THURSDAY, MAY 17, 1888.

FLORA OF THE HAWAIIAN ISLANDS.

Flora of the Hawaiian Islands; a Description of their Phanerogams and Vascular Cryptogams. By William Hillebrand, M.D. Annotated and Published after the Author's death by W. F. Hillebrand. 8vo, pp. 673, with Frontispiece and Four Maps. (London: Williams and Norgate, 1888.)

THE Sandwich Islands, from a botanical point of view, are a group of peculiar interest. There are about a dozen of them, and they form an area of which the northern end falls just within the tropical zone, at a distance of 2000 miles from America, and separated from it by a deep gulf. From the nearest points of Polynesia proper, the Marquesas Islands and Tahiti, they are distant 1860 and 2190 miles. The largest island, Hawaii, is the most southern of the group. It has an area of about 5000 square miles, and its mountains, one of which is an active volcano, rise to a height of nearly 15,000 feet. The other islands, all taken together, are not equal to more than half the area of Hawaii. The capital of the group, Honolulu, is situated on the south side of the small island of Oahu. The average annual temperature of Honolulu is 75° F., the general range of the thermometer being from 70° to 83°, so that within an area about equal to that of Yorkshire we have every variation of temperature from equatorial heat to perpetual snow. Dr. Hillebrand estimates the total flora of the islands (Phanerogamia and Vascular Cryptogamia) at 999 species, representing 365 genera, and 99 orders. Of these 999 species, 653 are absolutely restricted to the Sandwich Islands, 207 native species are known elsewhere, 24 species were introduced by the natives in remote times, and 115 species are weeds of recent introduction. Leaving the introductions out of account, we have therefore a native flora of 860 species, of which three out of four are endemic. A vegetation thus individualized makes the group one of the most interesting fields of study in the world.

Dr. Hillebrand may be said to have devoted his life to the study of this question. He was born in Westphalia in 1821, and studied medicine at Göttingen, Heidelberg, and Berlin. After taking his degree, he settled down for a short time in practice in Germany, but his health soon broke down, and he sailed for Australia. After visiting the Philippine Islands and California, he made the Sandwich Islands his home, and his health became quite restored. He lived at Honolulu, mastered the language, and practised his profession with great success. He became private physician to the king, a member of the Privy Council, an active member of the Board of Health, and physician to the Queen's Hospital and the principal lunatic asylum. During twenty years he devoted his leisure to working out the botany of the group, and sent large collections to Kew and other European herbaria. He left the islands in 1871, but kept up a regular correspondence with various residents who were interested in botany, and who sent him further collections. He died in July 1886, just after completing the descriptive portion of this present work, which has been edited by his son, who lives in America, and who has prefixed to it the introduction which was drawn up by Mr. Bentham for our British colonial floras. His name is commemorated by the genus *Hillebrandia*, which is the only representative of the *Begoniaceæ* in Polynesia, and which was named after him by Prof. Oliver. The type specimens of the present work have been presented to the Berlin Herbarium, and the Prussian Government has made a grant towards the expense of its publication.

The book, which is dedicated to the Hawaiian people, consists almost entirely of careful descriptions, in English, of the orders, genera, species, and varieties, that form the flora, accompanied by full details of their distribution through the different islands, and the sort of places in which they grow. Nearly all the native plants are trees, shrubs, or perennial herbs. Comparing the islands with one another, Dr. Hillebrand's general view is that the flora of Kaui, the comparatively small north-eastern island of the group, is the richest and most individualized, and that of the large southern island of Hawaii, where the mountains rise the highest, is the most monotonous and least attractive. The total number of species here described as new is 180, but in some cases, as, for instance, by Mr. C. B. Clarke, in his "Monograph of the Cyrtandraceæ," issued in 1883, the publication of these has been anticipated, and the earlier names will have to be adopted. It is much to be regretted that the author did not live to work out fully his generalizations. A great deal has been written during the last few years on the general subject of plant-distribution, and in particular Wawra and Engler in Germany, and in England Wallace in "Island Life," and Hemsley in the "Botany of the *Challenger*," have discussed the various points of interest connected with the flora of these islands. What is wanted now is that Dr. Hillebrand's added facts should be compared together and summarized, and that the general conclusions which they establish should be carefully traced out.

