suggested that some additional points, in expansion of the abstract, should be given in these columns.

[1] "Die Continuität des Keimplasma's," Jena, 1885, 122 pages.
[2] "Die Zahl der Richtungskörper," Jena, 1887, 75 pages.

Certain recent observations on the maturation of the ovum are of great interest in this connection, as illustrating the possible mechanism by which ovogenous plasma in the extrusion of the first polar body, and a number of ancestral plasmata in that of the second, are removed from the nucleus of the ovum; the former process being designed to *equalize* in bulk the ovogenous and germinal plasmata contained in the nucleus (*Aequationstheilung*), the latter to *reduce* the total number of ancestral plasmata present by a half (*Reduktions-theilung*).

For this reduction in number of the ancestral plasmata there must be a second and special form of karyokinesis not as yet generally recognized. If any value be attached to the fact, first observed by Flemming,[1] that in normal karyokinesis the nuclear loops are split longitudinally, one of the resultant halves passing to each daughter-nucleus, then the two nuclei produced by such division must be precisely alike, not only quantitatively, but qualitatively. For Prof. Weismann's view, however, there must exist "a type of karyokinesis in which the primary equatorial loops are not split up, but separated into two groups,each of which groups forms one of the two daughter-nuclei." E. Van Beneden[2] has already shown that in the formation of the polar body of *Ascaris megalocephala* the nuclear division differs from the usual type of karyokinesis in that the plane of division is at right angles to the normal; and Carnoy[3] has more recently essentially confirmed the observation, and has further added that, of the eight nuclear loops which are to be found in the equator of the spindle, four are removed in the extrusion of the first polar body, and two of the remaining four with the second. Were it certain that each of the eight loops consisted of ancestral plasma, it would be necessary to regard the first division of the nucleus as a process of reduction, not of equalization; but this is not to be accepted, mainly because the extrusion of the first polar body is to be found also in parthenogenetic ova. With more probability the first polar body of the ovum of *Ascaris* is to be regarded as removing ovogenous plasma, since we know, through the observations of Flemming and Carnoy, that under certain conditions secondary splitting and consequent numerical duplication of the nuclear loops may occur. This shows, in Prof. Weismann's view, that there exist nuclei in which the same ancestral plasmata may be present in different loops. Such "identical loops," however, are not necessarily at the same ontogenetic grade; and this is probably the case here, as the four loops of the first polar body must be regarded as ovogenous plasma, the other four as germinal plasma. This would be practically proved if it could be shown that the eight loops were produced by longitudinal splitting of four primary loops, since such splitting is the means of separating plasmata of different ontogenetic grade from one another, without diminution of the number of ancestral plasmata.

With regard to the male cell, the facts at our disposal are too few to enable us to speak with such confidence as is the case with the ovum, but whether the theory of Pangenesis, or of the Continuity of Germ-plasma, be proved correct, a process of reduction of ancestral plasm similar to that occurring to the ovum must also take place in the maturation of the sperm cell, though probably after a different manner. The ancestral plasmata of the ovum undergo reduction only at the termination of ovarial maturation. Supposing, however, that reduction affected the first ovicell of an organism only, and that the rest were produced from this by normal division, then there would be practically but two kinds of ova in the ripe ovary, coresponding to the two halves of the original ovicell, and but two kinds of individuals produced from them, the members of each kind resembling each other as closely as twins. On the other hand, the later the period of germ-cell-formation at which the reduction is effected, the more will the ova differ in composition from one another, and the greater scope is afforded for variation among the resultant individuals. Finally, if reduction be deferred till the ova be mature, the variation insured among the progeny is as great as it is possible to achieve. The production of such maximum variation is the probable explanation of the fact that the second polar body is not extruded till the *end* of maturation. With the sperm-cells, however, the conditions of number and size are different from those obtaining in the ova. Though it is quite conceivable that the process of reduction may be deferred till the completion of sperm-cell formation (both of the fission-products probably remaining as sperm-cells), still the other possibility must also be considered—namely, that it may take place at an earlier date in the formation of the sperm, since the opportunity for extreme variation, however necessary in the case of ova of which a considerable proportion are fertilized, is far less requisite among sperm-cells, of which perhaps one in a hundred thousand or a million may be actually effective. The question can only be settled when we know which of the forms of nuclear division it is that effects the reduction of ancestral plasmata; in the meantime there is evidence to show that different types of fission are found at different stages of sperm-cell formation. Van Beneden and Julin[1] have shown that direct and karyokinetic division alternate in the spermatogenesis of *Ascaris megalocephala;* and the observations of Carnoy[2] and Plattner[3] on Arthropoda further point to the occurrence, at certain stages, of that less-known type of karyokinesis which, according to Prof. Weismann, is cha[illegible] the process of reduction. The "*Nebenkern*," described by La Valette St. George as occurring at the penultimate stage of spermatogenesis, is probably comparable to the first polar body extruded by the ovum.

As is now generally known, Prof. Weismann has succeeded in demonstrating that one, and only one, polar body is extruded from the parthenogenetic ovum; but the memoir[4] dealing with the details is but recently published, and is in a periodical inaccessible to most readers. His observations cover the following species:—

Cladocera.	Ostracoda.
Polyphemus oculus.	*Cypris reptans.*
Leptodora hyalina.	*Cypris fusca.*
Bythotrephes longimamus.	
Moina rectirostris.	Rotifera.
Moina paradoxa.	*Callidina bidens.*
Daphnia longispina.	*Conochilus volvox.*
Daphnella brachyura.	
Sida crystallina.	

The process in the Cladocera is as follows. The nucleus of the ovum approaches the periphery, and becomes gradually fainter till it is no longer recognizable except by the help of reagents. A normal nuclear spindle is then formed, and the polar body cut off with the resultant half-nucleus. After extrusion, the polar body may in some instances not only segment, and one of the resultant cells again segment, but, in the case at least of *Moina*, it appears that it secretes that part of the egg-shell which immediately overlies it, so that its true cell-nature is indisputable.

With regard to the Rotifera, a group in which its occurrence has been denied, a true parthenogenesis is proved by the following observation. A female of *Callidina* with two uterine embryos was isolated on a slide; after

[1] *Arch. Mikr. Anat.* xvi., and elsewhere.
[2] *Arch. Biol.* iv.
[3] *La Cellule*, 1886.

[1] *Bull. Acad. Belg.* (3) vii. 312.
[2] *La Cellule*, 1885.
[3] *Intern. Monatschr. f. Anat. Histol.* iii. Heft 10.
[4] Weismann and Ischikawa, "Ueber die Bildung der Richtungskörper bei thierischen Eiern," *Ber. Naturf. Gesell.*, Freiburg i. B., iii. pt. 1, 44 pages, 4 plates.

the lapse of a day was born a young one, which possessed in its uterus an ovum already in segmentation. From this ovum two days later was produced a third female, while a second ovum in the uterus of the mother was also already commencing to segment. Whether *all* the "summer" (parthenogenetic) eggs develop into females or not, has yet to be proved. Here also it was shown that one polar body was extruded.

The second part of the memoir sums up the literature relating to the subject, with the result that the extrusion of two primary polar bodies from fertilized ova has been demonstrated in sixty-six cases, that of one only from parthenogenetic ova in fourteen cases; while none of the few observers who describe the extrusion of one polar body only from a fertilized ovum, have endeavoured to show that a second one may not have been present, at an ontogenetic period other than that which they describe.

G. HERBERT FOWLER.

SIEMENS'S GAS-BURNERS.

OWING to the very high temperature of ignition of gas, the only way in which it can be successfully used with the greatest economy is by the application of regenerators. This was proved practically by the late Sir William Siemens in carrying out his own and his brother's invention of the regenerative gas-furnace. For more than eight years now Mr. Frederick Siemens has devoted a portion of his attention to the domestic applications of gas, and he has quite recently opened a depot in the Horseferry Road for the sale of his gas-lamps. Here, on Tuesday afternoon, he entertained several gentlemen interested in gas illumination, and tested photometrically some of the burners we propose to describe and illustrate.

It is well known that the light intensity of a flame increases with its temperature in a higher ratio than the arithmetical, although the actual ratio has not been absolutely determined. It is, moreover, known that the more the energy of flame is transformed into radiant light and heat the less is the amount carried away in the products of combustion. But the difficulty is to take advantage of these laws in practice, and to combine high temperature with durability, and the use of regenerators with simplicity of arrangement and elegance of appearance in the lamp.

