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A NATURALIST IN SOUTH AMERICA

Notes of a Naturalist in South America. By John Ball, F.R.S., M.R.I.A., &c. (London: Kegan Paul, Trench, and Co., 1887.)

I.

BY this unpretending little volume its author has opened up to view a new avenue to knowledge—a royal road, in short, to anyone as competent as he has shown himself to be to take advantage of all that it offers to an intelligent traveller with his eyes and ears open. Its contents are a rich collection of facts and thoughts, chiefly botanical, meteorological, and geographical, acquired during a five months' voyage over 18,400 miles of ocean, and embracing 100° of latitude, during which the author passed only seventy days on dry land; and they are laid before the reader in a style which is as attractive as instructive.

In the preface Mr. Ball says of his voyage:—"A tour round the South American continent, which was completed in so short a time as five months, may not appear to deserve any special record; yet I am led to hope that this little book may induce others to visit a region so abounding in sources of enjoyment and interest. There is no part of the world where a traveller can view so many varied and impressive aspects of Nature, whilst he whose attention is mainly given to the progress and development of the social condition of mankind will find in the condition of the numerous States of the continent, and the manners and habits of the many different races that inhabit it, abundant material to engage his attention and excite his interest." Mr. Ball adds that, though the aim of his journey was mainly to see Nature in aspects new to him, he, as an unprejudiced visitor, gives also his impressions as to the social and political condition of the different regions which he visited. With these impressions we need not concern ourselves, though we may say that they seem to us to be both just and liberal.

Leaving England in March 1882 as a passenger on board a West Indian mail-steamer, Mr. Ball found that the passage across the Atlantic offered nothing of unusual interest, but even this well-beaten track suggests some good ideas as to rate of flow of the upper and lower strata of the aërial currents forming the trade-winds. Barbados was made in thirteen days, where, amongst other vegetable treasures, he obtained the fruits of the sandbox-tree (*Hura crepitans*), the explosive nature of which is well known, though not the violence of its character, which would suggest an alternative name of the dynamite-tree. Mr. Ball carried away a specimen packed in a wooden box, which he subsequently placed in his herbarium room in London, where, nine months after it had been obtained, it burst with such violence that the box was broken to pieces, and the valves and seeds of the fruit were scattered all about the room.

A single day at Jamaica afforded him his first glimpse of a thoroughly tropical vegetation *in situ*, and it would be difficult to find a terser or better description of its appearance to a Londoner than his simple statement that "it seemed to me as if the inmates of the Palm House at Kew had broken loose and run scrambling up the rocky hills."

The Isthmus of Panama crossed and the Pacific reached, the real interest of the voyage begins. The first impression Mr. Ball gains—suggested by the breadth of the Bay of Panama (120 sea[1] miles across)—is of the vastness of the geographical features of America as compared with the ideas formed of them from experience of "our diminutive European continent," and from maps, and especially from those on Mercator's projection. In respect of this last he not inaptly complains that it profits nothing to explain, even to the most intelligent youth, the nature and amount of the errors involved in that mode of representing a spherical surface on a plane; and he goes on to say: "I verily believe that all the mischief done by the stupidity, ignorance, and perversity of the writers of bad school-books, is trifling compared to the amount of false ideas spread through the world by the production of that respectable Fleming."

A few hours botanising in the coast forests of Buenaventura, a port on the coast of Columbia, yielded a harvest of plants which forged the first link in a chain of reasoning that has led Mr. Ball to the conclusion (opposed to the view of all other writers on the same subject) that the most marked division of the flora of tropical South America is not that between the regions east and west of the Andes; for on his arrival in Brazil he found that, though he was nearly 3000 miles from Buenaventura, and separated from it by the great barrier of the Andes, the plants of the forests of that country were almost all nearly allied to Brazilian forms. This is followed by a bold speculation, dwelt on at greater length towards the conclusion of the work, that "the ancestors of the Brazilian flora, and to a large extent also those of the Andean flora, came into existence in the ancient high mountain ranges of Brazil, where we now see, in the vast extent of arenaceous rocks, and in the surviving pinnacles of granite, the ruins of one of the greatest mountain regions of the earth."

Crossing the equator, our naturalist was disappointed in not seeing Chimborazo, still in popular estimation the "hub" of the South American continent, though geographers have long known that it has to bow its head to Aconcagua, upwards of 2500 miles further south. Chimborazo is only seventy miles from Guayaquil, whence it is easily seen on clear days, but we are told these occur only about half a dozen times in the year!

Cape Blanco, the westernmost cape of South America, rounded, the so-called rainless zone of South America, which extends for nearly 2000 miles to the southward, is reached. This is a feature of the highest interest to the biologist and meteorologist. Its access was signalled by the sudden fall of temperature from an average of 80°, with a relaxing atmosphere "heavily charged with vapour,"[2] to 74°, with an elasticity in the air that dispelled a previous lassitude, which had rendered burdensome even the first taste of the charms of tropical scenery.

In no part of the world is a change in vegetation more suddenly effected than in the short distance, amounting to little over 100 miles, between the Gulf of Guayaquil and

[1] Surely an oversight for English miles.

[2] When shall we have accurate conceptions embodied in our colloquial phraseology? The vapour of water is lighter than atmospheric air, yet the latter is conventionally described as "heavily laden" with it.

Payta. Nowhere in the world are the forests more luxuriant than in the former place, whereas, on arriving at Payta, Mr. Ball was informed by the officers of the ship that it was no use his taking his botanical box ashore with him, because the country was absolutely without vegetation. As, however, the forewarned expected, this was not quite the case: stunted bushes grew in the cliffs, nor were plants absent on the plateau above, where, however, the vegetation was more scarce than he had anywhere seen it, except in the tract west of the Nile above Cairo. He remarks that the gullies furrowing the seaward face of the plateau show that heavy rains must visit this part of the coast, and on inquiry he was informed that abundant rain, lasting for several days, recurs at intervals of three or four years. This, he subsequently found, is a normal feature of the rainless zone, added to which he was informed that slight showers occur at intervals a few times in the year, which suffice to maintain the vitality of the few species of plants that hold the ground persistently; whilst the heavier rains are followed by an outburst of herbaceous vegetation covering the surfaces that have long been bare.

For the existence of this rainless zone Mr. Ball considers that the hitherto assigned causes are insufficient. These are: the influence of the Andes in condensing the Atlantic vapours brought by the westward atmospheric flow; the warming in its passage north of the vapour-bearing aërial currents that accompany the Antarctic or Humboldt oceanic current; and the effect of this warming of the air in enabling it to hold in suspense all the vapour it absorbs in its passage north Mr. Ball's principal objections to the sufficiency of these causes are that the Andes of Ecuador and Columbia do not condense the western vapour-bringing winds, whilst those of Peru, Bolivia, and North Chili do; and that the littoral zone of the former regions is, for a distance of 800 miles, even moister than parts of the coast of Brazil and Guiana. His supplemental explanation is based chiefly on the physical features of the Andes. In Peru the Andes present four parallel longitudinal chains, increasing in mean elevation in going westward, though the highest peaks are not on the westernmost range. In Ecuador only two such ranges, the two westernmost, exist, and these do not suffice to drain the vapour-bringing winds, a portion of whose moisture is precipitated on the Pacific coast. In Columbia, again, there are three of these parallel ranges, enough perhaps to drain the easterly winds; and its sources of moisture may be supposed to be derived from the diversion southwards of easterly currents from the Caribbean Sea which have crossed the Isthmus of Panama. On the whole, however, Mr. Ball considers that the influence of the Humboldt currents, oceanic and aërial, is of far greater moment than is that of the Andes, since the influence of these currents is felt even to the north of the Gulf of Guayaquil, as at Cape St. Elena, where the rains are less frequent than at Guayaquil. For the further description of this interesting subject we must refer to the work itself.

On April 15, Callao, the port of Lima, was reached, and a ten days' expedition to the higher Andes was effected. For this there were two railroad facilities. One line starts from the coast at Mollendo, south of Callao, and, running by Arequipa, crosses the crest of the Andes, and terminates at Lake Titicaca, 12,800 feet above the sea. The other starts from Lima itself. It was projected with the intention of piercing the crest of the Cordilleras at an elevation of 15,645 feet above the sea, thence descending to Oroya, a plateau between the main ranges. Its ultimate object was to afford a route to the fertile districts on the eastern slopes of the Andes. As yet it has only reached a village called Chicla, 12,200 feet above the sea, its progress having been stopped by the war between Peru and Chili. The first of these routes was obviously the most desirable for a naturalist, but want of time and the fact of Arequipa being in possession of a Peruvian force drove Mr. Ball to take the Chicla route. To the professed naturalist Mr. Ball's observations on this little expedition offer much of interest, but the season was unfavourable for botanising, the weather at the culminating point wretched, and the natural features of the country, under such conditions at any rate, anything but inviting. There is a brief discussion on mountain sickness, of which Mr. Ball has already detailed his symptoms in this journal (vol. xxvi. p. 477). They are anomalous; but as his elevation was only 12,200 feet, at which many mountaineers who suffer acutely at 16,000 feet and above it feel no inconvenience at all, his experience is insufficient. That the symptoms should disappear during bodily exercise is opposed to what is described in the cases not of man only, but of cattle, sheep, and horses, in crossing high passes. The observations on the temperature of the upper Andean regions as compared with that of the coast are very valuable, as are the notes on the zones of vegetation, the ranges of species, the distribution of endemic forms, &c.

On his return to Lima, Mr. Ball obtained some further information regarding the well-known hollowed cliffs of volcanic rock which occur along the coast, and reach to 700 feet above it, and which have been written of by Lyell and others as indications of a rise of the land. According to a very intelligent local observer, Mr. William Nation, of Lima, the excavations are due chiefly to a cryptogamic plant which grows on the surface of the cliffs, and is in active vegetation as a disintegrating agent during the dense fogs that prevail for many months of the year. Mr. Nation thinks that alternations of dry and damp air, by causing the cells of this burrowing plant to expand and contract, effect the removal of scales of mineral matter from the surface of the rock, and hence eventually excavate the latter. Fancying that the plants might (as do some lichens) chemically affect the rock, Mr. Ball submitted specimens to an eminent cryptogamist, who found it to be an Alga, and harmless in this respect. Mr. Ball himself is disposed to think that vicissitudes of temperature aided by alternations of moisture and dryness, dry fog and sun, may play the greatest part in effecting the hollows. It is to be hoped that Mr. Nation will follow up the problem, which wants only careful observation to solve it.

Between Callao and Coquimbo, along a monotonous coast, several places were visited, but these seem to be far from being oases; some of them, indeed, are dependent on transport by sea for a supply of fresh water. The track between Arica and Copiapo, a distance of 600 miles, "further than from Liverpool to Oporto," is that in which the rainless zone is most pronounced. With the possible exception of Pisagua, there is no inhabited place where drinkable water is to be had, and yet the wants (or greed) of men have established many industrial settlements along the coast for the purpose of working mines of silver, copper, and lead, and digging deposits of alkaline nitrates. Drinking-water is, in most of these towns, provided by the distillation of sea-water ; in others it is imported. Nine such places were touched at by the steamer ; their features were uniform, and, we may add, uniformly repulsive : chemical works with tall chimneys, sheds of reeds for workmen, a few clean-looking houses for managers, and grog-shops. At one of these, Tocopilla, Mr. Ball observes :—"At last I found, what I had often heard of, but in whose existence I had almost ceased to believe, a land absolutely without a trace of vegetable life. Not only was there no green thing ; not even a speck of lichen that I could detect, though I looked at the rocks through a lens. Even more than by the absence of life I was impressed by the appearance of the surface, which showed no token that water had ever flowed over it. Every edge of rock was sharp, as if freshly broken, and on the steep slope no trace of a channel furrowed its face. The aspect is absolutely that of the scenery of the moon—of a world without water, and without an atmosphere." Curiously enough, small birds, which live on stable manure, were the only trace of indigenous animal life ; what they were Mr. Ball could not approach them near enough to see. Seaweeds, however, though scarce, occurred in pools left by the tide, and relieved the barren coast from the curse of being without vegetation. At Caldera, the port of Copiapo, vegetation begins, and, though the environs are sandy, bushes and inclosed gardens are to be seen, and at Coquimbo green is, in the spring at any rate, a dominant colour. On May 9, Mr. Ball disembarked at Valparaiso, and made that town and Santiago his headquarters for twenty days. During this period he made numberless observations on the scenery, climate, vegetation, and geographical features, many of which though referring to matters that are familiar to every scientific reader, abound in thought and shrewdness, and are exceedingly instructive. Leaving Valparaiso, the voyager entered a totally different region of America, physically and biologically, and into it we shall follow him in a future number.

(*To be continued.*)

COLEOPTERA OF THE BRITISH ISLANDS

The Coleoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species indigenous to Great Britain and Ireland ; with Notes as to Localites, Habitats, &c. By the Rev. W. W. Fowler, M.A. Vol. I. Adephaga—Hydrophilidæ. Pp. xxii. and 269. Two Plates. (London : Lovell Reeve, 1887.)

DURING the last thirty years, seven or eight distinct catalogues of British Coleoptera have been published, and have met with an encouraging sale ; hence there can be no doubt that there exists a considerable number of collectors of British Coleoptera. But no really satisfactory systematic work on this department of the aunæ of our islands exists, and Mr. Fowler has done well in attempting to supply such an one. The earlier works of Curtis and Stephens are, for obvious reasons, of little practical use in the present day, and though, twelve years ago, Mr. H. E. Cox published a hand-book of British Coleoptera in two volumes, it cannot be said to have been the work required, owing to the facts that it contained no reference to localities, and that it consisted entirely of systematic tables, without the addition of any matter that could make it a pleasant book to use.

In the work now before us, the author has been very successful as regards these points ; he adopts the system of tables, but gives, in addition, brief diagnostic descriptions of all the species, and satisfactory details of localities and the distribution in our islands. In his prefatory remarks he very properly calls attention to the necessity of access to collections of an elementary nature, so that the student shall have some elementary notions about, at any rate, a few beetles before attempting to use the work. There can be no doubt that he is quite correct as to this point, and it may be hoped that the local museums and school collections that are now becoming numerous throughout the country will be of great use in this respect ; and for this object such institutions should possess a small but well-selected general collection in addition to that of their local fauna.

There are now about 3200 species of Coleoptera on the British list, and the present volume deals with only about one-sixth of these, so that the work when completed will be of considerable extent. The author promises to give, when it is concluded, an introduction to the system of classification employed in it. This is, indeed, indispensable, as at present the student is not supplied with any definitions of the "series" which form the basis of the arrangement used. He already finds, however, under the various subdivisions, remarks on classification and affinities ; these are usually well considered, and will, no doubt, increase greatly the interest of the work, and, it may be hoped, will induce the student to extend his studies to questions of greater interest and importance than the determination of the names of species.

The Coleoptera are an enormous order of insects, comprising already fully 100,000 species, and as their organisation is such that the details of their external structure can be readily observed, much has already been done towards establishing a natural classification of the order. The author has made himself well acquainted with the various recent improvements in this department, and acknowledges in the frankest manner his obligations to authorities in various parts of the world. There are some points of general interest as to the British Coleopterous fauna, such as the number of species peculiar to the islands, but the work before us has not yet sufficiently advanced to enable such points to be discussed with advantage, and we may perhaps find occasion at a future time to consider them.

It would be a very great advantage if zoologists could agree on a system of names for the various aggregates larger than genera. Mr. Fowler's work only gives the individual names of these larger aggregates, and distinguishes them merely by rather slight typographical distinctions ; as a consequence, the student finds himself introduced to a large number of these names in rapid succession, and they must be rather a source of bewilderment to him than a key to the classification adopted; it would probably be an improvement if, in future volumes, the author would prefix to these names the terms "Family," "Sub-Family," "Group," &c., so as to allow the systematic value of the names themselves to be more readily appreciated. The two plates accompanying the volume are intended to give an idea of those structural characters on which the classification used in the work is based, and they also give three figures of larvæ borrowed from Schiodte; it may be hoped that these latter extraordinary forms may incite some student to continue the work of investigating the earlier stages of beetles, so ably pursued by the talented Dane whose recent decease is still a matter of general regret amongst entomologists. The structural diagrams II. and III. on Plate A are, as given, far from being successful. They are described as representing the under-skeleton, but, actually, one-half of each of the diagrams represents the upper surface, and the manner in which the two halves are connected will inevitably suggest to a beginner that the structures displayed are those that would be seen on removing the parts covering the upper surface.

Mr. Fowler, as we have already stated, has taken great pains to make himself acquainted with the modern authorities, and to render his work as interesting as the nature of the subject and its great extent will permit; his efforts in these directions will no doubt be duly appreciated, and his work will, it may be hoped, find a place in the libraries of all our local museums, as well as on the book-shelves of the amateur.

D. S.

BRITISH STALK-EYED CRUSTACEA AND SPIDERS

British Stalk-eyed Crustacea and Spiders. By F. A. A. Skuse. (London: Swan Sonnenschein, Lowrey, and Co., 1886.)

THIS is a modest little volume of 126 pages, professedly written for the "tyro." We are informed, on p. 14, that the "pages do not profess to be either scientific or in the least anything beyond the production of a humble admirer of Nature, and only intended to put the reader on the road to the investigation of the creatures written about." This being so, it would be unfair to judge the work from the stand-point of more special treatises, and we need do no more than comment upon the introduction of a somewhat antiquated system of classification and of minor errors which would be unpardonable in a work of greater pretensions.

The book is a clearly stated compilation, and is, so far as it goes, fairly accurate and up to date. There is, manifestly, little room for originality, and the reader must be prepared to find that most of the more pleasing passages—those dealing with the habits of the animals described—are, of necessity, quotations from earlier authors, references to whose works are in all cases given as footnotes.

The subject-matter is apportioned into nine chapters and an introduction, and it deals with methods and accessories as fully as with the animals themselves. Under the head of Development (Chapter III.) are to be found the facts of morphology and physiology which fall within the scope of the work. It is in this that the author is at his worst, and there is much here which stands in need of revision. We are told, in the introduction, that "the earliest known insects have been found in the Devonian, so probably there also existed spiders." Taking the context into consideration, it is surprising that the author should thus presuppose the discovery of Palæozoic spiders, and overlook that of Silurian scorpions and cockroaches, the former so well to his purpose.

"Big-tails," "Queer-tails," and "Little-tails" are renderings of *Macrura*, *Anomoura*, and *Brachyura* as unfortunate as they are unconventional.