The following is his outline of the zones of vegetation and their characteristics:—

"(1) *The Lowland Zone.*—Open country, grass-covered after the rains, with isolated clumps of trees, represented by *Paritium tiliaceum*, *Erythrina*, *Reynoldsia*, *Pandanus*, *Capparis*, *Gossypium*, *Abutilon incanum*. This includes also the littoral zone.

"(2) *The Lower Forest Zone.*—Tropical in character, its upper limit between 1000 and 2000 feet above the sea. Its physiognomy is marked distinctly by *Aleurites moluccana*, the pale foliage of which, in contrast with the green colour around, attracts at once the eye of the beholder. The woods are rather open; *Zinziber Zerumbet* covers the ground. *Cordyline*, *Eugenia domestica*, *Zinziber Zerumbet*, and other species, are strictly confined to it. *Pandanus odoratissimus* and *Paritium tiliaceum* do not pass beyond it, but *Freycinetia* does. To its upper portion, but extending also into the lower part of the next zone, belong also most *Sapotaceæ*, *Apocynaceæ*, *Gardenia*, *Psychotria*, *Maba*, most *Urticaceæ*, *Pisinia*, *Elæocarpus*, *Aurantiaceæ*, and others.

"(3) *The Middle Forest Zone.*—This lies within the region of clouds, and develops the greatest luxuriance in trees and jungle. *Pelea* and *Cheirodendron* are representative genera. The prevailing trees are indeed *Metrosideros polymorpha* and *Acacia Koa*; but, although they reach here their greatest development in size and number, they

are not confined to this zone, but ascend above and descend below it. It is the home of all Rutaceous and most Araliaceous trees, the ubiquitous *Dodonæa viscosa*, *Alphitonia*, and *Coprosma*. The ferns luxuriate in it, and tree-ferns attain only here their full dimensions. Old trunks are wrapped in creeping ferns, mosses, and lichens. Here also the *Lobeliaceæ*, the peculiar pride of our flora, exhibit their most striking forms, invariably in isolated individuals. The upper limit of this zone may be drawn at an elevation of 5000 to 6000 feet.

"(4) *The Upper Forest Zone.*—This extends as high as 8000 to 9000 feet, and is characterized by stunted trees, chiefly *Sophora chrysophylla*, *Cyathodes*, *Myoporum*, arborescent *Raillardiæ*, *Wikstromiæ*, and *Coprosma Menziesii*. Between them luxuriate shrubby *Compositæ* (*Raillardia*, *Dubautia*, *Camphylotheca*, and *Artemisia*), with strawberries, brambles, and *Vaccinium*. Ferns are scarce, and mostly belong to widely spread species .Our shrubby *Geraniums* and silvery-leaved *Argyroxiphium* extend beyond this zone to the upper limit of vegetation, which on Mauna Kea may be placed at 11,000 feet. *Santalum* belongs to this zone and the upper levels of the last.

"(5) A place apart must be assigned to the bog flora of the high table-land of Kaui and the broad top of Mount Eeka, on West Maui. The turfy soil is covered with tussock-like *Gramineæ* and *Cyperaceæ*, all endemic species, with *Sphagnum*, creeping forms of woody *Metrosideros*, *Cyathodes*, *Geranium*, *Lysimachia*, and a number of rare, mostly single, representatives of genera which have their home in the Antarctic regions, New Zealand, the Falkland Islands, and the Southern Andes."

As a whole the flora of the Sandwich Islands stands out remarkably isolated from those of the two nearest great botanical regions, Polynesia and Central America, and has curious affinities with those of Australia, North America, the north temperate zone of the Old World, the Mexican highlands, the Andes, and the Antarctic regions. The subject is well worth working out in the same thorough way in which Sir J. D. Hooker has dealt with the floras of Tasmania and New Zealand.

Dr. Hillebrand's book is also valuable as a contribution to the study of varieties. In the Sandwich Islands we get a comparatively small number of species, that have lived for a long time in a country where there are great variations in temperature and humidity and little interference from man. In many of the endemic genera the species are very difficult to individualize, and he has named and characterized a great number of varieties. Altogether the book is of exceptional value, not only to the systematic botanist, but to all who are interested in the problems connected with the origin and distribution of species. J. G. BAKER.

THE GEOLOGICAL EVIDENCES OF EVOLUTION.