After the Smoke Abatement Exhibition, at which Mr. Frederick Siemens's regenerative gas-lamps were for the first time exhibited in this country, a great outcry was raised on account of their unsightliness. The economy

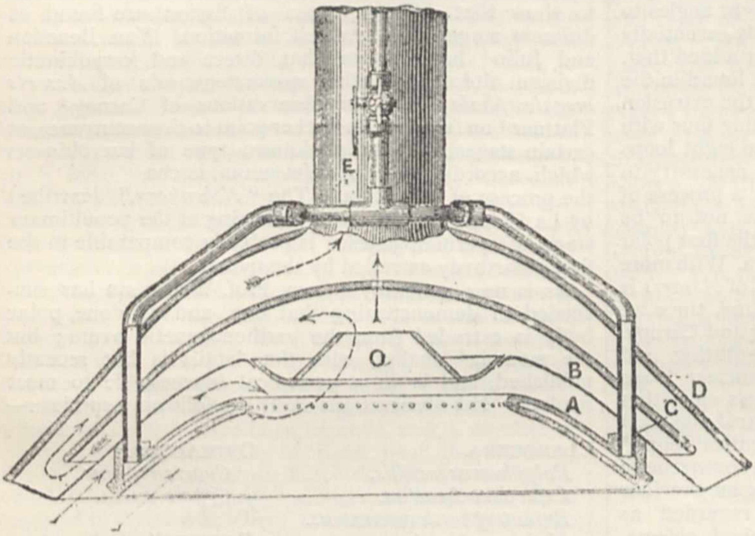

FIG. 1.

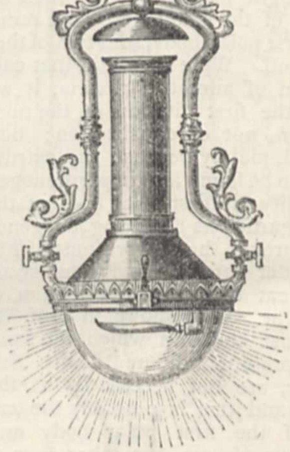
FIG. 2.

of the light and its intensity were in vain dwelt upon: the British public were not inclined to entertain the new lamps, and a comparatively small business was done in them. Besides this, it was discovered by degrees that when impure gas was employed the gas passages became blocked with a sulphurous deposit, so that, in order to maintain their high efficiency when in constant use, these passages had from time to time to be cleared. Mr. Siemens set to work to overcome both these defects, and the lamps he has now produced lend themselves to artistic ornamentation, and have no passages to offer obstructions to gas of ordinary quality.

The lamp we propose to describe in the first instance is the one known as the open-flame sunlight pattern. It is designed for use in positions where the ordinary sunlight lamp is employed, such as public halls, concert, dining, and billiard rooms, banks, and theatres. The flame in this lamp is extremely delicate and elegant in appearance, having the form of an inverted cone of light, apparently unsupported. The annexed drawing illustrates the construction of this lamp. Four hoods made of suitable material are arranged one above the other so as to form passages through which the products of combustion are removed, their waste heat being utilized to heat the air supplied to the flame. The jets of flame issue in a ring from the lowest hood; the products of combustion, passing through the aperture O, are drawn downwards through the annular space B, and then upwards through C to the chimney E. The hood between the passages A and B is intensely heated by the products of combustion descending on its upper surface; and the air which travels through the annular space A, on its way to supply the gas-jets, takes up the heat from the hood, the flame being thus supplied with heated air, as well as burning in an intensely hot atmosphere. The lamp we were shown consumes 24 cubic feet of gas per hour, and gives, with ordinary London gas, a light equal to 180 sperm candles, or 7·5 candles per cubic foot of gas, which is more than twice the light obtainable from the same amount of gas burnt in ordinary burners. This lamp was set up with a ventilator, but was much too brilliant for use in the room in which it was exhibited, the ceiling being only about 12 feet above the floor, whereas it should be placed at an elevation of 30 feet or more, when it would not only serve for illuminating-purposes, but also for those of heating.

The Siemens regenerative flat-flame burner, as will be noticed from the accompanying illustration, is a lamp of a quite different character from the one just described, burning as it does within an inclosing glass, the previous lamp being quite open to the air. The lamps exhibited consumed from 7 to 8 feet of gas each per hour, and are of various ornamental forms. It consists simply of an ordinary bat's-wing burner supplied with hot air through perforated plates, which are heated by the waste heat from the products of combustion, and by radiant heat communicated to the perforated plates. The advantages of this form of lamp are those of construction, application, and economy. The principal parts of the regenerator consist of simple castings, whilst the only wearing part is the tip or burner, which is, as already stated, of the ordinary kind, and may be easily replaced at trifling cost. It can be fitted to the ceiling of a room like any other gas-lamp, or may be connected up to a chimney, so that the products of combustion may be withdrawn from the apartment. There is a provision for lighting this lamp without removing the glass globe, the glass being sufficiently far removed from the flame not to receive any deposit upon its surface. With a consumption of 7·2 cubic feet of gas per hour, this lamp has been found to give without reflector a light equal to 72 sperm candles, or 10 candles per cubic foot, being more than three times the light produced by ordinary gas-burners, whilst if three flames are inclosed in the same lamp the efficiency obtained is still higher.

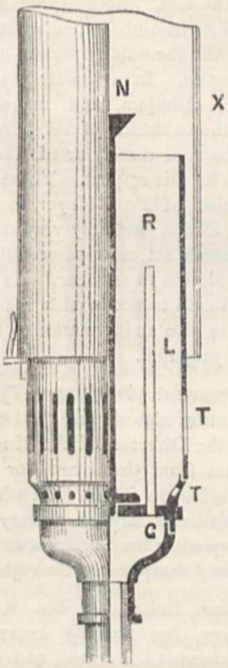

FIG. 3.

A third form of burner is Siemens's improved argand. This is not a regenerative gas-burner properly so called, and hence the economy is not so great as in either of the burners previously described. Instead of utilizing the waste heat of the products of combustion, in this burner the heat of the lower or non-luminous portion of the flame is applied for the purpose of heating up the air which is supplied to the burner. The sketch shows the arrangement in half-section. It consists of gas-chamber, G, and tubes, R, from which the gas issues and is burnt; a metal stem, N, rises a certain height above the top of the gas-tubes, serving the double purpose of improving the form of the flame and conducting a certain amount of heat down to assist in heating the air supplied to the burner. The air enters through the slots T, in the lower portion of the cylindrical case L, which surrounds it, a hot chamber being thus formed, from which the heated air passes to the flame. A glass chimney, X, incloses the flame as in the ordinary argand burner.

By means of this lamp an intense white light is produced with some economy of gas, the light produced with 6 cubic feet of gas being 26 candles, or 4·33 candles per cubic foot per hour, as compared with 3·2 in the ordinary form of argand burner. When an opal glass shade or reflector is used, throwing down a portion of the light, this burner gives a light of 6·33 candles per cubic foot. Its applications are various, but it is mainly applied for reading and desk purposes.

Mr. Siemens, in reply to a vote of thanks, said that the only economical way of burning gas was with the application of regenerators. This had already been proved by both the late Sir William Siemens and Mr. Frederick Siemens as regards furnaces for industrial purposes, and it is now being exemplified by Mr. Frederick Siemens in the domestic applications of gas.

NOTES.

THE University of Cambridge has sustained a severe loss by the death of Mr. Coutts Trotter. He died on Sunday morning last. Next week we shall give some account of his services to his University and to science.

THE United States Chief Signal Office has suppressed both its mountain stations, Pike's Peak and Mount Washington. The latter was suppressed at Michaelmas. The grounds alleged are—the reduction of the grant by Congress, which has been very serious, and, further, inability to use the reports in forecasting.

THE Chief Signal Officer (Washington) has issued a circular, dated November 10 last, stating that, in view of the large number of letters he has received deprecating the discontinuance on January 1, 1888, of the International Meteorological Observations (see NATURE, vol. xxxvi. p. 545), he has decided to continue to receive such observations, made at noon, Greenwich time, after that date. He does not promise to publish them as regularly as heretofore, but he will do what he can to give observers some return for their labours in the interests of the science of meteorology.