The illustrations are good as a whole; some are excellent, being faithful copies of standard figures. More spiders might be advantageously delineated, and exception must be taken to the wretchedly wooden drawings of crustacean larvæ, especially of the young lobsters (p. 27). For the latter the author would do well to substitute, should a second edition be demanded, the strikingly truthful drawings of Sars ("Om Hummerens postembryonale udvikling," Christiania, 1874), or, failing those, Kent's figures ("International Fisheries Exhibition Literature," vol. vi. "Conferences").

There is much truth in the author's assertion (p. 10) that "everybody knows a crab. Everybody knows a spider. But it is just these every-day things that people know really least about; while, on the contrary, things that must be sought for in order to be seen are often most commonly known." The writer is true to this tenet, and his book ought, in the hands of an intelligent "tyro," to be productive of good results; while passages such as that in which he describes (p. 73) the construction of the spider's web are well calculated to arouse that enthusiasm which he is sanguine enough to presuppose. The appreciation of the beautiful in Nature must precede the devotion to that which is more useful, and the little handbook before us, invested, as it is throughout, with a true dignity of purpose, will serve as a means to this desired end.

OUR BOOK SHELF

Catalogue of the Fossil Mammalia in the British Museum, (Natural History) Cromwell Road, S.W. Part IV. Containing the Order Ungulata, Sub-order Proboscidea. By Richard Lydekker, B.A., F.G.S. (London: Printed by Order of the Trustees, 1886.)

THE collection of Proboscidean remains preserved in the British Museum is by far the largest in any Museum in the world; containing as it does the splendid collections made in the Siwaliks of India by Sir Proby T. Cautley, the unrivalled British series of mammoth remains, the unique collection of pygmy-elephant remains from Malta, the series of remains of dinotherium and mastodon, from Eppelsheim, &c., and a fine collection of American mastodons from the United States and from South America.

An immense collection like this, containing remains belonging to nearly all the described forms, was admirably adapted for the study of transition forms, and Mr. Lydekker has not been content in this Catalogue with giving merely a detailed enumeration of the contents of the cases, but has written a full account of the families, genera, and most of the species of the known extinct Proboscidea. In a short introduction he gives some most interesting notes on the geographical and geological distribution of the species. In reference to the subject of the structure of the cheek-teeth Mr. Lydekker thinks that this can be traced from the most generalised to the most specialised member of the Elephantidæ. So complete indeed is this transition that not only is there no real line of demarcation between Mastodon and Elephas, but several of the species of the two genera seem to pass so imperceptibly into one another that it is not unfrequently a matter of extreme difficulty (if indeed it be not an absolute impossibility) to determine to which species individual teeth really belong.

In regard to geographical distribution, there appears to be considerable evidence in favour of an easterly migration of the mastodons having taken place from Europe to India; while the restriction of the stegodont group of elephants to the latter country and the regions to the eastward, points to the conclusion that the transition from the mastodons to the higher elephants took place in those regions. From this we may also infer that there subsequently ensued a westerly migration of these higher forms to Europe, and finally on to North America, where the true elephants did not make their appearance till the Pleistocene, and then appear to have been represented only by two species, one of which ranged over the greater part of the higher latitudes of the northern hemisphere. The descriptive details are very usefully illustrated by a number of woodcuts of the teeth and cranial bones. The work, despite its name of Catalogue, is a most important contribution to our knowledge of the subject.

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.*]

Iridescent Clouds

THIS phenomenon is very common here in the winter, occurring, with few exceptions, whenever there are scattered clouds near the sun. The colours are often brilliant enough to catch the attention of the most casual observer, but at other times they can only be made out with the aid of dark neutral-tint spectacles. These reduce the intensity of the glare near the sun to a point favourable to the discrimination of colour.

I have lately been watching the somewhat complicated phenomena, and taking rough measures of the angular distances of the various colours from the sun, and I have little doubt that the colours are due to diffraction of light by fine particles of ice.

Within a circle, radius about 2°, the clouds are white, perhaps faintly tinged with blue; but it is difficult to observe a delicate shade of colour so near the sun. This circular space is surrounded by a ring of yellow or orange. The region of most vivid hues is comprised between 3° and 7°, the most striking being purple, blue, orange, green, and red. These are not arranged in rings, but are distributed over the thinner parts of a cloud in irregular patches. Beyond this region the only colours visible are green and red, becoming fainter as the distance from the sun is increased. I have detected them in three or four cases at a distance of 21°. At some distance from the sun the greens and reds are frequently arranged in bands parallel to the edge of the cloud, sometimes as many as three bands of each being visible. I have often seen a cloud completely encircled by bands, the impression given to the observer being that the colour depends on the thickness of the cloud. No doubt the real explanation is that the ice particles are larger in the interior of a cloud. We have thus two independent factors to determine the colour of a particular portion of cloud: the distance from the sun, and the average size of the particles. Near the sun slight variations of the former are more important, so we get a tolerably regular yellow ring. Far from the sun the variations of the latter have overwhelming influence, and we have bands along the edge of a cloud. At a medium distance, in the region of vivid colour, we have the two factors nearly equally powerful, and indescribable confusion as the general result.

On one occasion, when the edge of a large cloud passed almost through the sun, I noted down the colours in order along the edge, where the size of the particles would be tolerably uniform: white, yellow, red; blue, green, yellow, pink; green, faint red. This list consists evidently of three successive diffraction spectra, and it is in satisfactory agreement with a number of less complete series that I have obtained. The blue, however, is often replaced by a brilliant purple, due to the first and second spectra overlapping. Another method of discovering the true order of the colours is by watching the changing hues of a cloud approaching or leaving the sun. This tended to corroborate the list just given, but I could seldom trace more than two or three changes, so rapidly did the clouds grow or dwindle away. I noticed, indeed, that the more rapid the growth the more brilliant were the colours displayed. One interesting observation deserves special mention. A cloud showed faint colour at a great distance from the sun. It was edged with green, with red inside. As it approached the sun, the bands moved inwards, and red appeared on the edge, then green, then red, then green. The last tint was very undecided, and afterwards the whole cloud remained white. The inward motion of the bands showed that the inner particles were larger.

We now come to the question of the form of the diffracting particles. The form most favourable to diffraction is the sphere, as with a sphere the angle of diffraction for any given spectrum depends only on its diameter. Thus if a cloud be composed of spheres of uniform size, and be at the angular distance from the sun corresponding to the first spectrum for that size, each sphere will send its quota of light to the observer. Next to the sphere comes the circular cylinder. In order that a cylinder may send diffracted light to the observer, its axis must lie in or near the reflecting plane. By the reflecting plane I mean the plane of a mirror which would reflect sunlight to the observer. But, when this condition is satisfied, the angle of diffraction, corresponding to any particular spectrum, depends only on the diameter of the cylinder. Any other form, a circular disk for instance, gives different diffracting angles according to the orientation of the particle. The spectra corresponding to different orientations would be superimposed and white light be the result.

Now, among the manifold forms of snow-crystals there is, I believe, nothing approximating to a sphere. But thin hexagonal prisms are common, either separate, or attached as rays to hexagonal disks. These would produce much the same effect as circular cylinders; for the extreme variation of the apparent diameter of an hexagonal prism from its mean value is only 7 per cent.

Granted that the diffracting particles are hexagonal filaments, my measurements of the angular distances of the colours from the sun supply data for determining the average diameter of the filaments. For this purpose purple is a useful colour, as it always arises from the overlapping of the first two spectra. I took some five-and-twenty measures at various times, which varied from $3\frac{1}{2}°$ to $6\frac{3}{4}°$. These give diameters from ·017 mm. to ·009 mm. Orange of the first spectrum ranged from $2\frac{1}{2}°$ to $5\frac{1}{2}°$, six measures. These give diameters from ·021 mm. to ·010 mm. Blues of the second spectrum, four measures, $4\frac{1}{2}°$ to $6\frac{3}{4}°$; diameters ·014 mm. to ·009 mm. If the colours I observed at 21° from the sun were produced by filaments ·013 mm. in diameter, they must have belonged to the ninth spectrum. But the ninth spectrum, in addition to being only one-fortieth as bright as the first, is overlapped by four spectra of higher order and three of lower, so it can hardly be distinguishable. At such a distance from the sun the finer particles would have a great advantage in colour-producing power, so I think it probable the spectrum was of the fifth order, produced by particles of diameter ·009 mm.

The next difficulty is to explain why colours are not seen in clouds composed of minute spheres of water. As explained before, the spherical form has a great advantage. I find by calculation that if the spheres were of uniform size, diameter ·013 mm., the colours of the first spectrum would be about twenty times as brilliant as if the cloud were composed of filaments of the same diameter, arranged at random, but occupying the same fraction of the field of view. So we might *a priori* expect that water clouds would be more brightly iridescent than ice clouds. But it is not so. During the summer here I looked frequently and vainly for iridescence. This want of colour must arise from the minute drops not attaining sufficient uniformity of size. So we have to find some cause of uniformity which acts more powerfully on particles of ice than on drops of water. I venture to offer the following suggestions.

Let us consider what happens when an ice cloud is forming. Dust particles, no doubt, act as nuclei to ice crystals as well as to water drops; so that a number of crystals will start into existence about the same time. Soon there will be no more dust particles of sufficient size to form nuclei. The rate of deposition on a crystal will be proportional to its surface, so all the crystals will grow in diameter at the same rate. The ratio of the largest diameter to the smallest will become less. In fact the crystals will become more uniform in size. No doubt, too, the supply of aqueous vapour near a large crystal will be consumed more rapidly than it can be refunded by diffusion. So the larger crystals will grow somewhat more slowly. These are causes tending towards uniformity. They account for the observed fact that they are newly formed clouds, which show the brightest colours, though when they first come into view they are white. It is easy to give reasons why some clouds should lose their colour so soon. Varying conditions may affect the growth of different layers of particles in a different manner, or a slight increase in the rate of deposition may call new dust particles into action.

In the case of water clouds there are two special causes brought into action against uniformity. Sir William Thomson has shown that the maximum vapour-tension at the surface of water is largely increased when the surface is highly convex. So the large drops will grow more rapidly than the small ones, and the range of size will be more and more extended. Secondly, whenever two drops of water come into collision, they will combine into one larger one.

In conclusion I may remark that St. Moritz is 6000 feet above sea-level, and the iridescent clouds were generally above the surrounding mountains, *i.e.* at least 11,500 feet above sea-level. On some days the sky was overspread at a great height, with a thin haze gathered here and there into denser streaks (cirro-stratus?). The haze sometimes formed coronæ close around the sun. I have not made out more than two spectra. From rough measures of the diameters of the rings, I find for the diameters of these filaments values varying from ·04 mm. to ·07 mm.

JAMES C. McCONNEL

St. Moritz, Switzerland, March 14

Aino Hairiness and the Urvolk of Japan

IN Mr. B. H. Chamberlain's remarkable and instructive monograph on the Ainos, contained in the first number of the Memoirs of the Literature College of the Imperial University of Japan, just published, will be found an explanation of the different conclusions that have been arrived at by different observers as to the *hairiness* of that singular people, equally isolated, so far as our present knowledge extends, by language and by physical characteristics from all surrounding races. When I spent some days among these so-called savages in 1865 or 1866, I had the opportunity of examining some four or five score of them, chiefly men, and in every individual I found the phenomenon of hairiness more or less marked. The sternal, inter-scapular, and gluteal regions were, in particular, thus provided with a natural covering, the very regions where such a protection from the drip of rain would be most serviceable. I remember well that in some individuals the gluteal fur was so abundantly developed that thick tufts of hair, several inches long, could be grasped in the hand. But recent travellers have been struck by the number of natives they met with deficient in hairiness—whether they were proportionately lacking in face-hair is not stated—and it has been doubted whether hairiness is really an Aino characteristic. Dr. Baelz's investigations have, however, amply vindicated the claim of the Ainos to be the hairiest people in the world, and now Mr. Chamberlain shows that the smooth-bodied natives are in fact half-breeds, the progeny of native mothers by Japanese fathers. Unions of this kind have probably increased in frequency during the last two decades. Between the two races, however, some incompatibility seems to exist, for their progeny exhibit a diminished fertility. "The second generation," says Mr. Chamberlain, on the authority of the Rev. Mr. Batchelor, who has lived for years among the Ainos, and contributes an exhaustive grammar of their language to the volume of Memoirs before me, "is almost barren; and such children as are born—whether it be from two half-breed parents, or from one half-breed parent and a member of either pure race—are generally weakly. In the third or fourth generation the family dies out."

The injury to the reproductive system caused by this "miscegenation"—a phenomenon not unparalleled in the history of man, and proving the existence in man, as in other organisms, of a tendency to specific variation—has an important bearing upon the much-debated question of the proportion of Aino blood that runs in the veins of the Japanese of to-day. Mr. Chamberlain, chiefly from philological considerations based upon an examination of place-names, arrives at the conclusion that the *Urvolk* of the Japanese group, from the extreme south to the furthest north, was an Aino race, and we know from history that up to the time of Yoritomo (twelfth century A.D.), and probably later, the northern half of the main island was still, to some extent, peopled by Ainos. Yet even the northern Japanese are smooth-bodied, although it is extremely unlikely that "miscegenation" did not obtain between their Japanese ancestors and the aborigines. In the light of Mr. Batchelor's observations the explanation of this apparent anomaly is easy. The half-breeds died out, and the prepotency of the Japanese in numbers and civilisation gradually expelled the Aino element from the population, which has thus become an almost purely Japanese one.

It must not, nevertheless, be forgotten that at least two distinct races may still be traced in the existing population of the Japanese group. One is slim, high-headed, and often aquiline-nosed; the other stouter and broader, more brachycephalic, and flat-nosed. Excellent types of both, especially of the first, will be found in Siebold's "Nippon Archiepf." The former constituted the military class of Old Japan, the latter the peasantry; and of the latter some degree of hairiness of the limbs is a not uncommon characteristic. The drawings of Hokusai sufficiently prove this assertion, which the experience of every resident in Japan will confirm. It may therefore be safely assumed that the elimination of the Aino element has not been complete. For my own part I believe that the earliest inhabitants of Japan were tribes of Malayo-Polynesian blood coming from the south, and of Aino blood coming from the north. Altaic immigrants followed, and, partly perhaps through some degree of reproductive prepotency, gave a characteristic and predominant stamp to the population without total elimination of its aboriginal elements.

University of London, March 21 F. V. DICKINS

Units of Weight, Mass, and Force

HAVING read with much interest Prof. Greenhill's letter in NATURE of March 24, p. 486, I am inclined to think that much of the perplexity felt by some who begin the study of dynamics arises from the want of names for the units of the various magnitudes with which the science deals. We have names for units of time, space, mass, force, work; but no names for units of velocity, acceleration, impulse, momentum, &c. I venture to suggest the following:—Let the unit velocity be that with which a point describes uniformly one foot per second. Let this unit be called a vel. Let the unit acceleration be that whereby the velocity is uniformly changed by one vel per second. Let this unit be called a cel. Then everything becomes clear. *E.g.* the meaning of the equation $W = mg$ is seen to be this: The weight of a mass of m pounds at a place where the acceleration arising from the mutual stress between it and the mass of the earth is g cels being W poundals, the *numbers* $W\,m\,g$ are connected by the equation $W = mg$. Then, for the sake of the beginner, let the names of the units be given thus: $W = mg$ poundals, $m = \frac{W}{g}$ pounds, $g = \frac{W}{m}$ cels. It is too common to see acceleration expressed in feet per second, instead of in vels per second. If the weight of a mass of m pounds be defined to be the mutual stress between it and the mass e pounds of the earth, it is evident that the weight of e attracted by m is the same as the weight of m attracted by e; and, in the absence of either, the other would have no weight.

Bardsea, March 29 EDWARD GEOGHEGAN

The Earthquake in the Riviera

THOUGH there can be no question as to the amount of damage done by the late earthquake—I am writing in a shed, the hote being destroyed—I think that the violence of the shock has perhaps been very greatly exaggerated. I have only been abl to make a flying visit to this place and to Diano Marina, but I cannot help being struck by the fact that the peculiar architecture is the main cause of the large amount of destruction, Indeed, judging from the small amount of damage done to buildings in which flat or square stones and flat floors have been used, I should doubt whether the shock was much more severe than that which not long ago damaged the brick buildings in East Anglia.

At both Oneglia and Diano Marina the building material is usually rounded stones from the beach, or rubble with stones of all shapes and sizes. The stucco is apparently expected to make good any deficiencies. Besides this the floors are nearly always brick arches abutting against the vertical walls, without any reference to other lateral support. Most of these houses are three or four stories high. Of course any vibration affecting buildings of this construction will split the walls in all directions, for besides the lateral thrust of the arches, the walls are full of wedge-shaped stones ready to slip into any fissures which may form.

The complication caused by these arched floors makes it very difficult to trace the direction or angle of emergence of the shock. CLEMENT REID

Oneglia, March 13

Scorpion Virus

ALLOW me to state that the results of my experiments on Cape scorpions are in full accord with Prof. Bourne's conclusion that the poison of the scorpion has no fatal effect on the same individual or another individual of the same or even of another species. Speaking before the South African Philosophical Society in February 1883, I said:—"Members of the Society will see on the table a scorpion of the larger (Cape) species. That scorpion I caught at 11 o'clock this morning. I at once pierced him in three places with his own sting, on which in each case there was a drop of poison. In the last inoculation I held the sting in the wound, and squeezing the 'bulb of the sting' with the pincers forcibly injected poison. The creature is alive and active" (Proceedings for 1883). These and subsequent experiments, however, led me to believe that the poison has *some* effect, causing sluggishness and torpor for a while. I quite agree with Prof. Bourne that it is physically possible for a scorpion to sting itself in a vulnerable place; and though I never was able to observe the infliction of a wound on itself by any scorpion, I can well believe that this is possible, but, I am convinced, wholly accidental.

I found also that the poison of the ring-hals snake (*Naja hæmachates*) was not fatal when inoculated in the same individual or another individual of the same species.

University College, Bristol C. LLOYD MORGAN

The Supposed Myzostoma-cysts in *Antedon rosacea*

SOME eighteen months ago I called attention in these columns (vol. xxxii. p. 391, and vol. xxxiii. p. 8) to certain malformations which I had discovered on the pinnules of *Antedon rosacea* from various British localities. They often take the form of small cysts which are very like those produced by encysting Myzostomida on the arms and pinnules of various Crinoids from the Pacific; and as no other cyst-builders but *Myzostoma* were then known to infest the Crinoids, the inference seemed a natural one that the cysts on the pinnules of *Antedon rosacea* had been produced by a small member of this genus. I subsequently found several more cysts on some examples of *Antedon rosacea* which were dredged at Gibraltar by the Italian corvette *Vettor Pisani*, and the whole collection was sent to my friend Prof. L. von Graff for examination.