The Geological Evidences of Evolution. By Angelo Heilprin, Professor of Invertebrate Palæontology at the Academy of Natural Sciences of Philadelphia. (Philadelphia: Published by the Author, 1888.)

FEW chapters in the "Origin of Species" are more impressive, from their perfect candour and their far-sighted prescience, than those dealing with the objections which might be urged against the author's hypothesis, on the ground of the comparatively small palæontological evidence in its favour. But this evidence, as every student knows, has been almost surprisingly strengthened and augmented during the thirty years which have elapsed since the publication of Darwin's great work. It is, however, owing to the nature of the case, scattered up and down various scientific periodicals, many of which are practically inaccessible to the general public, so that both its amount and its force are under-estimated, and the old objections are confidently reiterated by that still numerous class to whom "Darwinism" is a bugbear, and the very name of "evolution" an absolute abomination. As Prof. Heilprin states in his preface, "There has not thus far appeared, to the knowledge of the author, any collective or consecutive statement of the evidence which geology and palæontology present in support of organic transmutation;" so "with the view of partially filling this gap in the literature of Darwinism, the author has prepared, at the request of many of his friends, the following pages, which represent, somewhat broadened, the substance of a Friday evening discourse delivered at the Academy of Natural Sciences of Philadelphia." Thus this little book, while scientific in conception and method, is popular in style. While there is no attempt at an appeal to prejudices, scientific terminology is as far as may be avoided, and the illustrations appended enable any reader, with a very moderate knowledge of natural history and palæontology, to comprehend the line of reasoning followed by the author.

It is needless to add that he is a thorough-going evolutionist, though, like his master, he is candid in admitting defects in the record, and transitions which as yet are merely hypothetical. In one case, however, he ventures on a statement which seems to us over bold: "It is not my purpose to-night to discuss the status of evolution, which has long since passed from the realm of pure and simple theory, but to present to you such of the more salient facts bearing upon its proof, drawn from my own department of geology and palæontology, as will permit you to understand why the greater number of naturalists consider the doctrine as firmly established to-day as is the Copernican theory of planetary revolution, the theory of gravitation, or the undulatory theory of light."

We cannot but think that, in making this confident assertion, Prof. Heilprin has exposed a joint in his harness to the arrows of his adversaries. In years to come, evolution, as stated by Darwin, may assume, probably will assume, the position of the above-named theories in physical science, but surely the evidence for it is not yet either so complete or so conclusive as for them. Hence it is unwise thus abruptly to exclude any possible modification or supplement. In scientific arguments it is better not to imitate the practices of political orators, but to err, if at all, on the side of understating rather than of overstating a conviction, and to impress by caution in reasoning rather than to dazzle by rhetoric.

This, however, is a matter of opinion: we pass on to indicate briefly the line of argument followed by Prof. Heilprin. At the outset he calls attention to two misconceptions relating to evolution which are widely prevalent, and are often made the ground of assaults upon the hypothesis. These are: that if the missing forms of life could all be recovered, they would form a continuous chain, and that "the progressive modification of individual organic forms need be, or indeed has been, one of con-

tinuous advance." Past and present organic life, as Darwin himself carefully pointed out, are combined, not in a continuous chain, but in a genealogical tree: "evolution recognizes modifications in the most divergent directions, and the tree of life that it restores is not a straight stem growing from a continuous apical bud, but a stem, or possibly even a limited number of stems, branching in varying directions." Thus the progress among organic beings is analogous to that in the development of civilization. "The united world advances, whereas individual tribes or nations remain at a standstill, or even degenerate and decay. Such is precisely the history of the organic development of our planet: new and more complicated organic types are being continually evolved, but side by side with these forms we still meet with those of a lower grade of organization, while still others, belonging to the earlier periods of the world's history, have completely dropped out."