THE *Annalen der Hydrographie und Maritimen Meteorologie* for November contains the first part of the explanatory text of the daily synoptic charts of the North Atlantic Ocean for the winter quarter of 1883-84, together with charts showing the positions of the principal barometric maxima and maxima (see NATURE, vol. xxxvi. p. 159). The depressions of January 22-31 are of especial interest, as they include the lowest barometrical reading ever recorded in Europe, viz. 27·332 inches at Ochtertyre, near Crieff, N.B., on January 26, 1884. The readings nearest to this are 27·33 inches, about 6° further south in the Atlantic, on February 5, 1870, and even 27·245 inches in Iceland on February 4, 1824. A still lower reading has lately been quoted for False Point (NATURE, November 17, p. 68). The storm of January 26-27 was also remarkable for the rapid fall before, and the rapid rise after, the minimum pressure.

THE Monthly Weather Charts of the Bay of Bengal and adjacent sea north of the equator, recently published by the Meteorological Department of India, very clearly illustrate the distribution of pressure, wind, and currents, as well as the changes of the monsoons, in those parts. The charts have been prepared from data for the years 1855-78, and supplied by the Meteorological Council, at the expense of the Indian Office. Each chart is accompanied by explanatory text.

LAST Saturday there was a severe earthquake in Calabria. Two shocks were felt: one at 5 o'clock in the morning, the other two hours later. Both shocks were felt all over the province of Cosenza, but the second was by far the most violent. All the signalmen's huts on the railway near Sibari were destroyed for a distance of 8 kilometres. The station of Lattarico was also destroyed. At Paola the barracks and the Prefecture and Communal buildings were damaged; at Rogliano and Gravina several houses fell, and all the others were seriously shaken; and at San Marco part of the monastery fell. The results were most disastrous at Bisignano, the greater part of which was destroyed. More than twenty persons were killed, and about seventy injured. The parish priest of Bisignano, after having made his escape from the church, re-entered it, when the building fell in, and he was killed. The results at Bisignano would have been even more terrible, had not most of the inhabitants, alarmed by the first shock, fled from their houses. It is said that 900 houses are in ruins.

A CORRESPONDENT writes to us from Blackburn:—"A shock of earthquake occurred at Chorley, Lancashire, on December 1, at about 10 minutes to 7 o'clock a.m. It was also felt over a wide area. At Blackburn, two distinct vibrations were felt. The direction of the disturbance appeared to be from south-west to north-east."

ON November 5, at 7.16 p.m., a severe shock of earthquake was felt at Bodö, on the north-west coast of Norway. Houses shook, and several objects on walls fell down. There was only one shock, and it lasted about half a second.

ON the evening of November 21, at 5.18 p.m., a magnificent meteor was observed in the neighbourhood of Stavanger, on the west coast of Norway. It first appeared in the western sky, and, having described a semicircle, disappeared below the horizon. Its size was that of a child's head, and its light a brilliant white. The weather was fine and starry at the time.

MR. JOHN AITKEN has contributed to the Proceedings of the Royal Society of Edinburgh an interesting note on the formation of hoar-frost. Experiments were made with a sheet of glass exposed horizontally near the ground. During the deposition of dew the windward edges were generally dry, because the air has to travel over the cold plate before its temperature is reduced to the dew-point; but, when hoar-frost is deposited, the windward edges of the plate have the heaviest deposit. In this case the air seems to act as if it were supersaturated. Although this is impossible in ordinary conditions, the author shows that, if we have a water suface and an ice one at the same temperature, the vapour will tend to pass from the water to the ice, because the vapour-pressure of water is the higher; and he concludes that something like this takes place when hoar-frost is forming, the air which is saturated to a water surface being supersaturated to an ice one.

DR. FRIDTJOF NANSEN, of the Bergen Museum, has announced his intention of attempting to cross the interior of Greenland next summer on *Ski*, viz. the snow-runners found so advantageous during the last Nordenskiöld expedition across that continent. It may be remembered what extraordinary progress the Lapps made at that time on these Scandinavian means of locomotion across snow-fields. Dr. Nansen, who has on a former occasion visited the inland ice in Greenland, has placed his plan before Baron Nordenskiöld, who fully believes in its realization, and is giving Dr. Nansen every assistance. The explorer purposes crossing from the east to the west coast, the reverse of Baron Nordenskiöld's attempt.

AN important paper by Prof. Lothar Meyer, upon the subject of "oxygen carriers," will be found in the current number of the *Berichte*. It embodies the results of a systematic series of experiments in which currents of oxygen and sulphur dioxide gases were simultaneously passed for some hours through solutions of certain salts of known strength contained in flasks heated upon the water-bath. At the end of each experiment the sulphur dioxide remaining in solution was expelled by a current of carbon dioxide, and finally a determination was made of the amount of sulphuric acid formed by oxidation of the sulphur dioxide. The results show that the salts of certain metals exert a most remarkable action in causing the union of oxygen with sulphur dioxide. The most active of all is manganous sulphate, $MnSO_4 . 5H_2O$, 2·4 grammes of which, dissolved in 200 c.c. of water, caused the formation of no less than six times as much sulphuric acid as that originally contained in the salt; that is, for every molecule of the sulphate employed, five molecules of free acid were synthesized. Manganese chloride under like circumstances was also found to act as an energetic oxygen carrier, one molecule of $MnCl_2 . 4H_2O$ causing the formation of 4·3 molecules of free sulphuric acid. Copper salts were next experimented upon, and a 3 per cent. solution of the sulphate, $CuSO_4 . 5H_2O$, was found to be most effective, one molecule causing the production of about a molecule of the acid. Both cuprous and cupric chlorides, the former in spite of its insolubility, act even more energetically than the sulphate, while the oxide hydrate, and, metal itself also work in a lesser degree. In a similar manner salts of iron, cobalt, nickel, zinc, cadmium, and magnesium were found capable of causing the oxidation of sulphurous acid, while salts of thallium and potassium merely acted like pure water, being absolutely powerless in this respect. These remarkable results are due, in the opinion of Prof. Meyer, to alternate oxidations and reductions, and this is certainly very strongly supported by the fact that those metals act most powerfully which readily pass from one stage of oxidation to another. As zinc, cadmium, and magnesium are also found to act in this manner, it is presumed that these metals have also an inclination to form sub-salts which have never yet been prepared.

SOME days ago a peasant ploughing at Tjöring, in Denmark, unearthed a handsome armlet of pure gold weighing 12 ounces, which, according to the Director of the Museum of Antiquities in Copenhagen, dates from the second or third century A.D. There was formerly a barrow in the field where the armlet was found, and flint implements, broken pottery containing decayed bones, &c., have frequently been brought to light; but all traces of the barrow have now disappeared through ploughing.

IT is reported from India that Mr. Rea, of the Madras Archæological Survey, has recently excavated some ancient burial-places at Dadampatti, Paravai, and other places in the Presidency, and investigated the cromlechs near Kodaikanaul. He has obtained a considerable collection of ancient pottery, and in some of the tombs found a large number of bones and a complete human skull. The latter had been filled up and inclosed in soft clay, so that its contour and characteristics are perfectly preserved. Mr. Rea also brought away a small specimen of a pyriform tomb.

LAST Thursday, Sir John Lubbock read a paper before the Linnean Society, in continuation of his previous memoirs, on "The Habits of Ants, Bees, and Wasps." He said it was generally stated that our English slave-making ant (*Formica sanguinea*), far from being entirely dependent on slaves, as was the case with *Polyergus rufescens*, the slave-making ant *par excellence*, was really able to live alone, and that the slaves were only, so to say, a luxury. Some of his observations appeared to throw doubt on this. In one of his nests the ants were prevented from making any fresh capture of slaves. Under these circumstances, the number of slaves gradually diminished, and at length the last died. At that time there were some fifty of the mistresses still remaining. These, however, rapidly died off, until at the end of June 1886 there were only six remaining. He then placed near the door of the nest some pupæ of *Formica fusca*, the slave ant. These were at once carried in and soon came to maturity. The mortality among the mistresses at once ceased, and from that day to this only two more have died. This seems to show that the slaves perform some indispensable function in the nest, though what that is still remains to be discovered. As regards the longevity of ants, he said that the old queen ant, which had more than once been mentioned to the Society, was still alive. She must now be fourteen years old, and still laid fertile eggs, to the important physiological bearing of which fact he called special attention. He discussed the observations and remarks of Graber as regards the senses of ants, with special reference to their sensibility towards the ultra-violet rays, and referred to the observations of Forel, which confirmed those he had previously laid before the Society. Prof. Graber had also questioned some experiments with reference to smell. He, however, maintained the accuracy of his observations, and pointed out that Graber had overlooked some of the precautions which he had taken; his experiments seemed to leave no doubt as to the existence of a delicate sense of smell among ants. As regards the recognition of friends, he repeated some previous experiments with the same results. He took some pupæ from one of his nests (A) and placed these under charge of some ants from another nest (B) of the same species. After they had come to maturity, he placed some in nest A and some in nest B. Those placed in their own nest were received amicably, those in the nests of their nurses were attacked and driven out. This showed that the recognition is not by the means of a sign or password, for in that case they would have been recognized in nest B and not in nest A. Dr. Warsmann had confirmed his observations in opposition to the statement of Lespis, that white ants are enemies to those of another nest, even belonging to the same species; the domestic animals, on the other hand, can be transferred from one nest to another, and will be amicably received. In conclusion, he discussed the respective functions of the eyes and ocelli, and referred to several other observations on various interesting points in the economy of the Social Hymenoptera.