To our great surprise, however, he has not found a single *Myzostoma* in any one of the fourteen malformations of the pinnules, whether cysts or otherwise, which he has opened; and "the new British Myzostoma" must therefore be disestablished.

But what, then, has been the cause of these malformations? Prof. von Graff has found them to be always associated with the presence of a minute globular body, which has the appearance of an egg that has undergone superficial cleavage, but yet exhibits no trace of nuclei when stained. It is impossible to decide at present what this structure may be. Prof. von Graff has described it more fully in a "Supplementary Report on the Myzostomida of the *Challenger* Expedition" which he has just completed. But its nature seems to be as problematical as that of the sacculi; and fresh material, not spirit specimens, must be examined before we can expect to learn much more about it. In any case, however, it would seem that we have to deal with a hitherto unknown parasite of the Crinoids, which is capable of producing modifications in the calcareous tissues of the arms and pinnules, of essentially the same character as those caused by *Myzostoma*, though of smaller size.

I would commend the question to the attention of those naturalists who may meet with *Antedon rosacea* in the dredgings of the ensuing season; and in order that they may know how to catch their hare, I shall be most happy to forward specimens of the cysts to anyone who desires to become acquainted with their external appearance. I may add that the largest cysts I have seen are on Comatulæ from the Cumbrae, Milford Haven, and Gibraltar; while I have no knowledge of their occurrence either at Naples or anywhere else in the Mediterranean.

Eton College P. HERBERT CARPENTER

On some Observations on Palæobotany in Goebel's "Outlines of Classification and Special Morphology of Plants"

THE few modern authors of botanical text-books who have ventured to summarise recent palæobotanical researches have achieved but moderate success. These authors have too little knowledge of the rapid progress of the study of fossil plants during the last few years to make success possible; hence, their summaries, if not absolutely inaccurate, are usually misleading. So long as these errors are confined to works published in Continental languages, British palæobotanists need not take the trouble to correct them. But the case is altered when English translations of these books appear amongst us. Palæobotany has nowhere made greater progress during the last few years than with ourselves. Many errors have been corrected, and new truths, results of careful and prolonged investigations, have taken their place. With the more important of these new discoveries many of our younger students of geology are now familiar. It is desirable that what they have been taught should not be contradicted by the utterances of authors ignorant of the subjects upon which they venture to express an opinion.

Some little time ago Dr. Goebel, of Rostock, published a volume which was virtually a new edition of Book II. of Sachs's "Lehrbuch der Botanik," and an English translation of this volume, made by Mr. H. E. F. Garnsey, and revised by Prof. I. B. Balfour, has just appeared. Dr. Goebel's volume contains some references to the Palæozoic flora which are seriously behind the times. To allow these statements to reach our students uncorrected will do harm, because they must suggest to those students that certain questions are still open and debatable which cannot now be regarded as such.

Had I not unfortunately misunderstood a wish expressed by my friend Prof. Balfour, some explanatory footnotes would have been introduced into the above volume, which would have rendered this communication unnecessary.

On p. 193 of the translation we find the following statement:—"Other groups are the Sphenophylleæ, Lepidodendreæ, and Sigillarieæ, the first of which are only heterosporous Lycopodiaceæ." We have no reasons for concluding that Sphenophyllum is Lycopodiaceous, still less that it is heterosporous. This latter statement rests upon M. Renault's interpretation of a minute *multicellular* fragment which he observed in a sporangium, and which he believed to be a macrospore; it could not be this, since the exosporium of a macrospore is a *unicellular* organism. On the other hand, the Lepidodendra were both homosporous and heterosporous. As to the Sigillariæ, even M. Renault now admits that all the vertically-fluted forms are Lycopodiaceous. The assertion that the Lepidodendra were all heterosporous is repeated on p. 196. On p. 272 we have a brief paragraph of eight lines remarkable for the number of the inaccurate statements which it contains. I have indicated these inaccuracies by reproducing them in italics.

"The Calamites are Equisetaceæ which appear in the older geological formations, *beginning in the Carboniferous Limestone* (1), culminating in the Coal-measures, and disappearing in the Permian formation. The spikes of sporangia are either not known, or so badly preserved (*Calamostachys*) (2), *that their structure cannot be determined; it remains doubtful, therefore, whether they were homosporous or heterosporous forms* (3). The stems *had neither leaves* nor leaf-sheaths, *or else these were transitory formations and soon fell off* (4). In other respects *the structure of the stems resembles that of the Equisetaceæ* (5).

Their surface was marked with ridges (6), and they had a central hollow divided by diaphragms."

I will examine these statements *seriatim.*

(1) The author appears to have been strangely ignorant of Sir William Dawson's magnificent discoveries of Calamites and other Carboniferous plants in the Devonian strata of North America, announced in his Report on the subject in 1871.

(2) In 1874 I published in the Philosophical Transactions the detailed structure of extremely beautiful examples of *Calamostachys Binneyana*, and, since then, Prof. Weiss, of Berlin, has figured equally fine examples of *Calamostachys Ludwigi.* In the Philosophical Transactions for 1881 I further showed that this genus comprehended both homosporous and heterosporous forms. At the same time Calamostachys is not the fruit of Calamites.

(4) Both Sir William Dawson and Prof. Weiss have shown that the slender twigs of Calamites were abundantly supplied with verticils of linear leaves.

(5) This statement is true with an important limitation, which Dr. Goebel ignores; or, as a follower of M. Renault, he more probably rejects. Whilst the type of Calamitean organisation is unquestionably Equisetiform, their arborescent stems and branches contained an enormous xylem or woody cylinder, developed exogenously, which made them differ very widely from their degenerate living representatives.

(6) This is a repetition of the old fallacy, which regarded the vertical groovings of the surfaces of the inorganic casts of the fistular medullary cavity as belonging to the cortical surface. We have now numerous sections of the Calamitean cortex, no one of which exhibits the slightest trace of vertical flutings; they are all smooth.

On p. 281, speaking of heterosporous Lycopodiaceæ, the author accepts M. Renault's old conclusions that in Lepidodendron "there is no certain indication of secondary growth in thickness." "The connection of fossil stems capable of great increase in thickness, such as the Sigillarieæ and Calamodendron is at present questioned." These facts are no longer capable of being justly questioned. The structure of *Lepidodendron Selaginoides* alone suffices to settle the matter so far as that genus is concerned; to say nothing of the many other species that demonstrate the same fact. M. Grand'Eury himself, long one of the most influential questioners, has now recognised that the genus Arthropitus only represents the thick woody zone of a true Calamite. Prof. Stur, of Vienna, long ago demonstrated in an unanswerable manner the almost absolute identity of Calamites and Calamodendron; and M. Renault himself, as I have already observed, has still more recently been compelled by the discovery of a Sigillarian fructification by M. Zeiller to alter his view respecting the Sigillariæ. He no longer insists that these cannot be Cryptogams because their stems grow exogenously, but now hands over to his opponents, who have so long contended for the Lycopodiaceous affinities of this Sigillarian genus, all the vertically fluted examples of it.

Whilst deeming it desirable that his readers should be put in possession of the other side of the question to which he refers, it is only fair to Dr. Goebel to say he is himself aware that those questions are dealt with in a one-sided manner. In a footnote on p. 272 of the English translation the author says:—"The short description given in the text from Renault may serve at least to draw attention to these interesting types, in which there is much that is yet uncertain. We cannot enter here into disputed or doubtful points." At the same time it is to be lamented that the leading botanists of the world cannot give us palæontologists more of that valuable aid which their special studies would so well enable them to do. I do not yet despair of enlisting some of the Strasburgers, de Barys, Goebels, and Van Tieghems in this honourable service. W. C. WILLIAMSON

Owens College

A Sparrow chasing Two Pigeons

ON Sunday, I asked three men what they were observing, when they pointed out a sparrow chasing two pigeons.

The pigeons were evidently greatly alarmed at their pugnacious attendant, who took occasional pecks at them when flying underneath, and whenever possible. The sparrow lost ground when the others made their more rapid doubling, but soon came up with them again, and renewed its attack.

What was the original quarrel of course we do not know, but the persistency of the sparrow's attack greatly amused us. Have any of your readers observed anything like this? or is there any record of the like? E. A. C.

Luton, Chatham, March 14

Top-shaped Hailstones

I DREW attention to hailstones possessing the above form in *Science Gossip* of December 1884. These pellets, which fell in my garden at Polmont, Stirlingshire, on the morning of May 6, 1884, were about one-fourth of an inch in length, and nearly three-sixteenths of an inch across. I did not see any horizontal stratification as observed by your correspondent Mr. Middlemiss, but found that each transverse section, when examined by a good lens, exhibited a fairly well-marked internal radiated fibrous structure, somewhat similar to that shown in sections of the mineral wavellite. Below are two (transverse

FIG. 1.—Transverse section (near base of cone) × 2.

FIG. 2.—Longitudinal section × 1½.

and longitudinal) diagrammatic sections of the Polmont hailstones.

Since then, however, I have found top-shaped hailstones com-

FIG. 3.—Longitudinal section.

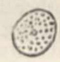


FIG. 4.—Transverse section of Fig. 3.

posed of fibres radiating from the summit of the pyramid as shown in Fig. 3. ALEXANDER JOHNSTONE

Edinburgh University

A Peculiar Radiation of Light

AT 10.30 p.m. this evening, my attention was called to a peculiar radiation of light in the eastern sky. The centre of radiation was due east, and the bars on the *right-hand side* were increased in brilliancy by light evidently arising from the moon, which was not visible, but concealed by cloud. The extent of these rays was from horizon to zenith; the rays being of unequal size, but of a pale gray colour, slightly iridescent.

The east wind was blowing smartly at the time, and I should like to be informed whether this strangely beautiful appearance in the sky was caused by the radiation of light from a rising moon on thin clouds, or was it the effect of a strong current of wind from a given point?

By 11 p.m. the moonlight was full; the moon still to the right of the axis of the rays, and the rays nearly dispersed.

Falmouth, March 12 ROBERT D. GIBNEY

THE CHEMICAL SOCIETY'S ANNIVERSARY MEETING

THE anniversary meeting of the Chemical Society was held on Wednesday, March 30. We give some extracts from the address of the President, Dr. Hugo Müller, on the recent progress of chemical science:—

As we contemplate this ceaseless activity in chemical research now manifested all over the world, and which from year to year is continually on the increase, we are nevertheless bound to recognise the fact that vast as the work thus accumulated may appear, there remains still much to be accomplished. The more the field is worked the richer will be the harvest.

Overwhelmed by the quantity of material, especially in the direction of the production of new compounds, hasty critics were wont to denounce such work as superfluous, but it is now generally recognised that we must still continue with the patient and careful elaboration of the substructure of facts before we can with advantage proceed with the longed-for rearing of the edifice of a comprehensive scientific generalisation, that is to say, of ideal chemistry.

The infinite complexity which inquiry reveals in every direction bids us more than ever to be cautious in taking flight on the wings of speculation.

In the meantime we must content ourselves with the use of working hypotheses in the various fields of inquiry; these we develop and modify as we go on, or, it may be, discard in favour of others which for the time being seem more in accordance with the facts before us.

The triumphs of modern chemistry bear testimony that faulty and incomplete as our present theories undoubtedly are, our science is ever advancing.

It is now well understood that the most important data for the future extension of chemical theory will be derived from the interpretation of the results of investigations into the physical side of chemical phenomena.

The examination of the optical properties of chemical elements and compounds, the determination of thermo-chemical constants, and the verification of physical constants generally, are now pursued by a great number of investigators. Of late also the experimental inquiry into the connexion between electrical and chemical force is becoming a fruitful field of research; and we may hope that further determinations of the coefficients of conductivity of electrolytes will before long lead to a clearer perception of the intimate nature of chemical change.

To pass in review the chemical work published during the year, as some of my predecessors have done on similar occasions, has now become an impossible task, even supposing that the time at my disposal permitted me to do so. I am, however, tempted to refer briefly to a few results which strike me as particularly noteworthy.

The work accomplished in thermo-chemistry is, as I have already observed, very considerable, and thanks to the patient labour of many workers the results thus achieved are comprehensive enough to admit of a consideration of their general bearings. In this respect I wish to direct attention to the publication of Julius Thomsen's fourth and concluding volume of "Thermochemische Untersuchungen." This remarkable work is entitled to the highest appreciation of all who realise the manifold difficulties which beset the execution of thermochemical investigation. But while referring to the many highly important and remarkable deductions which the author draws from his experiments, we cannot at the same time help being struck by the many anomalous results and startling conclusions which he arrives at. It would seem that further determinations of the fundamental values, if possible by different and varied experimental methods, must be obtained before the full importance of this work can be entirely realised.

An important addition to our still very limited knowledge of the density of metallic elements in the gaseous state has been made by V. Meyer and Mensching, who have now succeeded in overcoming the great experimental difficulties formerly encountered in the determination of the vapour-density of zinc. The molecule of zinc has been found to be monatomic, like that of cadmium and of mercury, the only two other metals the vapour-densities of which are thus far known.

The remarkable results recently published by Crookes in his papers on the spectra of the so-called rare earths are still fresh in our memory, and the ingenious application he has made of the doctrine of evolution in this speculation on the genesis of the elements has not failed to attract the attention it deserves.

The further investigations of the chemical and physical properties of the new element germanium by Winkler, Nilson, and Petterson have established its chemical position, and the supposition that its proper place in the periodic system is that of ekasilicon has been confirmed.

Ladenburg's long-continued researches on conine have been crowned by success. He has effected its synthesis and has shown that it is identical with α-propylpiperidine. This must indeed be considered one of the most noteworthy achievements in organic chemistry of the past year, inasmuch as it is the first instance of the artificial formation of an optically active natural alkaloid.

Wallach found that the diazo-amido-compounds formed from diazo-salts and piperidine are for the most part well-characterised substances, and that when heated with concentrated hydrofluoric acid they yield the fluor-derivative in almost theoretical proportions. He has prepared in this way fluorbenzene, parafluortoluene, parafluornitrobenzene, parafluoraniline, and fluorphenyl, &c.

Studying the action of sodium on mixtures of ethers such as oxalic and acetic ethers, W. Wislicenus has discovered a new and ready method of effecting the synthesis of compound acids, and this reaction cannot fail to become of great value.

Brieger has succeeded in isolating a well-characterised alkaloid from the liquid used for cultivating a certain Bacillus which causes tetanus traumaticus in animals. This substance, which the author calls tetanine, seems to be the immediate cause of the toxic action of this Bacillus, and thus for the first time a specific pathological effect of a microbe has been traced to a well-defined chemical compound produced or secreted in its life-process.

Finally, I must also allude to the very remarkable observation recently published by Liebreich which demonstrates the fact that under certain conditions chemical reaction is retarded, and even altogether suspended. He noticed that in a mixture of aqueous solutions of chloral hydrate and sodium carbonate the formation of chloroform does not take place uniformly throughout the liquid. For instance, on performing the experiment in a test-tube there appears immediately below the meniscus a sharply defined space of 1–3 mm. thickness in which no reaction takes place. Similar results were obtained when an aqueous solution of iodic acid was mixed with sulphurous acid and soluble starch. The inert space manifests itself on the surface of the liquid which is in contact with the air or separated from it by a thin membrane. In narrow tubes the reaction is much more retarded, and it is altogether suspended in capillary tubes.

In my opinion this preliminary communication contains the germs of a discovery in a new direction, and the further study of the nature of these subtle influences which bring about the phenomenon in question must lead to important results.

In bringing this report to a conclusion I must briefly allude to a subject only indirectly connected with our Society, viz. the progress made in the organisation of technical education in this country, which, more particularly under the guidance and fostering care of the City and Guilds of London Institute, is gradually making its way.

Most of you are aware that the President of this Society is one of the *ex officio* members of the governing and organising body of this Institute, and it may be mentioned in passing that the regular attendance at the frequent meetings of the various Committees and Sub-Committees involves the necessity of devoting a by no means inconsiderable amount of time to this honorary office.

The chief event to be recorded in this connexion is the inauguration of the Central Institution which is to fulfil the function of a Technical University or Polytechnicum, and to afford higher scientific education to the future owners, directors, managers, engineers of manufacturing works, and the teachers in the various branches of technology. This magnificent Institution has now started on its career, and we have every reason to think that before long its value will be fully recognised by those who ought to take advantage of its existence. It is, however, unfortunate that the organisation of this Institution has stopped short of the plans originally laid down, and has been not at once carried to completion. Strange as it may appear, this is due to the want of funds. The City and Guilds, in taking so prominently charge of the initiation and diffusion of technical education in this country, have thus far most liberally furnished the means required, and have thus earned the gratitude of the country; but as the development of the scheme progresses an even and commensurate flow of further contributions is required, which, being voted in many cases but annually, at once demonstrates the somewhat precarious conditions on which this important enterprise is dependent.

It is to be hoped that a more general recognition of the absolute need of an education of a higher scientific character both for masters and men will before long have its proper effect; and that the ways and means will be forthcoming to carry out a work which promises so well, and that the Central Institution may then stand a fair comparison with numerous institutions of a similar kind in other countries which have already helped in so marked a degree to advance the industries of those countries.

The mistaken notion is still too prevalent that technical education has to confine itself to the theoretical considerations of known technical processes, and that a more extended acquisition of scientific knowledge is not required. It is obvious that a pupil educated on these lines may find by the time he is able to enter on his practical career that the processes with which he has been made acquainted have in the meanwhile become obsolete, and unless his education has been sufficiently comprehensive to enable him to strike out new lines for himself he will be ill fitted to compete with those who have been educated on a wider basis.

Essential as it is to impart to the future manager scientific knowledge, it is above all necessary to train him by practical work and research in the laboratory how to investigate a subject which may present itself in his daily occupation, whether it be some unexpected development in a new direction, or whether it be some new difficulty which confronts him in carrying out the processes under his direction.

It is self-evident that such knowledge and such practical experience in carrying out investigations is not to be attained by merely attending one or two courses in the lecture-room or in the laboratory. Those who mean to effectually qualify themselves for such functions can only accomplish this object by devoting years of patient and intelligent work under the guidance of the professor in properly appointed laboratories.

THE INSTITUTION OF NAVAL ARCHITECTS

THE spring meetings of the Institution of Naval Architects this year were, to a considerable extent, adversely affected by the recent death of Mr. William Denny, of Dumbarton, the eminent shipbuilder, who was for many years one of the most active members of the Council, and who was foremost amongst the mercantile shipbuilders of this country in the application of scientific methods to naval architecture. Mr. Denny, as is well known, set up at Dumbarton a large experimental tank similar to that contrived by the Admiralty at Torquay for the late Mr. W. Froude, F.R.S., and in which most of his famous experiments on the resistances of the hulls of ships were carried out. It is not often that manufacturers can be induced to spare time and money for the purposes of scientific investigation, even when such investigation is directly conducive to the success of their business. But Mr. Denny was an exceptional man. He firmly believed in the mercantile value of exact scientific knowledge, and he possessed the courage and the ability to act up to his beliefs. It is satisfactory to know that he considered himself fully repaid for the risks he ran, in the results which he attained.