After a brief sketch of the first appearance of vertebrate life, Prof. Heilprin describes the relations of the fishes, the amphibians, and the reptiles, indicating the affinities of the first and second, which have led Prof. Huxley to treat them as sub-groups of a single division, the Ichthyopsida. In the structure of the heart, mode of breathing, and nature of circulation, the young frog agrees with a fish, while in these respects the mud-fishes (*Ceratodus*) agree with the amphibians. Now this link between these great groups exists in very early times, as the hypothesis would demand. "Dipterus and its allies are fishes that belong to the Devonian period of time," and Ceratodus itself was living in the Permian, and thus "represents the oldest living vertebrate type known to naturalists." The peculiar structure of the teeth of the labyrinthodonts, found also in some of the earliest fishes, and still retained by the alligator-gar, is another link. Next, in regard to the date of the appearance of birds and mammals, which is sometimes regarded as rather anomalous, Prof. Heilprin points out that both the earliest birds and the earliest mammals have marked reptilian affinities, which in the former are very distinct, so that such forms as *Archæopteryx* and some of the early dentigerous birds on the one side, and the *Pterosauria* on the other, do much to link together the two classes. Further, the ancestry of the non-flying birds, such as Dinornis and its allies, may be traced with greatest probability to members of the Dinosauria, such as Iguanodon, Hadrosaurus, and Compsognathus. In like way the affinities of the monotremes with the reptiles are pointed out, and attention is called to the significant fact that "the earliest reptilian forms—those of the Permian period—are the only animals which possess the remarkable dental characters of the Mammalia."

In the second section of the book Prof. Heilprin deals more especially with the development of the Mammalia themselves, instancing the position occupied by the Eocene *Creodonta* between the now widely divergent *Carnivora* and *Insectivora*, the relationships among the groups of the former, and of the latter to the lemurs, the well-known pedigree of the horse, the ancestry of the hornless ruminants, the development of the horns of the deer, from the simple forked crown in the early Cervines of the Middle Miocene to the complicated forms assumed in the Pliocene and more recent times. *Cervalcas americanus*, the newly-discovered link between the Canada stag and the elk, also receives notice, as does the relation of the homocercal and heterocercal to the primitive diphycercal fishes. Attention is also called to the development of the brain in various vertebrates.

In the third section the author glances at the question of the antiquity of man. In regard to some of the alleged evidence he exercises a wise scepticism, and states that up to the present time he has been unable "to find satisfactory proof of man's belongings having been found in deposits very much (if at all) older than the Post-Pliocene," though he thinks it not unlikely that such may ultimately be found. In connection with this subject he mentions some human vertebræ, mineralized by limonite, of unknown but evidently high antiquity, discovered by himself in Florida.

Lastly, he calls attention to a class of evidence which the comparative persistency of conditions in certain parts of the United States has rendered accessible to American geologists—namely, the relation of living forms to their more immediate predecessors. Instances of this may be obtained in the sheltered regions of the Gulf of Mexico and in the comparatively modern rocks of the Florida peninsula. As examples, species of the genera *Strombus*, *Voluta*, *Fulgur*, and *Melongena*, are figured, showing the gradual transition from an extinct to an existing species, and to these are added a group of Paludinæ from the Middle Tertiary of Slavonia, illustrating successive varietal and specific forms.

The book is attractively written, though we must venture to protest against two instances of American-English: "The swift-footed animal . . . elevates the body so as to *weight* it principally upon the extremities of the toes;" and "the evidence is . . . but a mere *figment* of that which pertains to zoology." The first gains so little that brevity can hardly be pleaded as its excuse; the second, unless a misprint, is worthy of Mrs. Malaprop. T. G. B.

THE SHELL-COLLECTOR'S HAND-BOOK FOR THE FIELD.

The Shell-Collector's Hand-book for the Field. By J. W. Williams, M.A., D.Sc. Small 8vo, pp. 148 (interleaved). (London: Roper and Drowley, 1888.)

HANDY books for collectors, whether of birds, beasts, fishes, mollusks, or other organisms, are always most acceptable when well put together and carefully contrived, even if they be not original. The present little book might at first sight lay claim to having fulfilled all these conditions. It is small enough for the pocket, and the type is clear and legible; but when we enter upon the work itself, alas! we do not find our dream of a typical collector's hand-book realized by any means. Chapter I. "The Anatomy of a Snail," and Chapter II. "The Anatomy of a Fresh-water Mussel," should have been altogether omitted. They are not cleverly compiled, they are sadly full of mistakes, and these too clearly betray the fact that the author himself is not familiar with Mollusca from an anatomical point of view, but rather has got up his subject after the style of "Cousin Cramchild." Thus, the *colour* of the shell (says Dr. Williams), *exists entirely* in the *periostracum* or *epidermis*. We would advise the learned author to try and

remove the epidermis from a snail-shell and observe the result.