In an interesting paper read the other day before the National Academy of Sciences, New York, Prof. W. P. Trowbridge gave an account of a discovery which had lately been made by his son. This discovery is that birds of prey and some others have the power to lock securely together those parts of the wing holding the extended feathers, and corresponding to the fingers of the human hand. The action of the air on the wing in this condition extends the elbow, which is prevented from opening too far by a cartilage, and the wings may keep this position for an indefinite length of time, with no muscular action whatever on the part of the bird. While resting in this way, the bird cannot rise in a still atmosphere; but, if there be a horizontal current, it may allow itself to be carried along by it, with a slight tendency downward, and so gain a momentum by which, with a slight change of direction, it may rise to some extent, still without muscular action of the wings. Prof. Trowbridge also believed it quite possible for a bird to sleep on the wing. In discussing this paper, Prof. J. S. Newberry said that he had once shot a bird which came slowly to the ground as if still flying, but reached it dead. He believed that it had died high in the air; but he had never been able to account for the manner of its descent till now, when he found an explanation in the statement of Prof. Trowbridge.

The cultivation of oysters in France appears to have greatly increased of late. Thus, while in 1885 the number exported was 30,000,000, 35,000,000 have been exported in the first eight months of 1887 (twice as much as in the corresponding part of 1886), and the total for the year will probably be about 52,000,000. At the same time the importation into France from Portugal has been declining. Thus, from 154,647 kilogrammes in 1883, it had fallen to 1500 kilogrammes in 1885, and no figures are forthcoming for the first eight months of 1887.

In his Report for 1886-87, presented to the Parliament of Tasmania, Mr. Saville-Kent speaks of the oyster-fisheries on the Tasmanian coast-line. The results obtained during the past year, from the series of Government oyster-reserves established in accordance with Mr. Saville-Kent's recommendations, seem to him to justify the opinion that, with an extension of the same system, conducted on scientific principles, the produce of these reserves, combined with that raised on the private beds, will be sufficient within the course of a few years to establish once more a lucrative oyster trade in the colony. At all of the several reserves there has been an abundant fall of spat, but more especially in those of the Spring Bay district. This locality, Mr. Saville-Kent anticipates, will, as in former years, become the chief station of the Tasmanian oyster-fishery. The number of breeding-oysters at present laid down upon the various Government reserves may be reckoned at about 150,000; to these may be added, as the produce of the past year's spatting season, at least an equal number of young brood. A further supply of 100,000 adult stock, for placing on the additional reserves projected or in course of construction, will be obtained from the natural beds during the current year.

Mr. Harry Page Woodward (eldest son of Dr. Henry Woodward, F.R.S.), who had served for more than three years, under Mr. H. Y. Lyell Brown, as Assistant Government Geologist in South Australia, has, by the advice and upon the recommendation of Dr. A. Geikie, F.R.S., Director-General of the Geological Survey of Great Britain, been appointed by the Secretary of State for the Colonies to the post of Government Geologist for Western Australia. Mr. Woodward sailed for King George's Sound in the P. and O. steam-ship *Shannon* on the 2nd inst.

A peculiar phenomenon is being noticed in the large lakes near the village of Mazuren (near Gumbinnen, Prussia). The level of the water is continually decreasing; during the last ten years it has fallen 1 metre annually, so that many of the islands in the lakes have now become peninsulas.

The People's Lectures, begun under the auspices of the London Society for the Extension of University Teaching, have attracted large audiences, and there is no reason to doubt that the success hitherto achieved will be maintained. Yesterday evening, Prof. H. G. Seeley, F.R.S., delivered, at the Great Assembly Hall, Mile End Road, the first of a course of three lectures on "Glimpses into Nature's Workshop." The special subject of this lecture was "Water, the Earth Leveller." The next two lectures of the course—"Ice, the Earth Engraver," and "Underground Heat, the Earth Moulder and Modeller"—will be delivered on December 14 and 21, at the Memorial Hall, London Street, Bethnal Green.

Another series of lectures at the Memorial Hall, London Street, Bethnal Green, is likely to be of good service. It is intended especially for working lads, and the lectures are called "Science Talks." Last Thursday, Dr. Gerard Smith delivered a lecture on "The Structure of Trees and Plants"; and this evening he will lecture again, taking as his subject "Microscopic Life in the Sea." On December 15, Mr. C. A. Newton will lecture on "The Wonders of the Heavens."

A Conference on Technical Education will be held at the Royal Victoria Hall, Waterloo Bridge Road, on Wednesday, the 14th inst. Sir Henry Doulton will take the chair. Two short papers—one by Dr. Fleming, of University College, the other by Mr. Bochett, a working man—will be read; and it has been arranged that the reading of these papers shall be followed by a discussion. It is hoped that employers and employed will both be largely represented at the meeting. The Hon. Secretary will be glad to send tickets for the platform or for reserved seats to anyone who may apply for them.

IN the Report of the Newcastle Public Libraries Committee for 1886-87, it is stated that, at the annual stock-taking in June-July 1886, only three volumes were found to be unaccounted for. Only sixteen volumes have been lost since the opening of the Library in 1880. During the same period the issue of v olumes has reached a total of 1,538,445.

A NEW edition of the catalogue of books in the juvenile lending department connected with Newcastle Public Library has just been issued. A glance at the contents, as the compiler truly says, will show that in this juvenile department "a wonderful wealth of entertainment is placed at the command of the young people of Newcastle." No fewer than two thousand carefully selected volumes are at their disposal. During the seven years the Library has been open, the Committee has more than doubled the stock of books in this collection, and 215,092 volumes have been lent to children.

A VISITOR to the beaver colony at Amlid, some distance from Christiansand, in Norway, to which we referred some months ago, states that the colony has flourished considerably during the summer, and is now probably the largest in Norway. Sometimes as many as a dozen animals may be seen at a time in the water. The huts are built close to the shore, and have two stories, one above and one below the surface of the water. The walls are made of timber, laid as in a human dwelling, whilst the roof is covered with twigs and mud. All the aspen-trees in the vicinity have now been felled, and the animals have begun to attack the birches. Trees upwards of 18 inches in diameter at the root have been cut down. The animals appear to have most use for the branches, many stems stripped of the same lying about in the woods. The material required is dragged to the waterside along regular "log runs," su ch as wood-cutters leave in forests, and in some places roots crossing the same have been gnawed off, so as to make the run smooth. Shortly after an increase in the colony the new-comers begin to build a new house. Not one of the animals has as yet been killed, and visitors come from all parts for the purpose of watching their peculiar mode of living. It has been found that sentinels are posted, giving the alarm to the rest of the colony in case of danger. When such an alarm is given, all the animals leave their dwellings for the water.