The opening address of the President dealt, as might have been expected in this Jubilee year, with the remarkable progress in steam navigation achieved during the fifty years of Her Majesty's reign; a progress which must certainly be acknowledged to be extraordinary when we remember that, at the commencement of the reign, the late Dr. Lardner publicly offered to eat the first steamship which should cross the Atlantic, whereas nowadays we have vessels which make the passage in a few hours over six days, and a fuel consumption at sea of $1\frac{1}{4}$ pounds of coal per indicated horse-power per hour is not uncommon. The speaker alluded to the various improvements, such as the use of steel in the construction of both hulls, engines, and boilers, the adoption of high-pressure steam and triple compounding, &c., which have principally contributed to the remarkable results attained.

The first paper read was by the late Director of Naval Construction at the Admiralty, Sir Nathaniel Barnaby, and dealt with the important subject of the connexion between the Royal Navy and the merchant service. This paper was rather political than technical in its character. The author's main object was to support the Admiralty in their recently announced policy of so organising the mercantile marine as to increase the power of national defence. He pointed out that a fast and properly constructed mail steamer may be as efficient a factor in naval war as an ordinary cruiser costing a quarter of a million sterling; and that there are even certain services which the mail-steamer, by reason of her greater size and travelling power, can perform better than the cruiser. On the other hand, the great mass of our mercantile marine is now relatively weaker than it has ever been before against the attacks of an enemy; for in the wars of the last century such ships as the armed East Indiamen possessed a well-recognised fighting value, but nowadays warships are so specialised that the majority of merchant vessels possess no powers of resistance whatever. Sir Nathaniel Barnaby also called attention to the fact that the State makes provision annually for a reserve of seamen, who are drilled periodically and paid by it, and who are liable to be called out to serve in case of war; and he then proceeded to show how, by good organisation, the superior merchant-ships, if manned mainly by naval reserve men, could in case of war be immediately available for service in whatever part of the world they might chance to find themselves. At the present moment the Royal and mercantile navies are under the control of two different Departments of State, and by some strange perversity the First Lord of the Admiralty is almost the only great political officer of State whose name is not to be found on the long list of members of the Board of Trade. As a natural consequence there is no community of action between the two Departments, and no organisation at present exists by which the services of the better class of fast merchant steamers could be rendered instantly available in case of war. The author's cure for this condition of affairs is the creation of a Secretaryship of State for the Navy, so that the interests of the merchant shipping and the Royal Navy might be united, and a truly national marine formed. There is no doubt but that Sir Nathaniel Barnaby in reading this paper has called attention to a very serious set of evils, which may all be remedied by a little organisation and by co-operation between two of the Departments of State. Even if the Board of Trade did not see its way to help in the work, what is to prevent the Post Office authorities from backing up the Admiralty by declaring that they would in future give the preference for mail-carrying purposes to steamers which fulfilled the Admiralty requirements of speed, subdivision, and structural strength, and what is to prevent the Admiralty from assisting the Post Office to obtain a cheap and efficient mail service by granting moderate retaining fees or subsidies to such steamers, provided they were always manned with a due proportion of naval reserve men and trained officers, and provided also that in consideration of the yearly subsidy their services were to be always at the disposal of the State in case of war at a fixed rental to be arranged beforehand. A beginning has undoubtedly been accomplished in the arrangements recently concluded between the Cunard and the White Star Lines on the one hand, and the Admiralty and the Post Office on the other, but much yet remains to be done, and we earnestly trust that Sir Nathaniel Barnaby's paper may be brought under the serious notice of those upon whom will devolve in time of war the care of our mercantile navy and the protection of our food supplies.

M. L. de Bussy, the Inspecteur-Général du Génie Maritime in the French Ministry of Marine, read a short paper on the results of a series of trials carried out on a torpedo boat at progressive speeds, in which he called attention to the fact that there is a diminution in the resistance of the hull after a certain speed has been passed. This fact was, however, already well known to members of the Institution, the peculiar sinuosities, or humps, as they are called, on the speed and power curves of vessels tried at progressive speeds having been often discussed at previous meetings. When all the causes of resistance to propulsion are separately analysed and expressed by correct formulæ, the causes of these successive maxima and minima of resistance will no doubt be clearly intelligible.

Mr. J. H. Biles, the scientific adviser of the firm of Messrs. J. and G. Thomson, of Glasgow, read an interesting paper on the twin-screw torpedo boats, *Wiborg* and *El Destructor*, constructed by his firm for two foreign Governments. The author first gave full particulars of the dimensions of the boats and engines, and their performances. These vessels were considerably larger than the generality of first-class torpedo boats, the *Wiborg* being 142 feet 6 inches, and the *Destructor* 192 feet 6 inches in length. They are both minutely subdivided, the former being provided with 23 and the latter with 39 water-tight compartments, the object being, of course, to enable them to keep afloat as long as possible when exposed to the fire of machine guns. The paper is interesting as showing the most recent tendency in torpedo-boat design. Recent experience in this country and in France undoubtedly points to the conclusion that the older type of first-class boats, though useful enough for harbour defence, are of little or no avail for service at sea. Whether the latest types described by Mr. Biles will fulfil reasonable expectations in this direction is a question which can only be solved *ambulando*. It may be noticed as a curious instance of the skill of modern marine engineers in evolving enormous powers out of engines of limited size, that the *Destructor*, whose load displacement is only 480 tons, has developed over 3800 horse-power, and has made the run of 495 knots from Falmouth to Muros in twenty-four hours, which corresponds to a mean speed of 20·625 knots.

Mr. Dixon Kemp, a well-known authority on yachting matters, read an interesting historical paper entitled "Fifty Years of Yacht-Building," in which he traced out the gradual evolution of the English and American types of racing yachts from the commencement of the present reign down to the most recent times. The author brings out very clearly the causes which have led to the adoption of the relatively narrow and heavily lead-ballasted boats which have hitherto found favour on this side of the Atlantic, and the broad, shallow, centre-board yachts peculiar to the Americans. In view of the recent triumphs of the American type, as represented by the *Puritan* and *Mayflower*, an alteration has been considered desirable in the old tonnage rule which taxed the beam so severely. The Committee of the Yacht-Racing Association appointed to report on the subject have recommended the following rule:—

$$\text{Rating} = \frac{\text{Length of loadline} \times \text{sail area}}{6000}.$$

The first outcome of the new rule is the Clyde-built yacht *Thistle*, the principal proportions of which contrast strongly with those of the now famous *Galatea*, as will be readily seen from the following figures:—

	Galatea.	*Thistle.*
Length of loadline	87·0 feet	85·0 feet
Beam extreme	15·0 ,,	20·3 ,,
Draught of water	13·5 ,,	14·1 ,,

It should be mentioned that in the case of the *Thistle* the depth of the hold is measured to the bottom of the keel, which is a hollow box intended to hold the lead ballast. The contests, which will doubless take place during the coming season, between the *Thistle* and some of the powerful American centre-board yachts, will be watched with great interest by yachtsmen. Whether a contest between a keel-yacht and one fitted with the centre-board is a satisfactory trial of merit is at least open to question. In this connexion it may be mentioned that a yacht like the *Mayflower* when sailing off the wind can effect a reduction of 10 per cent. in her immersed surface by housing the centre-board, an advantage which is manifest, especially in the case of light winds and slow speeds.

A subject of great importance with regard to iron and steel ships is the protection of their bottoms from corrosion. Mr. V. B. Lewes contributed a valuable paper on the nature and genesis of rust, and on the protection of plates from its effects. It seems now to be generally admitted that the corrosion which distinguished some of the earlier steel-built ships was due to the presence on the plates of mill-scale or black magnetic oxide of iron, which forms, with the metal of the plate, a powerful galvanic couple, and gives rise, in the presence of sea-water, to very rapid pitting or local corrosion. The action is, in fact, similar at the outset to that which takes place between metallic lead and its peroxide in the well-known Planté secondary batteries. At the present time, steel plates are always carefully freed from this magnetic oxide before being worked into the hulls of ships—a practice which has been attended with the best results. Mr. Lewes believes that the protective compositions of the future will be made by dissolving a good sound gum, not easily perished by sea-water, in a volatile solvent, care being taken that neither gum nor solvent give rise to any organic acids. Body will be given to this varnish by finely-divided metallic zinc, which can now be obtained in so fine a powder that it can be used as a pigment. When, in time, the varnish perishes, as it must do from the action of sea-water under pressure, the zinc will set up galvanic action with the hull-plates; but, being the more electro-positive of the two metals, it will corrode, and will thus protect the iron or steel plates. This paper does not deal with the much-vexed subject of anti-fouling compositions—a much larger subject, which the author reserves for a separate memoir.

Sir Nathaniel Barnaby read a second paper on the subject of fuel-supply in ships of war, which, together with a paper by Mr. Biles, on the comparative effects of belted and internal protection upon the other elements of design of a cruiser, apparently provoked more interest and discussion than any other communication made to the Institution this year. The ships to which Sir Nathaniel Barnaby alluded were the *Impérieuse* and *Warspite*, belted cruisers, for the design of which he was himself chiefly responsible. These vessels have lately been the subject of much adverse comment both in and out of Parliament. As originally designed, the armoured belt was intended to reach from a height of 3 feet 3 inches above the water-line to a depth of 4 feet 9 inches below it. The supply of coal on which this calculation was based was 400 tons, but bunker space was allowed for an additional supply of 500 tons. During construction various additions were made to the weights of the boilers and the armament, which in their turn involved an increase in the weight of hull, and the net result was that the total weight of each ship was increased by 415 tons. Moreover, the present Board of Admiralty have decided that war-ships are in future to coal up to their full stowage capacity; that is to say, in the case of the *Impérieuse* and *Warspite* 500 tons more fuel are to be carried than the designer allowed for. As a natural consequence, the addition of 915 tons to the total weight of each vessel has immersed these ships so deeply that the height of the armoured belt above water has been reduced from 3 feet 3 inches to a little under 1 foot, and there are not wanting those who declare that this circumstance greatly injures, if it does not totally destroy, their fighting efficacy. Sir Nathaniel Barnaby very successfully proved that the responsibility for the additions to the weights of the hull and machinery belongs to the then Board of Admiralty, and not to himself. He also demonstrated that the addition of the extra 500 tons of coal was a case of deliberate reversal of the policy of one Board by its successor, but, judging from the tone of the discussion, he failed to convince his audience that the original policy of calculating the immersion of the belt on a fuel-supply of 400 tons was a wise one.

Mr. Biles's paper, above referred to, on the armour question, was an interesting and useful attempt to solve a difficult problem. He commenced by taking, as the basis of a definite comparison, the latest type of British belted cruiser, viz. the *Aurora*, of 5000 tons displacement. This vessel has a belt 5 feet 6 inches wide, of which 1 foot 6 inches is above the load-line; the thickness of the belt is 10 inches, and its top edges are united by an armoured deck 2 inches thick, under which are placed all the vitals of the vessel. With this he compares a type of cruiser without any side armour, but protected by means of a plated deck, the sides of which curve down so as to join the bottom some feet below the water-line, the curved or sloping portions of the deck being covered with armour of the same horizontal thickness as the *Aurora's* belt. In making the comparison he assumes—

(1) That the length and draft of the proposed vessel are to be the same as in the case of the *Aurora*.

(2) That the displacements are to be the same in each case.

(3) That the costs are to be the same.

Mr. Biles claims that in design No. 1 the internally protected vessel would weigh less than the belted cruiser by about 210 tons; that it would cost nearly 40,000*l*. less; and that the designer would have the option, on the smaller displacement, of either increasing the thickness of the flat portion of the armoured deck by 40 per cent. amidships, or of adding about six-tenths of a knot to the speed, or finally of adding one 9·2-inch gun and two 6-inch guns to the armament.

In the case of design No. 2, where the displacements of the two types are equal, it is estimated that either a knot and a half might be added to the speed, or else that the thickness of the whole of the deck-plating might be increased by 44 per cent.

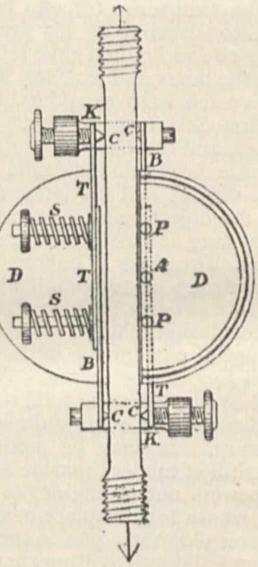
Lastly, on the assumption that the cost of the vessels is the same, Mr. Biles claims for the internally protected vessel the following important advantages: viz. 20 per cent. greater thickness of protection on the slope of the deck, 50 per cent. more on the flat, two more guns of the heaviest calibre, 20 per cent. more coal, and one knot additional speed. Mr. Biles very pertinently asks the question, Is the adoption of the belt worth the extra money paid for it with its accompanying sacrifices? or, If the money is to be spent, is the belt worth the sacrifice of speed, protection, and armament, which is entailed in its adoption?

The papers on marine engineering were not quite so interesting as some which have been read at recent meetings of the Institution. There were three on the subject of screw propellers, by Prof. Cotterill, F.R.S., Mr. Calvert, and Mr. Linnington of the Admiralty, and one on the machinery of small boats, by Mr. Spyer, also of the Admiralty. In addition to the foregoing there were two papers on stability, a subject which has been perhaps lately somewhat overdone; and an important contribution by Mr. Archibald Denny on the practical application of stability calculations in relation to the stowage of steamships. Mr. Jenkins, the newly-appointed Professor of Naval Architecture at Glasgow University, prepared a paper on the subject of the shifting of cargoes.

STROMEYER'S STRAIN-INDICATOR

THIS is a very useful and ingenious apparatus for measuring the extension or compression produced on any material by tensile or compressive forces. Such deformations having been observed, the corresponding variation in the stresses to which the material has been subjected may at once be inferred by the ordinary law of elasticity connecting strains and stresses in solid bodies. The instrument affords one of the many examples of the valuable results obtainable by the simplest possible mechanical means—results which before the construction of the strain-indicator were considered altogether unattainable.

The instrument is shown in the woodcut, and consists of two flat plates, T, B, about $1\frac{1}{2}$ inch wide and of any convenient length, pressed together by means of two springs, S, S, in such a manner that one plate projects at one end and the other at the other end. The plates are



free to slide over each other at their ends opposite A. Fixed centre-points, C, C, are screwed one into each end of each plate, and a graduated dial, D, is attached to the upper one of the two plates T. Two of these instruments are held together by a pair of clamps, K, K, fixed just over the centre-points, which, when screwed tight, press the centres against both sides of the test-pieces; for safety against slipping, a few taps of a hammer embed them more firmly. The figure shows a round bolt about to be operated upon by tensile force, the screwed ends forming attachments to the grips of the testing-machine. Then, when everything is ready, a pair of very fine hardened steel wire rolling pins, P, P, to which light pointers have been attached, are inserted between the plates. These rolling pins, when in position, should be in the centres of the dials. On applying the load to the test-piece, elongation takes place; the centre-points move slightly away from each other, carrying the plates with them, which, as they move in opposite directions, and as they are held apart only by the interposed rolling pin, cause it to revolve, and the angle through which it has moved can then be read off with the help of the pointer and dial. The best results have been obtained with a wire which was drawn, and which measures exactly ·015 inch in circumference. The dial is divided into fifteen equal parts, and their decimals, so that one division represents one-thousandth of an inch, and variations as small as a twenty-thousandth of an inch can be detected.

The above instrument is the outcome of another instrument invented by Mr. Stromeyer, of still greater sensitiveness, and which is based on the production of Newton's rings. Its extreme sensitiveness and certain practical difficulties, however, make it unsuitable for the use of the engineer or naval architect, to whom the present instrument is of great value, and by whom it can be very conveniently used.

The strains of a ship in a sea-way have always been very difficult to deal with. Agur and Solomon of old frankly admitted they were "too wonderful" for them, and although the same ingenuousness has not always been practised by naval architects since, the fact remains that the present state of knowledge in this subject is extremely meagre. Methods of calculation have, it is true, been in use by naval architects which have given results most useful for comparative purposes, but which in absolute units frequently indicated forces that ships could not bear. These methods therefore, except for the comparative purposes they were primarily designed to serve, threw no light whatever on the actual conditions of stress on the various parts of the structure in a sea-way. One able investigator showed that the dynamic constitution of sea-waves was such as to make the effective variation of buoyancy enormously less than the apparent variation, and that this difference meant a reduced variation of stress in large ships from, in some cases, 170 to 100. This investigation cleared up many pre-existing difficulties. Mr. Stromeyer, however, by means of his beautiful and simple apparatus, enables the variation of stress on any part of any structure, ship, or anything else under the action of any forces to be arrived at with certainty by direct experiment.

The invention of this little apparatus constitutes an era in the science of the strength of complicated structures such as ships, boilers, &c.

WILLIAM BABCOCK HAZEN

THE sudden death of Brigadier-General William B. Hazen, Chief Signal Officer of the United States Army, which occurred on Sunday, January 16, 1887, deprived the country of one of its most distinguished officers, and the Signal Corps of a chief who took a broad view of its duties and relations to the world of business and science.

General William B. Hazen was the great-grandson of Thomas Hazen, who was born 1719. Thomas Hazen was himself great-grandson of Edward Hazen, who emigrated from England before 1649, and settled at Rowley, Mass., where he died in 1683.

The descendants of Edward Hazen include many names eminent in business, theology, and war: energy, industry, and strong convictions characterise the members of the family on all sides.

General Hazen was born at West Hartford, Vermont, September 27, 1830. While he was a child his parents removed to Hiram, Portage County, Ohio. In 1851 he was appointed from Ohio as a cadet to the United States Military Academy, at West Point, from which he graduated on July 1, 1885. He was assigned to the 8th U.S. Infantry, and spent the next five years in frontier service, more especially against the Indians in California, Oregon, and Texas, in which service he displayed an energy and bravery that have been characteristic of his life. His record during these years embraces constant fights and pursuits. He was twice severely wounded, and by virtue of the latter he was, in January 1860, by the surgeon's order, granted a leave of absence as being unfit for duty. In consequence of this he was at the north while his regiment was in Texas at the breaking out of the Rebellion. The regiment having been captured and its officers released on parole, he alone was unembarrassed by the parole and was able to offer his services to the Union Army; he was at once assigned as temporary instructor at West Point. In May 1861, he became captain of the 8th Infantry of the regular army, and in October was made colonel of the 41st Regiment of Ohio Infantry in the volunteer army. During the war he distinguished himself on many occasions, and his commission as major-general was granted him December 13, 1864, for "specific distinguished services," *i.e.* "for long and continued services of the highest character, and for special gallantry and service at Fort McAllister." This placed him fifth in a list of twenty-four officers who had received commissions for distinguished service.