The lip or aperture of a snail's shell is not generally called the *peritreme* but the *peristome*. The lines of growth in a snail's shell are not "arranged *concentrically* with the *nucleus*," although this is the case with the growth-lines in bivalves.

We fail to understand how the *operculum* of a snail "differs from the true shell in having more *conchiolin* entering into its composition." Surely the author meant to say *less conchiolin* and *more chitine?*

The *epiphragm*, or layer of hardened mucus, sometimes strengthened with carbonate of lime, closing the aperture of the shell of land-snails during hibernation is called here also the *clausilium!* (p. 5). The description of the odontophore with its radula and jaws (pp. 6 and 7) is very inaccurately rendered, and in copying Prof. Lankester the author has carefully also quoted a mis-statement as to the formula of the teeth.

The eggs of snails are said by the author to be "laid in a string, which is called the *nidamental ribbon*, or inclosed in *horny capsules*." This is true of sea-snails, such as the whelks (*Fusus*, *Buccinum*, &c.), but it is not the case in land-snails, of which Dr. Williams is discoursing. In these the eggs are separate and protected by a shell, which is sometimes membranous and flexible, at others calcareous and brittle, while those of the fresh-water species are deposited in small glairy masses of soft transparent jelly-like consistence.

Turning from the snail to the fresh-water mussel (Chapter II.), the author, in describing the animal of the latter, appears to have made a mistake similar to that which he has made with regard to the garden snail: not knowing his subject well, he has in fact described a *siphonated Mya*, when he fondly imagined he was writing about a *non-siphonated Unio* or *Anodon*.

Turning to the species enumerated by the author, we regret to observe that here the discrimination of the expert is alike wanting. For example, *Anodonta anatina*, Linn., figures as a good species, whereas it is merely a variety of *A. cygnea*, Linn. It seems rather absurd to give in a shell-collector's hand-book such shells as *Physa acuta*, Drap., "Hab. In one of the lily-tanks in Kew Gardens, imported" (p. 72); *Bulimus Goodallii*, Miller (introduced into a green-house with exotic plants); *Vertigo tumida*, Westerlund, another "casual"; *P. dilatatus*, Gould, in the canals around Manchester, "introduced from America in cotton bales." If these are admitted, why omit *Clausilia parvula* and *C. solida*, also "casuals," which appear both in Sowerby's last edition, and in Gwyn Jeffreys, v. 161-62?

Far too much prominence is given to worthless varieties of the common snail *Helix aspersa*, such as *minor*, *maxima*, *albida*, and *sinistrorsum*, &c.; but, having put them in, why should the author omit such a one as *Unio timidus* var. *ponderosa?* Many of the genera, too, need revision to be brought up to date. Thus, *Achatina acicula* should be *Cæcilianella acicula*; *Bulimus acutus* should be *Helix* (*Cochlicella*) *acuta*; *Zonites* should be *Hyalinia*. By the way, *Zonites draparnaldi* is omitted altogether, although known for years.

The habitats of many of the species are badly given. Thus, *Testacella Maugei* is said to be found in gardens and fields, whereas it has been met with in the neighbourhood of Bristol, whence it has spread to a few limited localities.

Why are the three known localities for *Vertigo moulinsiana* (p. 129) omitted?—Itchen Valley, near Otterbourne; near Hitchin; and near Rye-House, Herts. Other quite local species are recorded as if they occurred everywhere, as *Helix pisana* and *H. obvoluta*, &c.

A few woodcuts are inserted, but they are very poor and not accurately drawn. *Testacella haliotidea* is reversed.

The minute characters of the shells, so useful in many instances in the field, are omitted. The book is interleaved, which doubles its thickness for field-work, and we at first wondered why so much plain paper was added. It has since occurred to us that the author had the convenience of the reviewer in his mind's eye, and we must say we found the blank pages most useful in correcting the text as we turned over the leaves.

Is it too much to hope that the author may be able to give some attention to the living land and fresh-water Mollusca before he brings out a new edition of his handy shell-collector's manual, and so avoid those pitfalls into which he who compiles unskilfully and without practical acquaintance with his subject is sure to slip?

OUR BOOK SHELF.

A Text-book of Biology. By J. R. Ainsworth Davis, B.A., Lecturer on Biology in the University of Wales, Aberystwith. (London: Griffin and Co, 1888.)