READERS of Icelandic Sagas will remember that in the celebrated Njal's Saga there is a record of an attack on Njal's dwelling, Bergthorshval (named after his wife, Bergthora), and of its being burned, with the whole of Njal's kin. In order to demonstrate the historical accuracy of the Saga, a member of the Iceland Archæological Society some two years ago proposed to excavate the spot where Njal's dwelling was said to have stood. This was done last year, and resulted in the discovery, at a depth of some 6 feet, of a layer of ashes, remains of charred beams, &c. But this was not all. Below the ashes three lumps of some substance of a spongy nature, dirty-white in colour, were found; and Dr. Storch, Director of the Royal Agricultural Laboratory in Copenhagen, by whom these lumps have just been analyzed, pronounces them to be ancient curdled milk and cheese. Such milk, called *Skyr*, was much liked in Iceland in remote times, and was often solidified to a kind of cheese by the fluid matter being pressed out. Strangely enough, the Saga mentions the fact of women bringing *Skyr* to extinguish the fire. Dr. Storch, by slowly treating fresh *Skyr* to a temperature of a little more than 100° C., has thereby obtained a substance in every respect similar to that found in the supposed ruins of Njal's dwelling.

THE additions to the Zoological Society's Gardens during the past week include a Striped Hyæna (*Hyæna striata*) from North Africa, presented by Mr. Ernest Heydon Marquis; a Crested Porcupine (*Hystrix cristata*) from Suakim, presented by His Grace the Duke of Hamilton, K.T., F.Z.S.; two Common Squirrels (*Sciurus vulgaris*), British, presented by Mrs. Henry Alex. Hankey; a Horned Tragopan (*Ceriornis satyra* ♂) from the South-eastern Himalayas, presented by Mr. R. J. Lloyd Price; a Vinaceous Dove (*Turtur vinaceus*) from West Africa, presented by Mr. R. H. Mitford; three South African Scorpions (*Scorpio* ——) from South Africa, presented by Mr. W. K. Sibley; a Zebu (*Bos indicus*) from Africa, two Sandwich Island Geese (*Bernicla sandvicensis*) from the Sandwich Islands, deposited.

OUR ASTRONOMICAL COLUMN.

THE NEW ALGOL VARIABLES, Y CYGNI AND R CANIS MAJORIS.—Mr. Chandler has just published in *Gould's Astronomical Journal*, No. 163, his elements for these two interesting variables. In the case of Y Cygni, it will be recollected (see NATURE, vol. xxxv. pp. 307, 329) that before its period had been fully determined by observation, Mr. Chandler concluded, from the analogy of all the then known stars of the type, that it would prove to be about thirty-six hours. This is now found to be correct, the actual period being 1d. 11h. 56m. 48s. The ground upon which the inference was based was the circumstance that with the other stars of the type the shorter the period of the star the higher is the ratio which the time of oscillation bears to the entire period. The first exception to this rule is R Canis Majoris, the variable star discovered by Mr. Sawyer last March (see NATURE, vol. xxxvi. p. 376), the duration of the oscillation for this star being 5h. instead of 6h., as it should be on the same principle.

The following are the elements of the two stars:—

	Y Cygni.	R Canis Majoris.
Epoch	1886, Dec. 9, 11h. 14m. 30s.	1887, Mar. 26, 14h. 58m. 30s.
Period ...	1d. 11h. 56m. 48s.	1d. 3h. 15m. 55s.
Brightness at maximum	7·1m. ...	5·9m.
Brightness at minimum	7·9m. ...	6·7m.
Duration of decrease ...	4h. ...	2·5h.
Duration of increase ...	4h. ...	2·5h.
Stationary maximum brilliancy	28h. ...	22h.

MINOR PLANET NO. 271.—This object has received the name of Penthesilea.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 DECEMBER 11-17.

(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 December 11

Sun rises, 7h. 58m.; souths, 11h. 53m. 22·9s.; sets, 15h. 49m.: right asc. on meridian, 17h. 12·9m.; decl. 23° 1′ S. Sidereal Time at Sunset, 21h. 9m.

Moon (New on December 14, 19h.) rises, 3h. 11m.; souths, 8h. 47m.; sets, 14h. 14m.: right asc. on meridian, 14h. 6·5m.; decl. 7° 27′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	6 7 ...	10 32 ...	14 57 ...	15 51·2 ...	18 26 S.
Venus.....	3 33 ...	8 46 ...	13 59 ...	14 4·9 ...	9 56 S.
Mars	0 47 ...	6 54 ...	13 1 ...	12 12·5 ...	0 44 N.
Jupiter....	5 37 ...	10 6 ...	14 35 ...	15 24·9 ...	17 47 S.
Saturn....	19 28* ...	3 16 ...	11 4 ...	8 34·1 ...	19 10 N.
Uranus ...	2 9 ...	7 43 ...	13 17 ...	13 1·6 ...	5 52 S.
Neptune..	14 44 ...	22 24 ..	6 4* ...	3 45·0 ...	18 3 N.

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

Dec.	h.	
11	8	Venus in conjunction with and 2° 37′ south of the Moon.
12	11	Venus at least distance from the Sun.
12	18	Jupiter in conjunction with and 4° 16′ south of the Moon.
13	9	Mercury in conjunction with and 3° 24′ south of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·3	81 16 N.	Dec. 12,	0 25 *m*
			,, 17,	0 5 *m*
Algol	3 0·8	40 31 N.	,, 11,	20 23 *m*
λ Tauri	3 54·4	12 10 N.	,, 11,	1 9 *m*
			,, 15,	0 2 *m*
ζ Geminorum	6 57·4	20 44 N.	,, 14,	19 0 *M*
R Canis Majoris	7 14·3	16 11 S.	,, 11,	3 28 *m*
			,, 17,	23 3 *m*
U Coronæ	15 13·6	32 4 N.	,, 14,	20 47 *m*
R Scuti	18 41·5	5 50 S.	,, 12,	*M*
β Lyræ	18 45·9	33 14 N.	,, 14,	20 0 *M*
Y Cygni	20 46·6	34 10 N.	,, 14,	22 4 *m*
			,, 17,	21 58 *m*
δ Cephei	22 25·0	57 50 N.	,, 16,	2 0 *m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near Pollux	117°	31° N.	Rather swift.
From Leo Minor	143	39 N.	Swift; streaks.
Near λ Draconis	158	72 N.	

M. POTANIN'S JOURNEYS IN EAST TIBET AND EAST GOBI.

A CONDENSED report of the results obtained by the three years' journey of MM. Potanin, Skassy, and Berezovsky, in China, Amdo plateau of Tibet at the sources of the Hoang-ho, and East Gobi, has just appeared in the Russian *Izvestia* of the Geographical Society (iii. 1887.) Without repeating what has already been mentioned in his letters, M. Potanin gives in his paper a masterly sketch of the physical characteristics of the various regions explored by his expedition.

The route followed was from Peking, across the Utai-shan mountains which border the Peking depression in the west, and where the well-known Utai Buddhist monasteries are situated, to the city of Kuku-khoto. Thence south, across the Ordos region, to Lan-tcheu, capital of the Han-su province, and to San-tchuan on the middle Hoang-ho, where M. Potanin spent the winter of 1884–85, while M. Skassy wintered at the above city, and M. Berezovsky at Hoi-siang, on the Sy-tchuan frontier of the Han-su province. Thence the expedition proceeded south-east to Min-tcheu on the Tao-he, and to Sun-pan. Lun-an-fu was the utmost point reached towards the south, and the expedition returned to Lan-tcheu to spend the second winter at the Humbum monastery, close by Si-nin. The third summer was spent for the return journey, which was made *viâ* Kuku-nor, across the mountains which separate the Tsaidam from the Mongolian plateau, and the cities of Han-tcheu and Su-tcheu. Then, taking a course due north, the expedition crossed the Gobi, as also several ridges continuing the Ek-tag Altai in the east, and the Hanghai ridge, and reached the Orkhon River, whence it proceeded to Kiakhta and across Siberia to Russia.

The Peking plain, covered with fertile loess, is separated by a series of three ridges built up of gneisses and limestones, from the plateau of the Ordos, watered by the middle Hoang-ho. Of Europeans, only M. Przewalski, the missionary Huc, and M. Potanin's expedition have visited the Ordos—a plateau about 3300 feet high, covered with shifting sands, the best part of which is on their eastern border. Owing to the moistness brought by the numerous streams which flow towards the Hoang-ho, the sands on the eastern border are not so bad as those described further west by M. Przewalski, and the *barkhans* are covered with bushes of *Shyavyk*, *Artemisiæ*, *Hedysarum lævi*, and thickets of the *Pugionium cornutum*—a new shrub discovered by Przewalski; sometimes dark growths of Thuja cover the *barkhans*. The hollows between the sandy hills are either covered with some bushes or occupied by the fields of the Mongols, who chiefly grow *setaria*, buckwheat, and hemp. The wet depressions, covered by meadow-grasses and partly with Halophytes, and called *tchaidams*, are enlivened by the herds and the mud huts of the half-nomadic Mongols. The sands are steadily moved by the winds from the south-west towards the north-east, and this constant motion explains why the Chinese gave to the sand-desert the name of Sha-he, or "River of Sand."