He continued serving on the frontier territories north and west, and was especially active in Indian affairs until 1870, in which year he was allowed leave of absence to visit the seat of war in Europe. The results of his observations and studies during his six months' absence are embraced in a volume entitled "The School and the Army in Germany and France, with a Diary of Siege Life at Versailles" (New York, 1872). This volume contains a very interesting sketch of Bismarck, and an account of the state of affairs in Europe. It contains especially a fair criticism of the relative excellencies of the German and French systems, both civil and military; in a special chapter on that subject he incidentally brought out more prominently some weak points in our own military organisation. It would seem that the courage displayed so brilliantly on the battle-field frequently nerved him to utter not only these but other fearless criticisms of things that were palpably wrong, and some of which have since been corrected.

He was married, February 15, 1871, to Millie, daughter of the Hon. Washington McLean, of Cincinnati, who, with one son, survives him.

On his return from Europe in 1871, he returned to duty in the Indian Territory, and was with his regiment in Kansas and Dakota, except for a short absence, until December 15, 1880, when he was, by President Hayes, appointed Brigadier-General and Chief Signal Officer, and has since then been stationed at Washington. The absence just referred to was occasioned by his again visiting Europe as Military Attaché to the United States Legation at Vienna, for the purpose of studying the operations of European armies during the Turko-Russian War. He was absent on this service from December 1876 to June 1877, and the results of his observations were published subsequently in a highly interesting popular volume.

The general account of his activity during the war of the Rebellion was published by him in his "Narrative of Military Service" (Boston, 1885).

His letters and pamphlets on the "Bad Lands" show that for many years General Hazen had been studying the relations of meteorology and agriculture. After his appointment as Chief Signal Officer, he was indefatigable in his efforts to improve the military and departmental relations of the Signal Service, its scientific character, its practical usefulness to farmers and herders, and its popular influence. His labours in Washington stirred up most virulent opponents, first when it became necessary for him to expose and prosecute the corruption of Capt. Howgate; again, when it became necessary in self-defence to expose the true reasons of the failure of the War Department to properly support and succour the Signal Service Expedition to Fort Conger; and again, when he had occasion to defend the advantages of the military character of the combined Signal Service and Weather Bureau organisation against those who would take it from the army without making a proper provision for its work in any other Department. The records of his successful defence against attacks prompted by implacable hate, official stubbornness, and personal ignorance, are to be found in the proceedings of "Courts-Martial," "Courts of Inquiry," "Committee of Congress on Expenditure," and especially in the "Testimony before the Joint Commission to consider the present organisation of the Signal Service," &c., which latter voluminous report and testimony was presented in June 1886.

General Hazen's interest in meteorology, as before said, properly dated back earlier than 1873, at which time he prepared a letter "On our Barren Lands, or the interior of the United States, West of the 100th Meridian, and East of the Sierra Nevadas." This was published in the *New York Tribune*, February 27, 1874, and led to a discussion in that paper and in the *Minneapolis Tribune* between himself and General A. A. Custer, which is summarised in a pamphlet of the above title, published by Robert Clarke and Co., of Cincinnati, in 1875. The motive of General Hazen evidently was the protection of investors and settlers against the too glowing accounts, which amounted to virtual misrepresentation on the part of the *employés* of the Northern Pacific Railroad. His compilation of climatological data, and his statement of personal experience based on long residence in that region, largely contributed to prevent blind emigration into an inhospitable country, while they doubtless also contributed to direct attention to the really valuable portions of our north-west territory, so that the permanent development of that portion of the United States has been furthered by his action. It was, however, at the time, on his part a very characteristic outspoken exposition of what seemed to him a fraud and imposition perpetrated by unscrupulous financiers upon foreign immigrants and over-confiding settlers and investors.

During his connexion with the Signal Office, General Hazen frequently took occasion to show his appreciation of the fact that the weather predictions were essentially not a matter of mere military routine, but that in all its details the office had need of the work of specially trained experts, that it was a mistake to shut one's eyes to the fact that, in a matter of applied science like this, some of those whom the scientific world recognises as meteorologists and physicists must be employed, and be required to keep the chief fully informed of the progress of science. Perhaps this is best exemplified by a quotation from his letter of March 24, 1886, addressed to a Committee of the House on Expenditures of the War Department:—"At the beginning of the work of the Signal Service the duty of giving notice of the approach and force of storms and floods for the benefit of commerce and agriculture throughout the United States implied that the notices should be correct, reliable, and timely, as none others could possibly be of benefit; it was therefore absolutely necessary to provide for the careful study of the atmosphere. On my accession I found every evidence from popular criticism that still further progress in weather predictions was expected. I therefore emphasised especially the necessity of the study of the instruments and methods of observing, and the investigation of the laws of the changes going on in the atmosphere. . . . . It is evident by these successive steps that in addition to knowledge gained for current work the office is powerfully contributing towards the establishment of a deductive science of meteorology which will eventually give us a solid, rational basis for predictions, thereby improving on the empirical rules by which predictions have generally been made hitherto." And he adds that he was led more especially to assist in the researches on the sun's heat by reason of the encouragement given him by the late President Garfield, whose "last words to me were, 'Give both hands of fellowship and aid to scientific men.'"

As a further illustration of General Hazen's appreciation of the scientific needs of the office must be noted his appointment of Prof. William Ferrel as meteorologist, and of Prof. T. C. Mendenhall as electrician. To the latter, all matters relating to standards, instruments, and instrumental research were also committed. Nor did General Hazen stop here; by appointing several younger men to positions as junior professors he largely increased the amount of study and research that the office was able to perform, and by publishing a series of professional papers and smaller notes, he took the final steps necessary to stimulate every man to do his best.

Labouring in this same direction, he sought to elevate the intelligence and scientific training of the Signal Corps proper by enlisting College graduates as far as possible, by extending the course of instruction for observers, and by establishing a course of higher instruction for commissioned officers.

In still another direction General Hazen showed his devotion to scientific interests, namely, by his desire to conform as thoroughly as possible to the recommendations of the International Meteorological Conferences. These recommendations, as soon as received in the printed Minutes of the Conferences, were, by General Hazen's orders, carefully examined, and instructions at once prepared calculated to introduce methods of observation and publication in conformity with the recommendations of the leading meteorologists of the world.

Among the items specially noteworthy wherein General Hazen developed new paths of activity for this service, may be especially mentioned the study of local storms: first, tornadoes, which were especially assigned to Prof. Hazen so far as a collection of general statistics is concerned, and to Prof. Mendenhall so far as concerns the electrical phenomena proper. The study of atmospheric electricity was especially authorised, in 1884, by an order of the Secretary of War transmitting the resolutions of the International Electrical Conference held in Paris the preceding year. After full consultations with numerous electricians throughout the country, General Hazen decided that a daily map of electric potential showing lines of equi-potential similar to the iso-barometric lines, offered hopeful prospect of eventually leading to a method of predicting the formation and motion of thunderstorms and tornadoes. But the methods of observation and the apparatus needed first to be determined upon after careful experimental work. This whole matter was, therefore, in 1885, committed to the hands of Prof. Mendenhall.

Perhaps the most important item in internal administration, so far as it affects the permanent scientific value of the office work, was the effort heartily furthered by General Hazen to improve the accuracy and international comparability of our instrumental equipment. The standards of the International Bureau of Weights and Measures were recognised by him as being the proper legal standards for this office, and every effort was made to determine the corrections needed to reduce the past as well as the current meteorological observations of the office to agree therewith.

Perhaps the generous breadth of General Hazen's views, the absence of injurious jealousies, and his confidence in the principle that the Weather Bureau would be strengthened by the widest diffusion of an intelligent appreciation of meteorology, are in nothing more clearly shown than in the earnestness with which he stimulated the formation of State weather services and encouraged the study of meteorology in every school and college. He was painfully impressed by the disastrous influence upon individuals and business of the widespread and utterly absurd predictions of the storms and weather of

March 9, 1884, which were distributed broadcast throughout the country, and emanated from Mr. Vennor. He saw clearly that all this harm could only be prevented by increasing the intelligence of the people in scientific matters, and heartily indorsed every effort to diffuse a more correct idea as to what constituted legitimate meteorology.

Although his duties demanded the maintenance of a great central office at Washington, yet General Hazen realised that centralisation could easily be carried too far in scientific matters, and would thus react injuriously upon the work of his office. He was desirous of rapid progress in all directions, and, to secure this, welcomed every prospect of co-operation with other institutions as well as with individuals. One of his first acts was the request for co-operation on the part of the National Academy of Science. He improved the opportunity to help Prof. Langley in the determination of the absorbing power of the atmosphere; he accepted Prof. King's offer to carry observers on his balloon voyages; he heartily furthered Lieut. Greely's efforts to maintain an International Polar Station, and joined with the Coast Survey in establishing a similar station under Lieut. Ray at the northern point of Alaska; he co-operated with the Bureau of Navigation in securing weather reports from the ocean; he powerfully assisted the Meteorological Society in its labours for the reformation of our complicated system of local times, the result of which was the adoption by the country of the present simple system of standard meridians one hour apart.

Equally successful was he in his efforts to co-operate in various methods of disseminating and utilising the knowledge obtained by the Weather Bureau for the benefit of the business interests of the country. With the telegraph companies he published the daily telegraph bulletin. Through the railroad companies, he displayed the railroad train-signals visible to every farmer along the railroads. With local Boards of trade and other business interests he elaborated our system of flood warnings in the river valleys.

General Hazen was especially clear in his views as to the importance of giving personal credit to each man for his own personal work. Routine work was credited to the assistants in charge and not to the impersonal office. Having assigned a special work to the best man available, he took pains to give him the credit and make him personally responsible for its success, thus securing more enthusiasm in the work.

This notice of a few prominent features in the intense activity of General Hazen's life seems eulogistic rather than historical; but the fact is that military life rarely offers a position that requires the promotion of any special science, and still more rarely do official or military circles present an officer who so thoroughly desired, as far as allowable, to relax stringent military law and liberally interpret cumbersome official regulations, so that scientific men might successfully promote their special work.

Washington, February CLEVELAND ABBE

SIR WALTER ELLIOT, K.C.S.I., LL.D., F.R.S.

BY the death at an advanced age of Sir Walter Elliot, we lose one of the few survivors from a group of men who, in the second quarter of the present century, by their contributions to the zoology of British India, laid the foundations of our present knowledge. The subject of the present notice was, however, so widely known for his acquaintance with the history, coins, languages, and ancient literature of Southern India, that his zoological work might easily be overlooked.

Sir Walter Elliot was born in 1803 at Edinburgh. He was the son of Mr. James Elliot, of Wolfelee, Hawick, Roxburghshire, and after being educated at Doncaster, and later at Haileybury, where he received a "highly distinguished" certificate, he entered the East India Company's Madras civil service in 1820. In that service he held many posts of distinction. From 1822 to 1833 he was assistant to the political agent of the Southern Mahratta country, and during this period he collected the information subsequently embodied in his Catalogue of the Mammalia inhabiting the region, and also commenced the series of archæological studies, some of the first-fruits of which in 1836 were presented to the Royal Asiatic Society in the shape of a paper on Hindu inscriptions. With this paper were sent two manuscript volumes containing copies of no less than 595 sculptured records from the Southern Mahratta country and the neighbouring territory.

In 1837 he was private secretary to Lord Elphinstone, then Governor of Madras, and he was subsequently for twelve years a member of the Madras Board of Revenue. The value attached to his linguistic knowledge was shown by his being at one time Canarese translator, and at another acting Persian interpreter to the Government. From 1849 to 1854 he was Commissioner for the Northern Circars. During this period he made the collection of Cetacea subsequently described by Sir R. Owen in the Transactions of the Zoological Society, vol. vi. Finally he was Senior Member of Council in Madras from 1854 to 1859, when he retired from the service, and returned to pass the remainder of his life at Wolfelee, the residence of many generations of his ancestors. Almost his last official act in India was, when in charge of the Madras Government in 1858, to take the principal part in the transfer of the Presidency from the rule of the East India Company to the direct government of the Queen. He was created a K.C.S.I. in 1866, and became a Fellow of the Royal Society in 1878, and he was Deputy-Lieutenant of his county.

In his retirement his attention was much given to numismatics, and despite the complete loss of his eyesight in his later years, he carried to completeness the studies commenced in his "Numismatic Gleanings on South Indian Coins," published in the *Madras Journal of Literature and Science* for 1857. He brought out in 1885, with the aid of Mr. Thomas, General Pearse, and other friends, a general work on the "Ancient and Mediæval Coins of Southern India." Up to the very last his interest in Oriental literature remained unabated. One of his friends received a letter signed by him and dated March 1, the day of his death, containing inquiries as to the forthcoming edition of a Tamil work, and suggesting that the attention of Madras native students should be bestowed upon the early dialects of their own language. During the last ten years numerous notes by Sir W. Elliot have appeared in the *Indian Antiquary*, the latest in the September number of last year. Largely through his efforts the Amravati sculptures, now in the British Museum, were added to the national collection, and this was but one of the valuable additions due to him. His Southern Indian coins, a very large and important series, were presented to the same institution, and his numerous zoological collections enriched the Natural History Museum.

Although his published papers on zoology give but an imperfect idea of his contributions to the science, for many of his observations were freely communicated to other naturalists, and published by them, his "Catalogue of the Species of Mammalia found in the Southern Mahratta Country," which appeared in the *Madras Journal* for 1842, was of unusual merit. It had the peculiar advantage that it was a list, not of museum specimens, but of the wild animals inhabiting the country, several of which, and indeed nearly all the smaller rodents, were discovered by the author. The habits of the larger animals were described from personal observation, not, as has so frequently been the case, from information derived from native collectors.

Personally, Sir Walter Elliot was one of the kindliest of men, with a charming manner and generous disposition. At Wolfelee, as formerly in India, he was widely known and universally respected. W. T. B.

NOTES

HE must be a very dull Englishman whose imagination has not been touched by the assembling of the Colonial Conference, an event which may hereafter be seen to have marked the first stage in one of the greatest movements in the history of mankind. In describing the commercial relations of the colonies, Sir Henry Holland, in his opening speech as President, had occasion to bring some very eloquent figures to the notice of the Conference. The imports and exports of the colonies were, in 1885, eleven times what they were in 1837. The British shipping trade with the colonies rose from 3,700,000 tons in 1837 to 56,600,000 tons in 1885, while, in the same period, British exports to the colonies rose from 11,300,000*l*. to 54,500,000*l*. This astonishing material progress, accompanied by an increase of population from 4,204,700 in all the colonies in 1837 to 15,763,072 in 1881, would, of course, have been impossible but for the rapid development of physical science and the steadily increasing application of its principles to the methods of industry. And it is interesting to note that, of all the questions which the Conference will have to discuss, by far the greatest are those most directly connected with the results of scientific investigation—questions relating to the naval and military defence of the Empire, and to the improvement of postal and telegraphic communication. In speaking of telegraphic communication, Sir Henry Holland quoted a striking letter he had received from Mr. Pender. Some of the facts brought together in this letter must have reminded the delegates very vividly of the debt which commerce owes to science. Twenty years ago there were only about 2000 miles of submarine cables, and some of the earlier cables were so badly constructed that they were practically useless. "Science has now, however," wrote Mr. Pender, "aided so greatly in the manufacture of cables that they can at the present time be laid with comparatively little risk of breakage and with an almost certainty of efficient repair." The consequence is that there are now 107,000 miles of submarine cables, which have cost something like thirty-seven millions sterling. The whole of this vast system, with the exception of about 7000 miles, is entirely under British control. To show the relative importance of the submarine cables, Mr. Pender stated that the length of all the land telegraphic lines now in existence in the world is about 1,750,000 miles, representing an estimated cost of 52,000,000*l*.

DR. BROWN-SEQUARD has been elected President of the Society of Biology, Paris. His immediate predecessor was the late M. Paul Bert.

A BILL was lately submitted to the U.S. Senate, providing for the creation of a Department of Agriculture and Labour. Various amendments were proposed, and among them was one for the transfer of the Weather Bureau from the Signal Office of the Army to the new Department. This amendment was accepted by the Committee on Agriculture, and *Science* says that it would certainly have been passed by the Senate had not difficultie uuexpectedly arisen with regard to the Bill as a whole. The President, it seems, did not wish to have an additional member in his Cabinet. The Bill was therefore referred back to the Committee on Agriculture, and it did not again come before the House. According to *Science*, there can be no doubt that the Bureau will be transferred next year to some Civil Department, public opinion being decidedly in favour of the change. In the meantime General Greely, General Hazen's successor, will retain the position of Chief Signal Officer.

IN the Report of the Scottish Meteorological Society, to which we referred last week, it is stated that during the winter Mr. Cunningham, Superintendent of the Zoological Laboratory of the Marine Station at Granton, and Mr. Ramage, have been continually engaged in a systematic study of the Chætopoda of the Firth of Forth. In the course of this work all the specimens obtained by dredging have been determined, and their anatomy has been investigated. Fresh specimens, and ova and young forms, have been collected on the shore at low tide, and by means of low nets; and a large number of drawings and descriptions have been made, among which are accounts of some species new to the district, and additions to the knowledge of anatomy and development. The results of this work are being prepared for publication.

THE Report for the year 1884 of the United States National Museum, under the direction of the Smithsonian Institution, has just been issued. It contains (1) the Report of the Assistant Director, (2) Reports of the Curator and Acting-Curators, (3) papers based on collections in the Museum, (4) bibliography of the Museum for 1884, and (5) a list of accessions to the Museum in 1884. Among the papers based on collections in the Museum are two admirable anthropological studies by Mr. Otis T. Mason—one on throwing-sticks, another on the basket-work of the North-American aborigines. There is also an excellent study, by Mr. John Murdoch, of the Eskimo bows in the Museum. These papers are carefully illustrated.

ON March 9 a Conference met in the Senate House, Cambridge, to discuss various questions in connexion with the Cambridge University Local Lectures. A report of the proceedings has been printed for the Syndics at the University Press, and it ought to be read by all who are interested in the subject of University Extension. Attention may especially be called to a speech by Dr. Westcott, who argued with much force that the affiliation of local centres to the University might provide an adequate foundation for a national system of higher education. Mr. Browne, Secretary of the Syndicate, who made a financial statement, set forth the claims of the movement to the support of all "who feel that the University Extension system has great powers for good, and has already done excellent work."