THIS is one of a class of books which the system of examining the whole world on a limited schedule, drawn up by a Board of disinterested philanthropists, is bound to produce. It will delight the misguided student whose sole desire is "to get through" with the least knowledge possible, and will disgust every competent teacher. Mr. Davis is in error in stating that his book supplies a gap in literature. The little text-book by Prof. Lloyd Morgan is on the same lines, and appears to us to be far less objectionable, inasmuch as it is, though of smaller dimensions, a more genuine exposition of the principles of the subject, less of a cram-book than the present work, and written with maturer judgment and literary power. The only way to prevent the study of biology, as directed by the University of London, from sinking into a worthless exercise of memory applied to the contents of such little books as this by Mr. Davis, is to change the animals and plants enumerated in the schedule every three years. This, however, would hardly suit the ubiquitous aspirants to a degree for whom alone the Imperial University arranges its curriculum. Nor would it suit Mr. Davis and other more distinguished authors of regulation cram-books. The fact is that genuine education in biology as a science, and the influence of personal contact and association with an active investigator and discoverer as teacher and friend, are destroyed by the Imperial system of schedule and examination; and their place is taken by weary grinding at little books written by teachers of no authority, and too often ignorant as well as unintelligent.

Mr. Davis has borrowed a number of excellent figures to illustrate his book, which is nothing more nor less than a strictly limited, and in minor points an inaccurate, description of the types named in the schedule of the University of London. The new figures are bad, and the short general introduction is not merely shallow but erroneous, *e.g.* the account of protoplasm and the tabular statement of differences between plants and animals.

Reports of the Geological Survey of New Zealand.

THE issue of an index to the Reports of the Geological Survey of New Zealand, from 1866 to 1885 inclusive, enables us to see at a glance how large an amount of valuable material has been accumulated by the staff of this Survey, under its accomplished and energetic Director, Sir James Hector. Several editions of the useful geological map of the colony have appeared, the latest dated 1885; and the volumes containing the yearly reports of progress are now eighteen in number. Monographs on the palæontology of New Zealand are stated to be in preparation, and there are, besides these, museum and laboratory reports, meteorological returns, and miscellaneous publications. The difficulties felt in correlating the strata of so isolated an area as New Zealand with the rocks of other districts must always be very great, and it is therefore not surprising to find that warm and animated discussions are taking place among the different geologists of the colony as to the age and relations of some of the fossiliferous deposits. We may feel assured that the solution of these questions will be fraught with important results having a direct bearing upon some of the most difficult problems that now confront geologists.

First Lessons in Geometry. For the Use of Technical, Middle, and High Schools. By B. Hanumanta Rau, B.A. (Vepery: Printed at the S.P.C.K. Press, 1888.)

THIS is a second edition, revised and enlarged, of a very good book for those who are beginning the study of geometry. Much stress is laid all through on the construction and careful drawing of the figures, and great pains seem to have been taken by the author to make his meaning as clear as possible by means of simple examples, thereby inducing the reader not to learn the propositions by heart.

The volume is well arranged as regards the order of the subjects, and teachers, as well as taught, will find in it a good amount of useful information.

LETTERS TO THE EDITOR.

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

Dissemination of Plants by Birds.

I FULLY agree with Dr. Guppy that birds may have effected much more in the distribution of plants than is generally admitted, and I think it is most desirable that his suggestion respecting the examination of the contents of the crops of birds shot at sea in high southern latitudes should be carried out. At the same time I am of opinion that his explanation of the probable origin of the vegetation of the distant islands in the South Atlantic and South Indian Oceans is insufficient to account for the endemic element, unless we suppose a former belt of vegetation in a higher latitude than these islands, which is now extinct. Assuming the existence of such a belt of vegetation at some remote period, it would not be difficult to explain the relationships between the floras of America and Australasia, as well as the presence in these islands of plants not known to exist elsewhere.

Pringlea antiscorbutica, the Kerguelen cabbage, is the most remarkable of the endemic plants. As a genus, it is as well characterized as the majority of the genera of the Cruciferæ; but, what is more significant, it has no near ally in the southern hemisphere, being most nearly related to the northern genus *Cochlearia*, differing from it more in habit of growth than in any structural peculiarity. It is one of the commonest plants in the islands, from Prince Edward Group to the Macdonald Group, and produces seeds in great abundance.