In the highlands which connect the Tibet mountains with those of Shan-si the expedition spent fifty days. Thick layers of loess cover there the horizontal layers of salt-bearing sandstones and conglomerates. The region is a high plateau deeply burrowed by the *cañons* of the rivers, which sometimes are 2000 feet deep, and are cut both through the loess and the sandstones. The narrow *cañons* are mostly waterless, while the broader ravines are watered by rivers and therefore are the seat of many villages. There is little wind or rain, and the atmosphere is charged with dust.

In Tibet the expedition crossed only the Amdo plateau, separated from the Mongolian plateau by the Nan-shan ridge. For 400 miles the expedition crossed there a region the lowest parts of which rise above 7000 and 8000 feet. Even the Hoang-ho at Gui-dui has an altitude of 7600 feet, and the valley of the E-tsin at the Pabor-ta-sy monastery is 8000 feet high; the valleys of the Urunvu and the Tumun-guan are at altitudes of from more than 9000 to 10,000 feet. The highest parts of the plateau rise, however, to 12,000 feet, and Lake Kuku-nor is spreading its waters at the height of Alpine peaks, *i.e.* 10,700 feet. Still higher grassy plateaus, where it never rains but often snows, and marshes spread over large areas, rise to the south of the lake. Only a few of the mountain-ridges which inclose this plateau are snow-clad. It has a quite original flora, discovered by General Przewalski. Forests are few; as to the high meadows, they are inhabited by nomad Tangutes, and, on lower levels, by a mixed population of Chinese and settled Mongols described under the name of Daldas.

The Alpine highlands watered by the northern tributaries of the Blue River, which separate the Amdo high plateau from the Chinese lowlands, are the most picturesque part of China. The routes which cannot follow the bottoms of the narrow and rocky valleys pass over the mountains, flights of steps being cut in the rocks, or wooden balconies being built along the steep slopes of the rocky hills. Suspended bridges, swinging under the weight of a mule, cross streams which flow in a succession of rapids and waterfalls. The Chinese monsoons deposit all their moistness on the south-eastern slopes of the mountains; thick forests, of Conifers on higher levels and of deciduous trees lower down, clothe the mountain slopes. Maples, lime-trees, oaks, *Helwingiæ*, and a number of shrubs and climbing plants are growing in impracticable thickets, while all crags are thickly covered with ferns, mosses, and orchids. Mollusks (*Bulymus* and *Helix*) cover the crags by thousands. And finally at the foot of the mountains the sub-tropical flora—palms, bamboos, banana-trees, and tea-trees—makes its appearance.

The villages and the towns—clean and well-watered—are strikingly picturesque, as the houses (with windows, like our European dwellings) are built in the shape of amphitheatres on the slopes of the steep forest-clothed hills. In some towns the roofs of the houses are the workshops and sitting-places of the inhabitants. The valley of the "Golden Lakes"—Kser-ntso—with its background of snowy peaks is especially picturesque.

As to the region crossed between the Amdo plateau and Kiakhta, it is sharply divided into two parts. The southern is a true desert, which stretches towards the north as far as the Khangai Mountains. The Nan-shan rises as an immense snow-clad wall on its southern border; then comes a narrow strip of inhabited and cultivated land, which is followed by a gravelly desert, where only a few trees of *Haloxylon Ammodendron*, and bushes of *Calligonum* and *Ephedra* grow here and there, while the course of the E-tsin is marked by narrow strips of meadows covered with *Elymus*. The depression of the E-tsin, which flows into the Gashiun-nor, has an altitude of only about 3000 feet, and it is bordered in the north by the Tostu ridge, and three other parallel ridges, of which the northern is snow-clad. The valleys which separate these four ridges are waterless; old river-beds, now dry, are seen on their bottoms, but even the *Haloxylon* forests which formerly grew in their valleys are now disappearing, only decayed trees having been seen by the expedition.

As to the plateau in the north of the Khangai Mountains, it is covered with rich meadows, while the slopes of the hills are clothed with forests of larch; the Siberian cedar-tree also makes its appearance. In the lower valleys the Mongols carry on some agriculture.

The above account is followed by an ethnographical sketch of the Ordos-Mongols and the Daldas.

The results obtained by the expedition are very important. A survey has been made of a stretch of no less than 4400 miles. Latitudes and longitudes have been determined at sixty-nine places. Two hundred photographs, 700 specimens of mammals and birds, a bulky herbarium, and rich collections of lizards, insects, mollusks, and rocks have been brought in. M. Berezovsky still remains in the region he has become so fond of, and he wrote last February, from Hoi-siang, that his journeys about Si-ning and Tai-tchan have enriched his collection with 500 more specimens of birds, some of which are very interesting.

P. A. K.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17.—"Specific Inductive Capacity." By J. Hopkinson, M.A., D.Sc., F.R.S.

Colza Oil.—This oil has been found not to insulate sufficiently well for a test by the method of my former paper. Most samples, however, were sufficiently insulating for the present method. Seven samples were tested with the following mean results:—

No. 1. This oil was kindly procured direct from Italy for these experiments by Mr. J. C. Field, and was tested as supplied to me—

$$K = 3{\cdot}10.$$

No. 2 was purchased from Mr. Sugg, and tested as supplied—

$$K = 3{\cdot}14.$$

No. 3 was purchased from Messrs. Griffin, and was dried over anhydrous copper sulphate—

$$K = 3{\cdot}23.$$

No. 4 was refined rape oil purchased from Messrs. Pinchin and Johnson, and tested as supplied—

$$K = 3{\cdot}08.$$

No. 5 was the same oil as No. 4, but dried over anhydrous copper sulphate—

$$K = 3{\cdot}07.$$

No. 6 was unrefined rape purchased from Messrs. Pinchin and Johnson, and tested as supplied, the insulation being bad, but still not so bad as to prevent testing—

$$K = 3{\cdot}12.$$

No. 7. The same oil dried over sulphate of copper—

$$K = 3{\cdot}09.$$

Omitting No. 3, which I cannot indeed say of my own knowledge was pure colza oil at all, we may, I think, conclude that the specific inductive capacity of colza oil lies between 3·07 and 3·14.

Prof. Quincke gives 2·385 for the method of attraction between the plates of a condenser, 3·296 for the method of lateral compression of a bubble of gas. Palaz (*La Lumière Électrique*, vol. xxi. 1886, p. 97) gives 3·027.

Olive Oil.—The sample was supplied me by Mr. J. C. Field—

$$K = 3{\cdot}15.$$

The result I obtained by another method in 1880 was 3·16.

Two other oils were supplied to me by Mr. J. C. Field.

Arachide.—K = 3·17.

Sesame.—K = 3·17.

A commercial sample of *raw linseed oil* gave K = 3·37.

Two samples of *castor oil* were tried: one newly purchased gave K = 4·82; the other had been in the laboratory a long time, and was dried over copper sulphate—

$$K = 4{\cdot}84.$$

The result of my earlier experiments for castor oil was 4·78; the result obtained subsequently by Cohen and Arons (*Wiedemann's Annalen*, vol. xxviii. p. 474) is 4·43. Palaz gives 4·610.

Ether.—This substance as purchased, reputed chemically pure, does not insulate sufficiently well for experiment. I placed a sample, purchased from Hopkin and Williams as pure, over quicklime, and then tested it. At first it insulated fairly well, and gave K = 4·75. In the course of a very few minutes K = 4·93, the insulation having declined so that observation was doubtful. After the lapse of a few minutes more observations became impossible. Prof. Quincke in his first paper gives 4·623 and 4·660, and 4·394 in his second paper.

Bisulphide of Carbon.—The sample was purchased from Hopkin and Williams, and tested as it was received—

$$K = 2{\cdot}67.$$

Prof. Quincke finds 2·669 and 2·743 in his first paper, and 2·623 in his second. Palaz gives 2·609.