Science and Art, the first number of which has just been issued, deserves, and will no doubt receive, a cordial welcome from the class of readers to whom it appeals. Its principal object is to bring the schools of science and art into closer contact with one another. The articles, notes, and correspondence will be on subjects likely to be of especial interest to teachers in those schools, and it is also hoped that the journal may be of benefit to students. Each issue is to contain test-questions in science and art subjects, for which prizes of books and instruments will be given.

ON Tuesday last Messrs. Mourlen, Belgian electricians, had an interview at Brussels with M. Granet, the French Minister of Posts and Telegraphs, relative to the establishment of a telephone line from Paris to London.

AN excellent "General Guide" to the Natural History Museum, Cromwell Road, has just been printed by order of the Trustees. It contains plans and a view of the building.

MR. T. B. COOMBE WILLIAMS has compiled an interesting bibliography of the books, in his own library, on fancy pigeons. The authorship of the works in his list may, he says, be apportioned as follows: English writers, 58; German (including translations), 45; French, 21; Dutch, 3; Latin, 3; Italian, 5; Spanish, 1; Arabic, 1. More books on this subject have been printed in English and German than in any other language.

In a recent Bulletin of the U.S. Fish Commission, Mr. J. W. Collins describes the finding of a knife of curious workmanship in the thick flesh of a large cod. The "find" was made at Gloucester, Mass., on September 15, 1886, by Capt. John Q. Getchell, when discharging a fare of codfish from his schooner. He had lifted several fish from a tub, and, running his hand over the thicker portion of one of them to call the attention of the by-standers to its fatness, he felt something hard beneath his fingers. Further examination produced a knife. The handle of the knife is of brass, curved and tapering posteriorly, with a longitudinal incision, on the concave side, to receive the edge of the blade. The form is remarkable, and suggests "the handiwork of some savage tribe, or the scrimshaw work of a sailor." The blade, which is of a lanceolate shape, has been corroded a good deal, and the extreme point is very thin. The total length of handle and blade together is 6¼ inches. "As to where the fish got the knife," says Mr. Collins, "we can only conjecture, unless some ethnologist can point out its origin. In any case, the finding of such a remarkable implement in such a strange place must be a matter of interest to the ethnologist and naturalist alike."

The Colonial Council of Cochin China has decided to grant a sum of 6000 francs a year for life to M. Pierre, the Director of the Botanical Gardens at Saigon, provided he undertakes to finish in Paris the publication of his "Flore de la Cochinchine," and will leave all the manuscripts and collections which he has employed in the preparation of this work to the colony. The same body has granted La Société des Études Indo-Chinoises a subvention of a thousand francs to aid in the publication of its *Bulletin*.

We have received the numbers of the *Essex Naturalist*, the journal of the Essex Field Club, for January, February, and March of the present year. The steady growth of the Club has led the Council to decide upon the issue of a monthly journal in place of the former Transactions and Proceedings at irregular intervals. It is scarcely surprising that residents of the county of Essex should appreciate the labours of the Society, inasmuch as they are wholly devoted to the county, and are of interest even to persons who know little of Essex. In this respect—namely, the thorough examination of the district lying at their doors—the members of the Essex Field Club set an example that similar Societies elsewhere would do well to follow. Anything relating to the natural history, geology, and prehistoric archæology of Essex is welcomed. Thus, amongst the papers in the three numbers before us, we have a discussion on a curious subsidence near Colchester in 1862; a report on the flowering plants in the neighbourhood of Colchester, by Mr. Shenstone, which is a kind of supplement for that particular district to Gibson's "Flora of Essex," published twenty years ago; notes on the saffron plant in England and its connection with the name of Saffron Walden; a paper on primæval man in the valley of the Lea, by Mr. Worthington Smith; and a paper on the deer of Epping Forest, by Mr. Harting. Apart from a succession of papers such as these, it is scarcely necessary to remind readers of Nature of such excellent special work as Prof. Meldola and Mr. White's report on the East Anglian earthquake of April 1884, published by the Society. There are few associations in the United Kingdom which perform so adequately and thoroughly the proper functions of a local Field Club or Naturalists' Society, as the Essex Field Club.

Earthquakes are reported from Travnik, in Bosnia, where a shock, lasting for five seconds, and followed by two others, was felt on March 22, about 3 a.m. On March 23 three shocks were noticed about 11.15 a.m. at Campfer and St. Moritz (Grisons). At Stuttgart, on March 25, about 4 a.m., a perpendicular shock was felt in the direction from west to east, followed by oscillations continuing for ten seconds. At Savona, in Italy, an earthquake was noticed about the same time. According to a telegram from Aden, dated the 5th inst., shocks of earthquake had been repeatedly felt there during the previous four days, but no damage had been reported.

Mr. Edward Woods, President of the Institution of Civil Engineers, will give a *conversazione* on Wednesday, May 25 (Derby Day). It will take place in the South Kensington Museum by permission of the Lords of the Committee of Council on Education.

The semi-centennial anniversary of the University of Louisville was celebrated on March 2. The doctorate address on the occasion was delivered by Dr. David W. Yandell, who offered some interesting reminiscences of teachers of medicine in the University. When the institution was founded, it was the fourth medical school west of the Alleghanies. "There are as many schools now in Louisville alone," said Dr. Yandell, "as were then in all the territory which extended from the Ohio River to the Pacific Ocean." Dr. Yandell claimed on behalf of the University that it is "a school where practical medicine is taught in all its branches in a thorough, practical way." "It points to its record with becoming pride, and finds there its guerdon and its hope for the future."

On April 1 the fine Botanic Garden of Glasgow passed from the hands of the shareholders of the Royal Botanic Institution into the possession of the Corporation of Glasgow. The Garden was founded in 1816. Shortly after this date the Botanic Institution received a Royal Charter, and in consideration of the importance of the teaching of botany in the University, as well as for the general encouragement of the study of this science, a sum of 2000*l*. was granted from the Treasury. A further sum of 2000*l*. was advanced by the University of Glasgow, on condition that special facilities should be given to the Professor of Botany in the University for teaching his science; and it need hardly be said that from this point of view the maintenance of the Garden is of primary importance. The financial history of the Garden has at no time been fully satisfactory, and the Institution has at the end of seventy years found itself in the position of a debtor to the Corporation to the extent of 46,000*l*. The greater part of this sum has been expended in recent years in the erection of fine conservatories, which, in point of condition and extent, place the Garden at the head of provincial establishments. The collections of plants date back to the foundation of the Institution, but the bulk of them have been acquired within the last ten years, very large and valuable donations having been received from Kew, Edinburgh, and Glasnevin, while large contributions have also been made by the leading growers throughout the country. Owing to peculiar municipal complications, following on the totally unexpected rejection of a Bill in Parliament for the annexation of Hillhead and Kelvinside to the city of Glasgow, by a Committee of the Lords, after it had passed through the House of Commons, it is as yet uncertain what line of action the Corporation may adopt with regard to this valuable property which has fallen into their hands. It is in their power to disperse the collections, sell the fine and costly houses, and dispose of the twenty-three acres of land for building-purposes. This course would be deplored not only by the citizens of Glasgow, who would thus lose for ever a most picturesque open space, but also by all who are interested in the botanical progress of the country. Were the establishment maintained on its present footing as a Botanic Garden, the Corporation would do credit to itself, and would materially assist in the advance of that which has always been the most generally popular of the sciences. Already the Corporation has shown that it is disposed to further botanical science by admitting students of the University to the Gardens under certain conditions, while the gates are locked to the general public. It is earnestly to be hoped that this may be the first step towards a permanent policy of encouragement of the study of botany in one of the most densely populated centres in the United Kingdom.

SOME of the American whitefish (*Coregonus albus*) turned into the waters of the Marquess of Exeter at Burghley Park a year ago, were lately caught. They were 7 inches long. This is important evidence as to their adaptability to English waters. The National Fish-Culture Association are incubating a large quantity of the ova of this species for acclimatisation purposes.

SINCE 1878 the Ontario and Western Railway Company has been engaged in re-stocking streams in America within the area of its route. Mr. J. C. Anderson, general freight and passenger agent of the Company, writes to the *American Angler* to the effect that, within the past nine years, 2,220,000 trout have been planted by the Company in the Beaverkill, Willowemoc, Neversink, the east and west branch of the Delaware, and their tributaries.

WE have received vols. xxxix. and xl. of the Proceedings of the Literary and Philosophical Society of Liverpool, containing the principal papers read to the Society during the Sessions 1884-85 and 1885-86. Among the papers of scientific interest in vol. xxxix. are: "Observations on the Nematocysts of *Hydra fusca*," and "The Relationship of Palæontology to Biology," by Mr. R. J. H. Gibson; "On a New Organ of Respiration in the Tunicata," and other papers, by Dr. W. A. Herdman; two papers on "Technical Education," by Mr. F. H. Edwards; "The Armorial Bearings of the Isle of Man, their Origin, History, and Meaning," by Mr. John Newton, and "On the Rocky Mountain Goat," by Mr. T. J. Moore. Vol. xl. contains an address on "Modern Scientific Theories of Man," by the President, Dr. William Carter; "Two Curious Papyri in the Khedivial Museum," by Mr. R. L. Benas; "Recent Locust Plagues in Cyprus and North America," by Dr. Nevins; and "Report on a Successful Importation of Living Soles to the United States," by Mr. T. J. Moore. With vol. xl. is bound "The First Report upon the Fauna of Liverpool Bay and the Neighbouring Seas," written by the members of the Liverpool Marine Biology Committee, and edited by Dr. W. A. Herdman.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus* ♂ ♂) from India, presented respectively by Mr. W. Spooner and Mr. F. A. Adeney; a Purple-faced Monkey (*Semnopithecus leucoprymnus* ♂) from Ceylon, presented by Mr. W. H. Markham; a Black-tailed Godwit (*Limosa ægocephala*), British, presented by Mr. Robert Barclay; a Common Guillemot (*Lomvia troile*), British, presented by Mr. Howard Bunn; a Ring-hals Snake (*Sepedon hæmachates*) from South Africa, presented by Mr. W. L. Holms; a Pinche Monkey (*Midas œdipus*) from Central America, deposited; two Bluebonnet Parrakeets (*Psephotus hæmatogaster*) from Australia; two Blue-crowned Conures (*Conurus hæmorrhous*) from Brazil, purchased; two Viscachas (*Lagostomus trichodactylus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN

BARON D'ENGELHARDT'S OBSERVATORY.—Baron D'Engelhardt has recently published the first volume of the results of the astronomical observations obtained at his private observatory in Dresden. At first the observatory was erected in the Rue Leubnitz, but was found to be too far from the dwelling-house, and in 1879 the present edifice was erected in the Rue Liebig, close to the Baron's residence, with which it is connected by a covered gallery. The observatory is very completely fitted up. The principal instrument is a fine equatorial by Grubb of 12 inches aperture, replacing one of 8 inches which had been erected in the first observatory. There are two sidereal clocks, a chronograph, a transit-instrument of the bent form, which replaces one by Cook, a very complete Repsold micrometer, and two comet-seekers of special construction. The conduct of the screw of the Repsold micrometer has been very carefully investigated and the inquiry occupies a dozen pages. The observations are principally micrometer measures of nebulæ and star-clusters; but besides these there are very many observations of comets and minor planets, of the phenomena of Jupiter's satellites and of the new stars in the great nebula of Andromeda and near χ_1 Orionis, besides meridian observations of the moon and culminator stars. The volume, which is a very handsome one, contains four plates representing different parts of the observatory. The geographical position of the centre of the transit-instrument is given as lat. = 51° 2′ 19″ N., and long. = 0h. 54m. 54·74s. East from Greenwich.

NEW RED STAR.—Circular No. 16 of the Liverpool Astronomical Society states that on the nights of March 23 and 27 a red star, 7·5 magnitude, was observed 5s. *f* and 3′ *s* of 26 Cygni. There is no star in the D.M. at this place. The spectrum of the new star is a fine specimen of type III. Place of 26 Cygni for 1887, R.A. 19h. 58m. 9s., Decl. 49° 46′·9 N.

THE PARALLAX OF Σ 1516.—It appears, from the researches of M. O. Struve on the relative motion of the components of this double star, that the fainter star does not participate in the proper motion of the brighter component, and that they therefore, in all probability, constitute a merely optical pair without physical connexion. Herr Berberich, from a discussion of a series of measures of distances made by Prof. Winnecke, found the relative parallax of the brighter star, compared with the fainter component, to be 0″·199 ± 0″·05 (*Astron. Nachr.*, No. 2624). Recently, Dr. L. de Ball has made a series of observations with the equatorial of the Cointe Observatory at Liège, extending from 1885 April to 1886 June, for the purpose of determining this quantity. From sixty-seven observations of relative position-angle he finds π = 0″·091, and from sixty-four observations of relative distance, π = 0″·112, and combining these according to their respective weights, π = 0″·104, with mean error ± 0″·008.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 APRIL 10-16

(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 April 10

Sun rises, 5h. 18m.; souths, 12h. 1m. 21·4s.; sets, 18h. 45m.; decl. on meridian, 7° 56′ N.: Sidereal Time at Sunset, 8h. 0m.

Moon (at Last Quarter on April 15) rises, 20h. 34m.*; souths, 1h. 47m.; sets, 6h. 50m.; decl. on meridian, 11° 44′ S.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury ...	4 42	10 30	16 18	3 8 S.
Venus ...	6 15	13 59	21 43	18 32 N.
Mars ...	5 25	12 14	19 3	8 47 N.
Jupiter ...	19 44*	0 51	5 58	10 55 S.
Saturn ...	9 46	17 55	2 4*	22 28 N.

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

Occultations of Stars by the Moon (visible at Greenwich)

April	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image	
			h. m.	h. m.	°	°
11	49 Libræ	5½	0 13	near approach	318	—
12	29 Ophiuchi	6	1 16	2 19	24	274
15	57 Sagittarii	5½	2 56	4 9	79	238

April	h.	
15	3	Mercury at greatest distance from the Sun.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
R Ceti	2 20·3	0 41 S.	Apr. 14,		M
Algol	3 0·8	40 31 N.	,, 12,	3 7	m
			,, 14,	23 56	m
ζ Geminorum	6 57·4	20 44 N.	,, 10,	2 0	m
			15,	2 0	M
U Monocerotis	7 25·4	9 35 S.	,, 15,		m
R Virginis	12 32·8	7 37 N.	,, 13,		m
δ Libræ	14 54·9	8 4 S.	,, 13,	21 29	m
R Herculis	16 1·2	18 41 N.	,, 15,		M
U Ophiuchi	17 10·8	1 20 N.	,, 13,	3 24	m
			and at intervals of	20 8	
W Sagittarii	17 57·8	29 35 S.	Apr. 10,	3 0	m
U Sagittarii	18 25·2	19 12 S.	,, 11,	21 0	m
			,, 14,	20 0	M
R Lyræ	18 51·9	43 48 N.	,, 15,		M
η Aquilæ	19 46·7	0 43 N.	,, 14,	2 0	m
δ Cephei	22 25·0	57 50 N.	,, 13,	4 0	m

M signifies maximum; *m* minimum.

Meteor-Showers

	R.A.	Decl.
Near β Ursæ Majoris	162°	57° N.
ν Virginis	180	7 N.
μ Draconis	249	51 N.
μ Herculis	270	25 N.

GEOGRAPHICAL NOTES

MR. GEORGE GRENFELL has recently made a successful ascent of the great Quango tributary of the Congo. In company with Mr. Bentley, in the steamer *Peace*, he succeeded in reaching the Kikunji Falls, the point at which Major von Mechow, descending the Quango from the south, was obliged to turn back in 1880. About six miles above the junction of the Kasai and the Quango they found another large tributary, the Djuma, entering the river from the east, which presented so great a volume of water that it was a matter of uncertainty which was the larger stream. A little beyond this the course of the Quango veered round, first south-south-west, and then west; at 4° 30′ S. lat. it had come back to its usual northerly course, and maintained it for the remainder of the journey. The Kikunji Falls (5° 8′ S. lat.) are about 3 feet high, and though insurmountable to the *Peace*, are said by Mr. Grenfell to be no obstacle to communication by canoes and small craft.

IN a letter from the Rev. W. G. Lawes, dated Port Moresby, January 20, it is stated that an Expedition is being equipped under the leadership of Mr. Vogan, the Curator of the Auckland Museum, with the intention of attempting, as soon as the rainy season was over, to cross South-East New Guinea, from Freshwater Bay to Huon Gulf.

THE April number of the Proceedings of the Royal Geographical Society is largely devoted to papers on Central Asia. First we have Mr. Delmar Morgan's account of Prjevalsky's journeys and discoveries in Central Asia. Mr. Morgan also contributes a translation in abstract of a recent lecture by M. Potanin on his journey in North-Western China and Eastern Tibet, which is followed by an account of the travels of Messrs. James, Younghusband, and Fulford in Northern and Eastern Manchuria. In this last will be found some welcome details concerning of the country not previously described.

ACCORDING to Dr. Hans Schinz, who has been recently in the Lake Ngami region, that lake is not dried up, though its dimensions are gradually decreasing. The River Okovango forms an extensive marsh on the north-west, which sends very little water a part into the lake during the dry season.

IN a paper by Dr. Ochsenius in the *Zeitschrift* of the Berlin Geological Society, on the age of certain parts of the South American Andes, are some details of geographical and ethnological interest. The author believes that the South American Cordilleras, or at least a portion of them, are no older than the Quaternary (as contrasted with the certainly older coast Cordilleras), and infers, therefore, that Lake Titicaca and the surrounding region must have been raised to its present elevation of about 13,000 feet within the historical period. Dr. Ochsenius therefore maintains that the enormous ruins of the old Inca city Tihuanaco on that lake admit of no other explanation than that these colossal monoliths were not worked at their present elevation, far less transported thither; it is incredible that the highly civilised Incas would have located their emporium on a tableland now almost uninhabitable. The author supports his conclusions by the fact that representatives of the Pacific fauna still live in Lake Titicaca.

NEWS of Herr G. A. Krause, who is now investigating the district between the Gold Coast and Timbuctoo, has reached Berlin. The traveller arrived at Woghodogho, the capital of Mosi, in October 1886. He obtained permission from the King of Mosi to continue his journey in a northerly direction to Duensa, on his way to Timbuctoo. He hoped to reach the former place in seventeen or eighteen days, to arrive at Sarafaram in four or five days more, and then to descend the Niger to Kabara, the port of Timbuctoo. Herr Krause describes the country between Salanga and the capital of Mosi as being perfectly plain at first, and then followed by a district of low hills and another plain. A day's journey north of Walawala, the traveller crossed the Upper Volta, the source of which lies probably in a north-easterly direction.