Lyallia kerguelensis is, so far as is known, confined to Kerguelen Island. It is one of the degraded types of the Caryophylleæ-Polycarpeæ, and nearly related to the Andine genus *Pycnophyllum*, and the North Mexican genus *Cerdia*.

To my mind there are other difficulties in the way of such a derivation of this insular vegetation as that suggested by Dr. Guppy, but I will not enter into them here, as it would occupy too much space. W. BOTTING HEMSLEY.

On the Reappearance of Pallas's Sand Grouse (*Syrrhaptes paradoxus*) in Europe.

THIS bird suddenly reappeared at the end of April of this year at different localities of Central Europe, not having migrated so far since 1863. A. R. Wallace, in his important work, "The Geographical Distribution of Animals," published in 1876, figured this sand grouse among the characteristic birds of Mongolia (vol. i. p. 226, plate 3), and remarks:—"A curious bird, whose native country seems to be the high plains of Northern Asia, but which often abounds near Pekin, and in 1863 astonished European ornithologists by appearing in considerable numbers in Central and Western Europe, in every part of Great Britain, and even in Ireland." Vol. ii. p. 337, the same author says in the work quoted:—"*Syrrhaptes* normally inhabits Tartary, Thibet, and Mongolia to the country around Pekin, and occasionally visits Eastern Europe. But a few years back (1863) great numbers suddenly appeared in Europe, and extended westward to the shores of the Atlantic, while some even reached Ireland and the Faroes."

Mr. Wallace, speaking here of the geographical distribution of *Syrrhaptes*, has in view the two species of the genus, viz. *S. paradoxus*, Pallas, from Tartary and Mongolia, and *S. tibetanus*, Gould, from Thibet; whereas in the following sentence, treating of the extraordinary migration, only *S. paradoxus* appears to be meant. At least I am not aware that the second species has ever been observed in Europe.

Two years later not one bird of those that immigrated in 1863 appears to have been observed again here; they may have died, or been cruelly killed, or may have returned to their native steppes. No special notice having been taken of their movements, we did not learn the reason of that uncommon migration, nor the rapidity of their wandering, nor whether they returned to Asia or not.

The reappearance of the sand grouse in large flocks, consisting apparently of innumerable individuals, now gives us the opportunity of watching their movements in detail. This should be done everywhere, and for this reason I communicate the following notes, comprising all that I have learned till to-day about it. I am sure that many more observations will have been made in these days, and perhaps those who can add something to the following list will do so through the columns of NATURE. Observers should especially try to find out whether there are specimens of *S. tibetanus* among them.

April 21, Plock, Poland. On the same day specimens on the River Pilica, near Radom, and in the market of Warsaw, Poland.
,, 24, at 5 p.m., near Pirna, Saxony.
,, 25–26, in the night, near Leipzig, Saxony.
,, 26, Kalisch, Poland.
,, 27, 3 p.m., near Grossenhain, Saxony; on the same day several flocks there.
,, 27, 4 p.m., near Pirna, Saxony.
,, 27, Brandenburg, Prussia.
,, 27, Elbing, Prussia.
,, 27, near Leipzig, Saxony.
,, 28, near Leipzig, Saxony.
,, 28, Kuchelberg, Silesia.
,, 28, Czerwinsk, Poland.
,, 28, Warscha, Poland.
,, 29, Cernowitz, Bohemia.
On the last days of April near Görgémy, Transylvania, and near Königstein, Saxony.
May 1, near Grossenhain, Saxony.
,, 1, Liobschütz, Saxony.
,, 1, Niederfaulbrück, Silesia.
,, 2, Ratzeburg, Holstein.
,, 2–3, in the night, near Grossenhain, Saxony.
,, 3, near Grossenhain, Saxony.
,, 3, near Bautzen, Saxony.
,, 3, near Schneeberg, Saxony.
,, 3, near Friedeberg, Silesia.
,, 4, near Grossenhain, Saxony; several flocks.

May 5, 4 a.m., near Grossenhain, Saxony.
,, 5, Island of Rügen, on the Baltic.
,, 6, near Freiberg, Saxony.
,, 6, near Königstein, Saxony.
,, 6, near Rendsburg, Holstein.
,, 7, Reichenau, Saxony.
,, 7, near Soldin, Brandenburg, Prussia.
,, 7, Palczyn, Posen, Prussia.
,, 7, near Leipzig, Saxony.