Amylene.—Purchased from Burgoyne and Company—

$$K = 2{\cdot}05.$$

The refractive (μ) index for line D is 1·3800,

$$\mu^2 = 1{\cdot}9044.$$

Of the benzol series four were tested: *benzol, toluol, xylol*, obtained from Hopkin and Williams, *cymol* from Burgoyne and Company.

In the following table the first column gives my own results, the second those of Palaz, the third my own determinations of the refractive index for line D at a temperature of 17°·5 C., and the fourth the square of the refractive index:—

			μ	μ^2.
Benzol	2·38	2·338	1·5038	2·2614
Toluol	2·42	2·365	1·4990	2·2470
Xylol	2·39	—	1·4913	2·2238
Cymol	2·25	—	1·4918	2·2254

For benzol Silow found 2·25, and Quincke finds 2·374.

Linnean Society, November 17.—Prof. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. A. Bennett drew attention to new British plants, viz. (1) *Arabis alpina*, gathered on the Cuchillin Mountains, Isle of Skye; (2) *Juncus alpina*, obtained in Perthshire; and (3) *Juncus tenuis*, got near Galloway, Kirkcudbrightshire.—Mr. W. H. Beeby made remarks on *Carex cæspitosa* from Shetland.—Photographs of a branched palm (*Borassus flabelliformis*) was shown for Surgeon-General Bidie, of Madras, and a letter thereon read. The tree is growing near Tanjore, at a village named Paducottah, and is remarkable in being divided into eight branches.—Mr. W. Wilson sent for exhibition branches with ripe berries of *Taxus baccata*, and its variety *hybernica*, produced by natural cross-fertilization: these were grown in Central Aberdeenshire.—Mr. T. Christy showed a new species of *Strophanthus* from the Niger; it is distinguished by its brown velvety seed and intensely bitter taste.—Mr. D. Morris exhibited the following specimens: (1) a fibre from Vera Cruz, named Broom Root, which examination showed to be the root fibres of *Epicampus macroura*, known as "Raviz de Zacaton" by the Mexicans, its yearly value in export is £60,000; (2) another Mexican fibre, "Ixtli," much used for nail-brushes, &c., in Britain, by reason of its short tough fibre, is found by the Kew authorities to be derived from *Agave heteracantha*.—Mr. J. G. Baker showed *Lycopodium albidum*, a new species from the Andes of Ecuador; it is allied to *L. clavatum*, but without chlorophyll except at the base. He also showed *Neobaronia xiphoclades*, a new Papilionaceous plant from Madagascar, obtained by the Rev. R. Baron.—A paper was read by Mr. P. Geddes, on certain factors of variation in plants and animals.—Then followed a paper on the Copepoda of Madeira and the Canary Islands, by Mr. I. C. Thompson. In all, sixty-five species were obtained. Of these, six are new to science, and three probably of generic significance. Twenty-three are known in British waters, and of these fourteen belong to the family Harpacticidæ. There is a similarity in species in the different islands, but the numbers of each vary greatly.

Geological Society, November 9.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—Note on the so-called "Soapstone" of Fiji, by Henry B. Brady, F.R.S. The Suva deposit, which has a composition very similar to that of the volcanic muds at present forming around oceanic islands in the Pacific, is friable and easily disintegrated. The colour ranges from nearly white to dark gray, the mass being usually speckled with minerals of a darker hue. Under the microscope the rock presents the character of a fine siliceous mud with crystals of augite, &c.,

together with the sparsely scattered tests of Foraminifera.' The approximate chemical composition of typical specimens is:—Silica, 50 per cent.; alumina, 18 per cent.; lime and magnesia, from 5 to 6 per cent.; ferric oxide, from 3 to 8 per cent.; water, 16 per cent., with a small proportion of alkalies, chiefly potash, and but small trace of carbonates. The author's attention was chiefly directed to the common gray friable rocks which may be softened in water and washed on a sieve, the residue consisting mainly of Foraminifera with a few Ostracoda. Of three specimens examined, (1) is a light-gray rock from close to the sea-level; (2) of a lighter colour, from about 100 feet elevation; (3) is nearly white and somewhat harder, and was derived from an intermediate point. So far as the Microzoa are concerned, the first two present no differences which might not be observed in dredgings from the recent sea-bottom, taken at similar depths a little distance apart. The third appears to have been deposited in somewhat deeper water. There is a marked scarcity of arenaceous Foraminifera. Then followed notes on the rarer and more interesting species, together with a list of the ninety-two species of Foraminifera found. Of these, eighty-seven are forms still living in the neighbourhood of the Pacific islands. Two of the remaining five are new to science, and the rest extremely rare. The author concluded that these deposits are of Post-Tertiary age, formed at depths of from 150 to 200 fathoms in the neighbourhood of a volcanic region. The following new or little-known species were selected for illustration:—*Ellipsoidina ellipsoides*, var. *oblonga*, Seguenza; *Haplophragmium rugosum*, D'Orb.; *Ehrenbergina bicornis*, nov.; *Sphæroidina ornata*, nov. The President hoped that this paper might be regarded as one of the first-fruits of travels undertaken by the author for the purpose of investigating the interesting deposits of this nature. Prof. Rupert Jones agreed that this was a valuable instalment of work to be expected. The peculiar Foraminifer specially mentioned by Mr. Brady (*Ellipsoidina ellipsoides*, var. *oblonga*, Seguenza) must have connections, so that, as the author has intimated, the interest attached to it was not yet wholly worked out.—On some results of pressure and of intrusive granite in stratified Palæozoic rocks near Morlaix, in Brittany, by Prof. T. G. Bonney, F.R.S.—On the position of the Obermittweida conglomerate, by Prof. T. McK. Hughes.—On the Obermittweida conglomerate: its composition and alteration, by Prof. T. G. Bonney, F.R.S.—Notes on a part of the Huronian series in the neighbourhood of Sudbury (Canada), by Prof. T. G. Bonney, F.R.S. The specimens noticed by the author were in part collected by him in the summer of 1884, when the Canada Pacific Railway was in process of construction, and in part subsequently supplied to him by the kindness of Dr. Selwyn, Director-General of the Geological Survey of Canada. The eastern edge of the district assigned to the Huronian consists of rocks, which may possibly be part of the Laurentian series modified by pressure. But after crossing a belt of these, barely a mile wide, there is no further room for doubt. All the rocks for many miles are distinctly fragmental, except certain intrusive diabases or diorites. These fragmental rocks are grits, conglomerates, and breccias, which are described as far as about two miles west of Sudbury. The included fragments in these rocks appear to have undergone some alterations subsequent to consolidation: these are described. In some cases the changes appear to be anterior to the formation of the fragments. The matrix also has undergone some change, chiefly the enlargement of quartz grains, and the development or completion of mica-flakes, as in the Obermittweida rock. The author gave some notes on other specimens collected by him along the railway, further west, and on those supplied to him from near Lake Huron by Dr. Selwyn. As a rule these are but little altered. Some contain fragments of igneous rocks, apparently lavas. The author discusses the significance of the changes in these rocks, as bearing on general questions of metamorphism, and states that, in his opinion, the name Huronian, at present, includes either a series of such great thickness that the lower beds are more highly altered than the higher, or else two distinct series; and he inclines to the latter view. Both, however, must be separated from the Laurentian by a great interval of time, and neither exhibits metamorphism comparable with that of a series of schists and gneisses, like the so-called Montalban. The newer reminds him often of the English Pebidians. After the reading of this paper there was a discussion, in which the President, Dr. Geikie, Mr. Rutley, and others took part.