ON CERTAIN MODERN DEVELOPMENTS OF GRAHAM'S IDEAS CONCERNING THE CONSTITUTION OF MATTER[1]

II.

A QUARTER of a century has elapsed since Graham formulated his conceptions concerning the constitution of matter. I wish now to indicate, as briefly as may be, how these conceptions have developed during these five-and-twenty years.

The idea of the essential unity of matter has a singular fascination for the human mind. It may be that it has its germ in the persistency with which every mind, even that of a child, seeks to get at first principles. The most superficial reader of the history of intellectual evolution cannot fail to perceive how greatly it has modified and directed the development of scientific thought. The whole course of chemistry, for example, has been controlled by this fundamental conception. The half-educated student of to-day may smile at the notion of the transmutation of the metals which held such sway over the minds of the early alchemists, but the men who followed this "*Ignis fatuus*" with weary faltering steps, and who frequently sank under the burden of disappointed hope and the sense that to them it was not given to know the light, felt that this idea rested on a rational basis. They, like we, could give a reason for the faith that was in them. And yet no article of scientific doctrine has in these later times suffered greater vicissitude. Men's ideas concerning the essential unity of things must have received a rude shock when it was found that such a thing as water was not only complex, but was made of bodies strangely contrasted in properties; that the air was still less simple in composition; and that, as it appeared, almost every form of earth could, by torture, be made to give up some dissimilar thing. The brilliant discoveries of Davy, which made the early years of this century an epoch in the history of science, seemed to open out a vista to which there was no conceivable ending. The order of things was not towards simplification: it tended rather towards complexity. And yet Davy himself seemed unable or unwilling to push his way along the path of which the world regarded him as the pioneer. It may be that he was unable to shake himself free from the domination of the schoolmen, or that he unconsciously felt the truth of the principles to which his own discoveries seemed opposed. It is difficult otherwise to account for the tardiness with which he accepted the hypothesis of Dalton; even to the last the Daltonian atom had nothing distinctive to Davy beyond its combining weight. Davy never wholly committed himself to a belief in the indivisibility of the atom: that indivisibility was the very essence of Dalton's creed. In arguing with a friend concerning the principle of multiple proportion, Dalton would clinch the discussion by some such statement as "Thou knows it must be so, for no man can split an atom." Even Thomas Thomson, whom I have already characterised as the

[1] The Triennial "Graham Lecture," given in the Hall of the Andersonian Institution, Glasgow, on March 16, by Prof. T. E. Thorpe, F.R.S. Continued from p. 524.

first great exponent of Dalton's generalisation, was torn by conflicting beliefs until he found peace in the hypothesis of Prout and Meinecke that the atomic weights of all the so-called elements are multiples of a common unit, and which he sought to establish by some of the very worst quantitative determinations to be found in chemical literature. It is curious to note the bondage in which the old metaphysical quibble concerning the divisibility or indivisibility of the atom held the immediate followers of Dalton. Graham, however, never felt such trammels. To him the atom meant something which is not divided: not something which cannot be divided. With Graham, as with Lucretius, the original atom may be far down.

Every philosophic thinker to-day has, I should imagine, come to be of this opinion. Not many years ago it was the fashion to maintain that Stas's great work had for ever demolished the doctrine of the primordial *ylé*, and that Roger Bacon's aphorism that "barley is a horse by possibility, and wheat is a possible man, and man is possible wheat," was henceforth an idle saying. Stas's work is a monument of experimental skill, and it has furnished us with a set of numerical ratios which are among the best determined of any physical constants. It may be that it demolished Prout's hypothesis in its original form, but it has not touched the wider question. Whether indeed the wider question is capable of being reached by direct experiments of the nature of those of Stas is very doubtful, unless the weight of the common atom is some very considerable fraction, say one-half or one-fourth, of that of the hydrogen atom. Dumas has, as you know, modified Prout's hypothesis in this sense, by assuming as the common divisor half the atomic weight of hydrogen, but there is no *a priori* reason why we should stop at this particular subdivision. The exact relation of Stas's work to Prout's law has, I think, been fairly stated by Prof. Mallet at the conclusion of his admirable paper on the atomic weight of aluminium, in the Philosophical Transactions for 1880 (vol. clxxi. 1033). Stas's main result, says Mallet, "is no doubt properly accepted if stated thus, that the differences between the individual determinations of each of sundry atomic weights which have been most carefully examined are distinctly less than their difference, or the difference of their mean from the integer which Prout's law would require. But the inference which Stas himself seems disposed to draw, and which is very commonly taken as the proper conclusion from his results, namely, that Prout's law is disproved, or is not supported by the facts, appears much more open to dispute. It must be remembered that the most careful work which has been done by Stas and others only proves by the close agreement of the results that fortuitous errors have been reduced within narrow limits. It does not prove that all sources of constant error have been avoided, and, indeed, this never can be absolutely proved, as we never can be sure that our knowledge of the substances we are dealing with is complete. Of course, one distinct exception to the assumed law would disprove it, if that exception were itself fully proved, but this is not the case. As suggested by Marignac and Dumas, anyone who will impartially look at the facts can hardly escape the feeling that there must be some reason for the frequent recurrence of atomic weights differing by so little from accordance with the numbers required by the supposed law." Prof. Mallet, in tabulating the atomic weights which may be fairly considered as determined with the greatest attainable precision, or a very near approach thereto, and without dispute as to the methods employed, points out that out of the eighteen numbers so given ten approximate to integers, within a range of variation less than one-tenth of a unit. And he then proceeds to calculate the degree of probability that this is purely accidental, as those hold who carry to the extreme the conclusions of Berzelius and Stas, and he finds that the probability in question is only equal to 1 : 1097·8. And he concludes that not only is Prout's law not as yet absolutely overturned, but that a heavy and apparently increasing weight of probability in its favour, or in favour of some modification of it, exists, and demands consideration.

It would be impossible for me to attempt to traverse the whole ground of this question which has been opened up during the past fifteen or twenty years. Even if I could claim the time and your indulgence, there is hardly the necessity for such a demand on your patience. Mr. Crookes, only so recently as September last, gave an admirably complete exposition of the present state of the case in his address to the Chemical Section of the British Association at the Birmingham meeting, and for me to go over the ground again with you would be simply to plough with Mr. Crookes' heifer. Some years ago Mr. Norman Lockyer, as you doubtless know, approached the subject from another point of view, and in his recent work, "The Chemistry of the Sun," you will find a summary of the evidence which the spectroscope has afforded us concerning the dissociation of "elementary" matter at such transcendental temperatures as we have in [illegible] he sun.

Now, when we pass in review all this evidence; when we reflect upon the mode of distribution of the elements, and especially their tendency to associate in correlated groups; when we bear in mind the absolute analogy which exists in the general behaviour and mode of action of the radicles which are confessedly compound with those which are assumed to be simple; when we have regard to the phenomena of allotropy, isomerism, and homology,—the mind insensibly appeals to the principle of continuity, and refuses to believe that the seventy and odd "elemental" forms, to which our processes of analysis have reduced all the kinds of matter we see around us, differ in essence from bodies which are known to be compound.

The connexion between the properties of the "elements" and the relative weights of their atoms, as developed by Newlands, Mendelejeff, Lothar Meyer, Carnelley, and others, has served to strengthen this conviction. The discovery that the physical and chemical properties of the elements are as periodic functions of their atomic weights, is unquestionably the most important generalisation we have had in chemical philosophy during the last five-and-twenty years. Its bearings upon the question of the origin of the "elements" have been worked out in the Presidential address I have already referred to. Mr. Crookes, like Mr. Lockyer before him, in seeking to apply to this question of the genesis of the elements the same principles of evolution which Laplace has already applied to the creation of the heavenly bodies, and which Lamarck, Darwin, and Wallace have applied to that of the organic world, is again appealing to the law of continuity. The mind which holds that Nature is one harmonious whole is fain to believe that the probability that the elements have originated by chance and are eternally self-existent is just as remote as that the animals and plants of to-day are primordially created things. I think in what I am now saying I may fairly claim to be reflecting the opinion on this matter of every philosophic thinker of to-day. Nay more, you must allow that the germ which has been kept alive for so many centuries, and which has come down to us through the brains of a succession of thinkers like Leucippus, Aristotle, Lucretius, Bacon, Newton, Dalton, and Graham, has become quickened and endowed by the light which modern science has shed upon it from all sides, with a vitality which will persist and strengthen.

Having thus traced the development of the idea held by Graham of the essential oneness of matter, let us spend the few remaining moments in considering, in the most general way, how the science of the last twenty-five years has worked out and extended his conceptions concerning the properties of the atom and its mode of motion.

The treatment which "the few grand and simple features of the gas," to quote Graham's phrase, have received at the hands of Clausius, Clerk Maxwell, Helmholtz, Sir William Thomson, and a score of workers in this country and on the Continent who have been actuated by their influence, has served to dispel much of the metaphysical fog which has enshrouded the notion of the atom, and to-day we are able to reason about atoms, as physical entities, having extension and figure, and of their number and dimensions and peculiarities of movement, with the confidence which is based on well-ascertained facts.

We have, of course, not yet attained to a complete molecular theory of gases. But we know the relative masses of the molecules of various gases, and we have calculated in miles per second their average velocity. The phenomena of diffusion indicate that the molecules of one and the same gas are all equal in mass. For, as was pointed out by Clerk Maxwell, if they were not, Graham's method of using a porous septum would enable us to separate the molecules of smaller mass from those of greater, as they would stream through porous substances with greater velocity. We should thus be able to separate a gas, say hydrogen, into two portions, having different densities and other physical properties, different combining weights, and probably different chemical properties of other kinds. As no chemist has yet obtained specimens of hydrogen differing in this way from other specimens, we conclude that all the molecules of hydrogen are of sensibly the same mass, and not merely that their mean mass is a statistical constant of great stability (see art. "Atom," "Encyclopædia Britannica," 9th edition). This line of argument has, it seems to me, an important bearing upon a question which has been raised by Marignac, Schutzenberger, and others, and which has again been raised by Mr. Crookes in the address I have already referred to. Mr. Crookes thinks that it may well be questioned whether there is an absolute uniformity in the mass of every ultimate atom of the same chemical element, and that it is probable that our atomic weights merely represent a mean value, around which the actual atomic weights of the atoms vary within certain narrow limits, or in other words that the mean mass is a statistical constant of great stability. The facts of diffusion would seem to lend no support to such a supposition.

Graham was still living when Loschmidt published what Prof. Exner calls his "epoch-making paper" on the "Size of the Air Molecule." Although the numerical estimate which Loschmidt deduced from the mean free path of the molecules and their volume has now only an historical interest, it has exercised a profound influence on the development of molecular physics in demonstrating that in dealing with molecules we are dealing with masses of finite dimensions, and further that these dimensions are by no means immeasurably small. The very manner in which Loschmidt stated his conclusions was well calculated to rivet attention. He showed that these magnitudes, small as they are, are yet comparable with those which can be reached by mechanical skill. The German optician Nobert has ruled lines on a glass plate so close together that it requires the most perfect microscopes to observe the intervals between them; he has drawn, for example, as many as 4000 lines in the breadth of a millimetre, that is about 112,000 lines to the inch. Now, if we assume, with Maxwell, that a cube whose side is 1/4000 of a millimetre is the smallest volume observable at present, it would follow that such a cube would contain from 60 to 100 millions of molecules of oxygen or nitrogen, and if we further assume that the molecules of organised bodies contain on an average 50 "elementary" atoms it further follows that the smallest organised particle visible under the microscope contains about two million molecules of organic matter. And as at least half of every living organism is made up of water, we arrive at the conclusion that the smallest living being visible under the microscope does not contain more than about a million organic molecules. I could have wished, had time permitted, to have dwelt a little upon the intensely interesting questions which such a conclusion at once raises. In the article "Atom" in the present edition of the "Encyclopædia Britannica," from which I have quoted, you will find Clerk Maxwell points out its relation to physiological theories, and especially to the doctrine of Pangenesis. Molecular science, says Maxwell, "forbids the physiologist from imagining that structural details of infinitely small dimensions can furnish an explanation of the infinite variety which exists in the properties and functions of the most minute organisms."

In the year following Graham's death Sir William Thomson still further developed the modes of molecular measurement, and from a variety of considerations based upon the kinetic theory of a gas, upon the thickness of the films of soap-bubbles, and from the electrical contact between copper and zinc, he arrived at estimates which, although sensibly different from that of Loschmidt, are still commensurable with it. In a subsequent lecture to the Royal Institution, given about four years ago, he extended the lines of his argument and arrived at the conclusion that in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than 1/5,000,000 and greater than 1/1,000,000,000 of a centimetre. And in order to give us some conception of the degree of coarse-grainedness implied by this conclusion he asks us to imagine a globe of water or glass as large as a football to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be more coarse-grained than a heap of small shot, but probably less coarse-grained than a heap of footballs (NATURE, vol. xxviii. p. 278).

Here I think we may leave the subject, at all events for to-night. I am painfully conscious that I have left unsaid much that ought to have been said, and possibly said some things that might well have been left unsaid. But my main purpose will have been served if I have succeeded in indicating to you Graham's position as an atomist, and in showing you how his ideas respecting the constitution of matter have germinated, and, like the seed which fell upon good ground, have borne fruit an hundredfold.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 17.—"On the Total Solar Eclipse of August 29, 1886 (Preliminary Account)." By Arthur Schuster, F.R.S.

The instrument intrusted to me by the Eclipse Expedition was similar to that employed in Egypt during the eclipse of 1882. The equatorial stand carried three cameras, one of which was intended for direct photographs of the corona, while the two others were attached to spectroscopes.

Photographs of the Corona.—The lens had an aperture of 4 inches, and a focal length of 5 feet 3 inches; giving images of the moon having a diameter of about 0·6 of an inch.

During the first minute of totality the corona was covered by a cloud, which was, however, sufficiently transparent to allow the brightest parts of the corona to show on the ten photographs exposed during that time.

During the remaining time, that is to say, during about two minutes and a half, the sky was clear, but there were clouds in the neighbourhood of the sun.

The time of exposing the photographs which had been fixed beforehand had to be altered in consequence of the uncertainty of the weather, and for this reason I can only give the actual times of exposures very approximately and from memory. One photograph on sensitive paper shows only little detail; but three photographs on glass were obtained, which, as regards definition, I believe to be equal to those obtained in Egypt. The approximate exposures were 15 to 20 seconds, 10 to 15 seconds, and about 5 seconds.

With the view of possibly increasing the amount of detail which it has hitherto been possible to obtain on the photographs of the corona, I have, on this occasion, given considerable attention to the different adjustments, so as to fix the cause which at present limits the definition, and I have come to the conclusion that, if we are to obtain better photographs of the corona, we can only hope to do so by means of a better mechanical arrangement for moving the camera.

Photographs of the spectrum of the corona were obtained by means of two instruments, one being identical with that employed at Caroline Island in 1883. This spectroscope has two prisms of 62° refracting angle, the theoretical resolving power being about 10 in the yellow. (The unit of resolving power is the resolving power which allows of the separation of two lines differing by the thousandth part of their own wave-length.) The slit of this spectroscope was placed so that it was tangential to the image of the sun formed by the condensing lens. One plate was exposed during the whole of totality. The results are good; a number of lines belonging to the prominences and to the corona are very distinct and can be measured with fair accuracy. The difficulty of measurement lies in the multitude of lines. I have measured at present between forty and fifty distinct corona lines between the solar lines F and H, and a number remain unmeasured.

A comparison between the photographs of 1882 and 1886 shows that, although the lines seem to be in the same position, their relative intensity has greatly altered. The strongest corona line during the last eclipse had a wave-length of about 4232; it is slightly but distinctly less refrangible than the strong calcium line at 4226.

The second spectroscope had its slit placed so as to take a radial section of the corona. It had one large prism giving a theoretical resolving power of 11·4; slightly larger therefore than the two-prism spectroscope.

The film was one prepared by Capt. Abney so as to be more sensitive in the green than the ordinary plates.

The photograph obtained is faint, but I believe will ultimately give good results.

A good drawing of the corona was obtained by Capt. Maling at the station occupied by Capt. Darwin and myself.

The plates were prepared by Capt. Abney, whose valuable help I have had in the whole of the preliminary arrangements.

March 24.—"Preliminary Note on the 'Radio-Micrometer,' a New Instrument for measuring the most Feeble Radiation."[1] By C. Vernon Boys.

The author considered that, if the thermo-electric power of a

[1] I have learnt that an instrument essentially the same in principle as the radio-micrometer was made and shown by M. D'Arsonval to the French Physical Society; it is hardly necessary to say that I was not aware of this before reading the paper.—C. V. B.

junction were properly utilised, a more sensitive instrument would be made than the bolometer, which depends on the change of resistance of a conducting filament with temperature. After showing the defects of the ordinary thermopile, he explained the construction of his instrument. A circuit is made of one turn of 1 square centimetre, of which three sides are thin copper wire, and the fourth is a compound bar of antimony and bismuth, each piece being $5 \times 5 \times \frac{1}{8}$ mm., soldered edge to edge. This circuit is supported by a thin rod, to which is fastened a mirror, and the whole is hung by a torsion fibre, so that the circuit is in the field produced by a powerful magnet with suitable pole pieces.

When radiant energy falls on the centre of the bar, the circuit is deflected, and the amount of the deflection measures the energy. The instrument supplies the most delicate means of detecting radiant heat yet made. For instance, the particular instrument made by the author—having proportions which he now knows to be not the best, and with the keeper on the magnet, so that the field was one of 100 units only—was capable of showing the heat which would be cast on a halfpenny by a candle-flame at a distance of 1168 feet, and as the sensibility is proportional to the strength of the field, it would be fully ten times as sensitive with the keeper off.

By calculation it may be shown that an instrument made with certain given proportions, which are easily obtainable, would be capable of showing a change of temperature of the junction of 1/100,000,000 of a degree of heat.

The author also showed a motor consisting of a cross of metal, the centre being antimony and the arms bismuth, to the ends of which are soldered four copper wires, whose free ends are joined by a ring of copper which rotates rapidly when the spark at the end of a blown-out match is held near it.

If the spark is held on the right-hand side of the north pole, the motor will start itself oscillating through angles which increase until it at last begins to revolve, which it will do indifferently in either direction. If the spark is held on the left-hand side, the motor at once stops.

This is interesting in that it is an electro-magnetic motor which goes, having neither sliding nor liquid contacts.