Royal Meteorological Society, November 16.—Mr. W. Ellis, President, in the chair.—The following papers were read:—The use of the spectroscope as a hygrometer simplified and explained, by Mr. F. W. Cory. The object of this paper is to suggest as simple a way as possible of using the spectroscope as a hygrometer in order to facilitate its introduction amongst observers as a standard meteorological instrument. The best form of hygro-spectroscope as a recognized standard for the purpose of investigating and scrutinizing the changes of the three parts of the spectrum mentioned is that originally termed by Mr. Rand Capron "The Rainband Spectroscope." It ought to have a fixed slit, and in addition a milled wheel at the side for the easier adjustment of the focus. The author concludes by giving a set of hints to observers for taking weather observations with a pocket spectroscope.—Rainfall on and around Table Mountain, Cape Town, Cape Colony, by Mr. J. G. Gamble. The author calls attention to the great and in some respects peculiar differences that exist between the quantity of rain that is registered on and around Table Mountain. The most striking feature is the small fall on the signal hill. The signal hill, otherwise called "the Lion's Rump," lies to the west of Cape Town, between it and the Atlantic. The average annual fall there is only 15 inches, while the fall at the western foot is 21 inches, and in Cape Town 27 inches. The signal hill is 1143 feet above the sea. The fall at Platteklip, on the northern slope of Table Mountain, overlooking Cape Town and 550 feet above the sea, is considerable, namely 45 inches. The greatest fall is at Waai Kopje, about half a mile to the southward of the highest point of the mountain, at an elevation of 3100 feet, or 450 feet below the top. Another station on Table Mountain further south—that is, to the leeward in the rainy season—and 2500 feet above sea-level, has only 39 inches. The eastern suburbs, Rondebosch, Newlands, and Wynberg, all have a comparatively abundant rainfall, 40 to 50 inches and upwards, the greater part of which falls in winter time.—On the cause of the diurnal oscillation of the barometer, by Dr. R. Lawson. The object of this paper is to show that the durnal oscillation of the barometer is mainly due to the combination of the earth's rotation with its orbital motion.

PARIS.

Academy of Sciences, November 28.—M. Janssen in the chair.—On the most general equations of double refraction compatible with Fresnel's wave surface, by M. Maurice Lévy. Whatever view be taken of polarized light in a plane, whether it be regarded as the effect of an elastic or electro-magnetic disturbance, whether it result from rectilinear vibrations or from mean rotations (vortices), or from any other cause, it is certain, as remarked by Maxwell, that this cause is measurable by a quantity which is in the nature of a vector. This vector, whether it be a vibration or a force, the axis of a vortex or of a magnetic momentum, or aught else, is here called a luminous vector, and an attempt is made to determine its most general expression compatible with Fresnel's wave surface.—On the movement of cirri and their relations to cyclones, by M. H. Faye. These phenomena are compared to the action of a river on which floating ice is borne along. Whenever an eddy is formed, the nearest fragments of ice are seen to be drawn within its influence, following its spiral movements and disappearing with it on reaching the centre, while the masses lying beyond its influence continue to drift with the stream. Precisely analogous phenomena are presented by the cirri carried along by atmospheric currents in the higher regions. They are in the same way sucked down by the gyratory action of the whirlwind, giving rise in the lower regions to heavy rains, hail, and thunder-storms, while the more distant clouds continue to follow the general course of the wind.—Researches on the importance of consumptive patients breathing a pure air uncontaminated by pulmonary exhalations, by MM. Brown-Séquard and d'Arsonval. These remarks are made in connection with an apparatus submitted to the Academy, which has been constructed for the purpose of removing from bedrooms all the air exhaled by one or more persons. The importance is shown of thus purifying sick-rooms, hospital wards, &c., especially when occupied by patients suffering from affections of the lungs.—On a class of differential equations, by M. R. Liouville. Here are studied more especially the differential equations, amongst which are comprised all those of the geodetic lines.—Action of vanadic acid on the fluoride of potassium, by M. A. Ditte. It is shown that vanadic acid in combination with the fluoride of potassium yields compound substances more or less rich in fluoride. But in the presence of oxygen a certain quantity of potassa is developed, which forms vanadates with a part of the vanadic acid employed in the process.—Ammonical cyanides of zinc, by M. Raoul Varet. The chloride, bromide, and iodide of zinc combined with ammonia yield a relatively large number of compound substances. But with the cyanide of zinc, whatever be the conditions, the only substances obtained are $ZnCy,NH_3HO$ when the reaction takes place in the presence of water, and $ZnCy,NH_2$ in all other cases.—Application of a method of de Senarmont to the reproduction of celestine and anglesite by the wet process, by M. L. Bourgeois. The process by means of which de Senarmont obtained artificial crystals of barytine is here applied to the production of the allied minerals, celestine and anglesite.—On the importance of the nutritive function in determining the distinction between plants and animals amongst the lower organisms, by M. P. A. Dangeard. The Chytridineæ and the Chlamidomonadineæ, the two primary groups of the vegetable kingdom, are both connected below with the Flagellæ, branching off upwards one to the Algæ the other to the Fungus group. It is here shown that by the process of nutrition alone is it possible to determine the point where plant and animal become differentiated.—On the suckers of the Rhinantheæ and Santalaceæ, by M. Leclerc du Sablon. These hold an intermediate position between non-parasitic and true parasitic plants, drawing their nutriment both through their roots and through suckers from other plants. The present observations deal exclusively with the suckers and their various functions.—On the discovery of carboniferous formations with marine and vegetable fossils in the neighbourhood of Raon-sur-Plaine, by M. Bleicher. The recent discovery of coal in this district supplies the connecting link between the carboniferous measures of the Bruche and Rabodeau valleys (Alsace and Lorraine).

BERLIN.

Physiological Society, November 4.—Prof. du Bois Reymond, President, in the chair.—Dr. Goldschneider spoke on the fact, which has been known for a long time, that when carbonic acid gas is allowed to come in contact with the skin it produces a greater sensation of warmth than air of the same temperature. He has carried out a prolonged series of experiments to determine the cause of this increased sensation of heat. He examined first the purely physical factors which might have some influence on the observed facts—namely, the moistness, specific heat, and heat-absorption by the gases. When he compared the sensation of heat produced by moist air with that produced by dry air, he found that the former always seemed the greater; the difference between the two might be as much as 5° C. to 6° C. when the air was at a higher temperature than that of the skin. Thus, air at 35° C. whose saturation with moisture was 80 produced the same sensation of heat as air at 41° C. whose saturation was only 30. When experimenting with carbonic acid gas he found that a difference of 40 in the saturation produced a difference in the resulting sensation of heat corresponding to 2° to 3° of temperature. But even when equally moist or dry air and carbonic acid gas were allowed to act on the skin the sensation of heat produced by the latter was always the greater. It does not seem possible to explain the greater sensation of heat with carbonic acid gas by reference to the extremely small differences of specific heat of air and this gas, still less by reference to their somewhat greater coefficients of heat absorption. He also investigated the effect of the more ready absorption of carbonic acid gas by fluids, by removing the epidermis with a blister on a circumscribed portion of the skin and allowing the gas to act upon this place. The carbonic acid gas was speedily absorbed by the lymph, but it still produced a sensation of greater heat even when all moisture was removed from the surface exposed by the blister. He hence considers that the purely physical properties of the gas will not suffice to explain its remarkable influence on the sensory nerves for heat. Dr. Goldschneider next investigated the physiological factors which might suffice to explain the observed phenomenon. He proved that there is no recognizable objective rise of temperature under the influence of the carbonic acid gas. It is true that he observed now and again a distinct dilatation of the blood-vessels, but this was by no means constant, and not sufficient to account for the increased sensation of heat. He proved however as has been observed by many physiologists, that the carbonic acid gas has a direct effect upon the sensory nerves; but in contrast to the results of others, who attribute an anæsthetic action to this gas, he observed that at first it produces a hyperæsthesia of those nerves specially connected with the production of heat sensations, and then this makes way for an anæsthesia. The nerves connected with heat sensations were more strongly stimulated than those connected with sensations of cold. The speaker summed up the results of his extremely numerous experiments by urging that in addition to the greater absorption of heat by the carbonic acid gas and its power of producing hyperæmia of the skin, its action is to be explained chiefly by its direct chemical action on the endings of the nerves concerned in the production of sensations of heat. This therefore is to be regarded as the cause of the observed phenomenon that when carbonic acid gas is brought into contact with the skin it produces a greater sensation of heat than does the contact of equally warm and equally dry air.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Thomas A. Edison and Samuel F. B. Morse: D. B. Denslow and J. M. Parker (Cassell).—Our Earth and its Story: Edited by Dr. R. Brown (Cassell).—Stigmaria Ficoides: W. E. Williamson (Palæontographical Society).—Index Catalogue of the Library of the Surgeon General's Office, United States Army, vol. viii. (Washington).—The Ethical Import of Darwinism: J. G. Schurman (Williams and Norgate).—A Manual of Orchidaceous Plants, Part 1, Odontoglossum; Part 2, Cattleya and Lœlia (Veitch).—Osservazioni e Studii dei Crepuscoli Rosei 1883-86: A. Riccò (Roma).—Journal of the College of Science, Imperial University, Japan, vol. i. Part 4 (Tokio).

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