The author promises, shortly, a complete paper in which the best proportions for the various parts are given, and to show an instrument in which these proportions are employed.

Geological Society, March 23.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—Notes on the structure and relations of some of the older rocks of Brittany, by Prof. T. G. Bonney, F.R.S. These notes are the results of a visit to some of the more interesting geological sections in Brittany, in the autumn of last year. The author is greatly indebted for information to the Rev. E. Hill, who took part in the summer excursion of the Société Géologique de France, and to Dr. Charles Barrois, who has for long been engaged in investigating the geology of Brittany. (1) The author briefly noticed the glaucophane-amphibolites and the associated schists of the Ile de Groix, which have been already admirably described by Dr. C. Barrois. (2) The next part of the paper treated of sections in the district about Quimperlé. (3) In this part of the paper were noticed the crystalline rocks of Roscoff, and (more briefly) the Palæozoic strata about Morlaix, with the mineral and structural modifications due to pressure and to the action of intrusive igneous rocks. The author pointed out that, in the latter case, the results either of pressure-metamorphism or of contact-metamorphism differ much from the crystalline schists, which, both in Brittany and elsewhere, are regarded as of Archæan age; and that here in the north at Roscoff, we have a series of banded gneisses, less modified by subsequent pressure than in the south, the structures of which are very difficult to explain on any theory of a "rolling out" of a complicated association of igneous rocks, but which are such as would naturally result from some kind of stratification of the original constituents. The result of the author's work is to strengthen the opinion which he has already expressed, that while the structures of some foliated rocks may be regarded as primarily due to pressure operating on suitable materials, the structure of others seems opposed to this explanation. At any rate the latter rocks appear to have assumed a crystalline condition with a semblance of stratification in Pre-Cambrian times; so that, whatever may be their genesis, they are rightly called Archæan gneisses and schists.—The rocks of Sark, Herm, and Jethou, by Rev. E. Hill.—In opening the discussion which took place after the reading of these papers, the President remarked on the value attaching to Prof. Barrois's work in Brittany, and on the interest of the observations made on the country by Prof. Bonney. The conclusions as to the Archæan age of the lower gneissose rocks would probably be generally accepted; but a question which must still be regarded as an open one was, whether foliation ever corresponded with original bedding. The supposed instances of unconformity and current-bedding depended on the assumption that such was the case. Mr. Becker, Mr. Rutley, and Dr. Hicks, also took part in the discussion.—Quartzite boulders and grooves in the Roger Mine at Dukinfield, by Mr. James Radcliffe. The statements made in this paper were discussed by Mr. W. W. Smyth, Prof. Boyd Dawkins, Mr. Blanford, and Prof. Bonney.

Royal Microscopical Society, February 9.—Annual Meeting.—Dr. Dallinger was re-elected President for the fourth time. We have already printed the remarks made by Dr. Dallinger in his annual address on the value of the new apochromatic lenses. Having dealt with this subject, he proceeded to record the results of experiments as to the changes of temperature to which the lower forms of organisms can be adapted by slow modifications. For nearly seven years continuous experiments and observations were made, with the result that several organisms had gradually become adapted to live and thrive under a high temperature. Commencing at the normal temperature of 60° F., the first four months were occupied in raising the temperature 10° without altering the life-history. When the temperature of 73° was reached, an adverse influence appears to be exerted on the vitality and productiveness of the organisms. The heat being left constant for two months, they regained their full vigour, and by very gradual stages of increase 78° was reached in five months more. Again a long pause was necessary, and during the period of adaptation a marked development of vacuoles was noticed, which again disappeared when it was possible to raise the temperature farther. The farther history of the experiments presented practically the same features—long pauses, vacuolation, slow advance—until at last the high temperature of 158° F. was reached, when the research was accidentally terminated. It is because it is so difficult to observe the effects of changes through a sufficient number of generations of larger animals that results obtained on the simpler forms are so valuable. Darwin distinctly insisted on the slowness of the process of adaptation. The organisms examined by Dr. Dallinger are incessantly multiplying by dividing, the longest interval being four minutes: half a million generations must therefore have been observed, giving the "countless generations" required. At the end of the series the organisms were found to be fully adapted to a change in the essential condition of life, sufficient to produce death originally.

March 9.—Mr. W. T. Suffolk, Vice-President, in the chair.—Mr. E. C. Bousfield exhibited photomicrographs of *Amphipleura pellucida*, to show what may be expected from the employment of Prof. Abbe's new lenses. The objective employed was a very fine 1/8 apochromatic homogeneous-immersion 1·4 N.A. He also exhibited photomicrographs of salicine crystals as viewed by polarised light, and the colours were purposely selected to test as severely as possible the capacity of the plate used—a Dixon's orthochromatic.—Dr. Crookshank exhibited two photomicrographs of flagellated Protozoa of the blood. These were taken with Zeiss's 1/18 homogeneous-immersion from a preparation stained with magenta. The amplification (1750) was obtained by enlargement from the original negatives. They illustrated the employment of the Eastman bromide paper, and the value of photomicrographs for teaching purposes. The flagella and the delicate longitudinal membrane were clearly demonstrated.—Mr. W. Watson exhibited and described the Watson-Draper microscope, which he had made on the designs of Mr. E. T. Draper. The microscope is an elaboration of the Watson-Crossley form, and the idea of the designer is "that when the object is on the stage, either it may be made to rotate in any direction, horizontal or vertical, round a fixed beam of light without the light ever leaving the object, or the stage may be kept fixed while the light is revolving round it in any direction, horizontal or vertical, always however remaining upon the object."—Mr. J. Mayall, Jun., described the Nelson model microscope exhibited by Mr. C. Baker.—Two papers were read: by Mr. G. Massee, on the differentiation of tissues in fungi; and by Drs. H. J. Johnston-Lavis and G. C. J. Vosmaer, on cutting sections of sponges and other similar structures with soft and hard tissues, and specimens of sections of sponges were exhibited of exceptionally large size.—An arrangement by Mr. W. A. Haswell was exhibited for mounting series-sections to the number of thousands on one disk for consecutive examination.

EDINBURGH

Royal Society, March 7.—Sir W. Thomson, President, in the chair.—The President read a third communication on the equilibrium of a gas under its own gravitation alone. He finds that a large part of his former conclusions has been anticipated by Mr. Homer Lane.—Sir W. Thomson also communicated a paper on Laplace's nebular theory, considered in relation to thermo-dynamics. In the light of thermo-dynamical principles, Laplace's theory is seen to be not a mere plausible hypothesis but a statement of actual fact.—Dr. Thomas Muir read part of a paper on the history of the theory of determinants, treating of authors from Hindenburg (1784) to Reiss (1829).—Dr. Muir also communicated papers on a class of alternating functions, and on the quotient of a simple alternant by the difference-product of the variables.—Mr. J. Aitken read notes on solar radiation, and on hoar-frost.—An account of researches on the influence of certain rays of the solar spectrum on root-absorption and the growth of plants, by Dr. A. B. Griffiths, was submitted by Prof. Crum Brown.

March 21.—Lord Maclaren, Vice-President, in the chair.—Prof. Nicholson read a communication on variations in the value of the monetary standard.—Mr. J. Y. Buchanan read a paper on ice and brine, and another on the distribution of temperature in the Antarctic Ocean.

PARIS

Academy of Sciences, March 28.—M. Janssen, President, in the chair.—On the calorimetric bomb and measurement of heats of combustion, by MM. Berthelot and Recoura. The improvements are described which have been made in this apparatus, originally invented by MM. Berthelot and Vieille for the purpose of measuring the heats of combustion of organic compounds. The method, already applied to slightly volatile substances and gases, may now be easily extended to all volatile compounds, and is consequently a universal method.—On aërial vortices, by M. D. Colladon. The author announces that he has succeeded in carrying out on a small scale the experiment alluded to in his note of March 3, demonstrating that in a fluid there may be set up a vortex with vertical axis and ascending movement.—On the variation of solubility of substances according to the amount of heat liberated, by MM. G. Chancel and F. Parmentier. The experiments here described show that to a solubility increasing with the temperature there does not necessarily correspond an absorption of heat, so that one of the relations established by M. Le Chatelier must be rejected.—Extracts from various reports of the local engineering service on the effects caused by the earthquake of February 23, communicated by the Minister of War. Among the results recorded at Nice were the fissures produced in the Barbonnet Hill running along its entire elevation almost vertically to the magnetic north pole.—The same earthquake as observed at Moncalieri, by M. F. Denza. The diagram is given which was traced by the seismograph (Cecchi system) at the Moncalieri Observatory.—On the latent heats of vaporisation of some very volatile substances, by M. James Chappuis. The process here applied to the study of the chloride of methyl, sulphurous acid, and cyanogen is based on the employment of the Bunsen calorimeter, by means of which may be determined with considerable accuracy the latent heats of ebullition at 0° under the maximum tension corresponding to the melting of snow. The mean results obtained were for the chloride of methyl, 96·9; sulphuric acid, 91·7; cyanogen, 103·7.—On the determination of the coefficient of self-induction, by MM. P. Ledeboer and G. Maneuvrier. The method here employed to determine this quantity consists of a new adaptation of those of Maxwell and Lord Rayleigh to a particular case in which the coefficient is too weak to produce an appreciable shock in the galvanometer. It possesses the advantage of dispensing with the use of the ballistic galvanometer, and of rendering possible the employment of an ordinary galvanometer with mirror.—A study of the alkaline vanadates, by M. A. Ditte. With a view to determining the place that vanadium should occupy in a classification of simple elements, the author here begins a study of the little-known metallic vanadates, taking first the vanadates of potassa: (1) VO_5,KO; (2) $2VO_5,KO$; (3) $3VO_5,2KO$, &c.—Double phosphate and arseniate of strontian and soda, by M. H. Joly.—On some ammoniacal combinations of the chloride of cadmium, by M. G. André. This subject, already treated by Croft and Hauer, is here resumed chiefly from the stand-point of the comparisons that it suggests between the three metals zinc, copper, and cadmium, whose oxides are soluble in ammonia.—Action of nitric acid on the solubility of the alkaline nitrates, by M. R. Engel.—On the metallic propionates, by M. Adolph Renard. Among the propionates here studied are those of aluminium, barium, calcium, cadmium, chromium, cobalt, copper, lithium, magnesium, manganese, lead, potassium, sodium, strontium, and zinc.—Age of the upheaval of the Montagne Noire, French Pyrenees, by M. A. Caraven-Cachin. This upheaval is regarded as comparatively recent, being referred to the beginning of the Upper Eocene. It is more recent than the profoundly dislocated Lutetian and Bartonian beds, but older than the Ligurian system.—On the dolmens of Enfida, Central Tunisia, by M. Rouire. For the first time a systematic description is given of this remarkable group of dolmens, about 800 of which are found concentrated in a space of some 250 hectares, disposed without any apparent order, at distances of from 10 to 50 metres from each other. All belong to a perfectly uniform type, consisting of a long horizontal slab resting on upright stones joined at right angles. Except in a few depressions of the ground, none are covered with heaps of earth or stones so as to form true mounds or barrows, and all that were examined had the entrance on the east or south-east side. Like those of Constantine (Algeria), they are all of small size, the vertical stones scarcely exceeding 1 metre in height, and varying from 0·20 to 0·25 metre in thickness. In the few that were opened, little was found except some human bones and very coarse pottery, now deposited in the Ethnographic Museum.

BERLIN

Physiological Society, March 11.—Prof. Munk in the chair.—Dr. A. Baginski communicated the results of his observations and experiments respecting acetonuria in children. He found that acetone was present in small quantities in the urine of healthy children, though not in all; and that in the case of fever attending any of a very wide range of diseases, the quantity of acetone present in the urine was increased. When children were affected with eclampsia, attended, as such disease mostly was, by serious disorders in the digestion, a larger proportion of acetone was regularly observed in their urine. In regard to the formation of acetone in the blood, experiments in feeding, on different sorts of animals, showed that it was not produced by carbo-hydrates, as might be conjectured from the composition, $CH_3—CO—CH_3$, but from the decomposition of albumen. A longer course of flesh food yielded a very considerable increase in the secretion of acetone, whereas during a course of feeding with farinose and fatty foods, the yield of acetone very rapidly declined, and at length ceased altogether. When a large deposit of albumen occurred in the animal body, after the period of lactation for example, no acetone was found in the urine, even though food rich in albumen was administered. No causal connexion between acetonous urine and eclampsia could be demonstrated either clinically or experimentally. In rhachitis, in which eclamptic attacks often occurred, no acetone was found in the urine, nor was the administration of large quantities of acetone, even though continued for a considerable length of time, found to produce any effect on the nervous system.—Dr. Frenzel produced a long series of zoological and anatomical preparations preserved in accordance with his method. The preparations were hardened by means of alcohol containing sublimate, and injected with glycerine. The glycerine injection was effected first with a more diluted and then with a more concentrated solution, to which a solution of sugar was added as an ingredient. The relative proportion of glycerine and sugar was determined by the nature of the object.—Dr. Blaschko demonstrated, by drawings and very beautiful microscopic preparations, the structure of the epidermis. Starting with the assumption that the final endings of the nerves of feeling must be sought in the layer of the epidermis and not in the cutis, he had studied the structure of the upper skin at the boundary between epidermis and cutis. He distinguished the main parts of direct feeling (the hairless parts of the skin) from the parts of indirect feeling (the hairy parts of the skin). The former possessed on the under side of the epidermis very beautifully developed grooves (*Leisten*) forming a reticular system with spiral longitudinal and transverse lines. The hairy parts of the skin were influenced in their structure by the hairs, which likewise stood in spiral series, and had but very indistinct reticulations in the intermediate spaces.

Physical Society, March 4.—Prof. von Helmholtz in the chair.—Dr. Pringsheim reported on a further research into the chemical action of light on mixed hydrogen and chlorine gas (*Chlorknallgas*). This investigation respected the peculiar inductive action of light observed by Bunsen and Roscoe, during which the formation of hydrochloric acid was not effected, although the mixture of chlorine and hydrogen absorbed light, and at all events became changed, seeing the further influence of the like quantity of light at the end of the induction produced a chemical combination of the gases. In a former research (*vide* NATURE, vol. xxxiii. p. 287), Dr. Pringsheim showed that during the inductive action of the light an increase of volume in the gas mixture took place. If by means of electric sparks he illuminated the gas mixture in a glass globe above water, and shut off by a water index, then, on subjection to the first and each following spark up to the fourth, there occurred each time only an increase of volume which rapidly passed away; with the fifth and following sparks the effect was an increase of volume succeeded by a diminution; the latter a proof that hydrochloric acid was now formed and absorbed by the water. The speaker demonstrated at length that the assumption of a thermic influence as the cause of the increase of volume was excluded. On the contrary, he argued, there could here be a case only of chemical change in the gas mixture. It was probably an intermediate condition we had here to deal with, which of course refused explanation from the contemplation of the two gases Cl and H. Seeing that aqueous vapour was also present in the glass globe, the part it played in the reaction was now examined, and the fact was established that its presence was absolutely indispensable in effecting the chemical light effect. Dry chlorine and hydrogen did not unite into hydrochloric acid under the influence of the light; or the process was in such a case effected only very slowly. In all probability, therefore, the induction would have to be explained on the ground that intermediate products with larger volume were formed from the molecules ClCl, HH, and HHO, products whose chemical nature it had not yet been possible to determine.—Prof. Neesen made some supplementary communications respecting the tuning-forks filled with quicksilver, and stated that they had been constructed at an earlier date by Herr König.—Prof. von Bezold described a simple method of presenting complementary colours by means of prism, lens, and a special screen.—Prof. Vogel produced three fluids in three flat phials—one yellow and two blue fluids—which he made use of in demonstrations regarding colour-mixture in order to dispel the belief which prevailed very largely amongst the public that yellow and blue when mixed yielded only green. Phial 1 contained "acid yellow" (*Säuregelb*); phial 2, solution of ammoniacal copper; phial 3, aniline blue. 1 and 2 superimposed on each other gave green; 1 and 3 a fiery red.

Chemical Society, February 14.—Prof. H. Landolt in the chair.—F. Tiemann gave an account of Kiliani's research, according to which arabinose-carboxylic acid has the same composition as gluconic and galactonic acids. Arabinose is regarded as an aldehyde of normal pentahydroxypentane.—Amongst the other papers may be mentioned:—A contribution to our knowledge of secondary and tertiary quinones, by R. Nietzki and F. Kehrmann.—Tetramidobenzene and its derivatives, by R. Nietzki and E. Hagenbach.—Substitution of the amido-group in aromatic compounds, by the groups SH and SO_3H, the change being effected by means of a new diazo-reaction, by P. Klason.—The six toluenedisulphonic acids, by the same.—The constitution of pyrene and its derivatives, by E. Bamberger and M. Philip.—The action of chlorine on acet-α-naphthalide, by P. T. Cleve.

February 28.—A. W. Hofmann, President, in the chair.—G. Kraemer gave an account of the work done by himself in conjunction with W. Böttcher on the constituents of mineral naphtha. They have examined naphthas from Tegernsee, Pechelbronn, and Oelheim, and find they consist of a mixture of hydrocarbons which are not acted on by concentrated sulphuric or nitric acid, and of such as are dissolved by the acids with formation of sulphonates and nitro-derivatives; also small quantities of acids. The indifferent hydrocarbons are distinguished by their low specific gravity; they constitute the greater portion of the naphtha, and they consist partly of paraffins and partly of hydrocarbons isomeric with the olefines; these are called naphthenes. The authors consider the non-aromatic hydrocarbons which are soluble in acid to be derived from the naphthenes by condensation, in the same way as naphthalene, anthracene, &c., are derived from benzenes. The authors also discuss the question of the origin of mineral naphtha.—Amongst the other papers may be mentioned:—J. W. Brühl, on J. Thomsen's theory of the heat of formation of organic substances.—C. Gottig, on a new hydrate of soda.—Claisen and Lowman, on a new method of producing benzoylacetic ether.—A. Piutti, synthesis of trimesic ether.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

Smithsonian Report, 1884, part 2 (Washington).—Supplement to Harmonies of Tones and Colours Developed by Evolution: F. J. Hughes (M. Ward and Co.).—Researches into the Etiology of Dengue (Chicago).—On the Influence of Fluctuations of Atmospheric Pressure on the Evolution of Fire Damp (Vienna).—On a Seismic Survey made in Tokio in 1884–85: J. Milne.—Über die Liasischen Cephalopoden des Hierlatz bei Hallstatt: G. Geyer (Fischer, Wien).—Mind, April (Williams and Norgate).—Jahrbuch der k.k. Geologischen Reichsanstalt, 36 Band, 4 Heft (Holder, Wien).

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