A. B. MEYER.

Royal Zoological Museum, Dresden, May 12.

"Coral Formations."

IN a recent paper read before the Royal Society of Edinburgh, I have pointed out the importance of taking into consideration the molecular condition of carbonate of lime in relation to its solubility in sea-water.

The (tabulated) results of an exhaustive series of tests (see NATURE, vol. xxxvii. p 605) show in a striking manner this difference between the crystalline (or massive) and the amorphous conditions of that body.

In Table II. the amount of carbonate of lime taken up by sea-water from decomposing shell-fish is shown to be very great, the clear newly filtered solution giving 0·384 grammes per litre (other determinations since made giving still higher results); this is due no doubt to the formation of carbonic acid, the result of the oxidation of the organic matter in the putrefying mass.

The clear (foul-smelling) liquid on standing exposed to the air rapidly decomposes, ammoniacal salts being formed; and a great portion of the amorphous carbonate of lime which was dissolved during the first stages of putrefaction is thrown out of solution and deposited in a crystalline and practically nearly insoluble form.

This may be due to the loss of carbonic acid, or its combination with ammonia, produced during decomposition of nitrogenous organic matter; or to the well-known action certain salts of ammonia (especially the carbonate) exert in degrading the solubility of carbonate of lime in water; but the result so produced, I think, meets all the objections Mr. T. Mellard Reade brings forward against the solution theory, which is Dr. Murray's explanation of the formation of coral lagoons.

Again, when a clear saturated solution of amorphous carbonate of lime in sea-water (see Table II., *a* and *b*) is allowed to stand for a few hours at ordinary temperatures, the solution becomes turbid and ultimately throws out in a crystalline condition a considerable proportion of the carbonate of lime it held in solution.

Dr. Murray, in a paper on "Structure, Origin, and Distribution of Coral Reefs, &c.," read before the Royal Institution, London, on March 16, refers to this change of condition as follows:—

"The whole of a coral reef is permeated with sea-water like a sponge; as this sea-water is but slowly changed in the interior parts it becomes saturated, and a deposition of crystalline carbonate of lime frequently takes place among the interstices of the corals and coral debris."

These facts seem to me quite sufficient to account for the formation of coral lagoons by the more rapid solution of the amorphous form of carbonate of lime, found in dead and decomposing corals. At the same time other deposits are preserved from wholesale solution by the change in the molecular condition which carbonate of lime undergoes,—always the after result of solution.

I need not here refer to other influences at work in maintaining the balance of absorption and secretion of lime salts in the ocean, because I consider the difference in solubility of various forms which carbonate of lime assumes equally accounts for the formation of lagoons and the preservation of coral reefs and shell beds or banks.

ROBERT IRVINE.

Royston, Granton, Edinburgh, May 14.

Aurora Borealis.

THE aurora borealis was visible here on Sunday night, May 6. We have difficulty in identifying it in this neighbourhood without spectroscopic aid, because the lights of Liverpool and its suburbs extend over the eastern horizon, and the sky to the north-east and north is filled with a glow from Bootle and Birkenhead, these several lights often giving, with clouds of varying height, effects resembling northern lights.

On Sunday night, at 1.30, the brightness in the north-western sky was not to be mistaken; and shortly before 2 o'clock a curved bluish-white beam—two brilliant sides inclosing a still brighter rounded angle of about 70°—shot up from the west, the apex coming first, and attaining a height of 60°, the sides there being about ½° broad; the extremities of the sides, 1° broad, touching the horizon in the north-north-west and south-south-east. This beautiful beam remained a few seconds, then went as it came, the apex disappearing last. The general phenomenon seemed to increase in brightness, but subsequent observations show that it could not then be satisfactorily distinguished from the early dawn and reflected lights.

L. J. H.

Rock Ferry, May 11.

Weight and Mass.

THE *weight* of a body is the quantity which is measured out by the operation of *weighing*. To *weigh* a body it is placed in one of the scales of a balance, and equilibrated by standard *weights* formed of lumps of metal called pounds, hundredweights, tons, &c., or kilogrammes in the metric system; and the sum of these weights is (*pace* Mr. R. E. Baynes) called the *weight* of the body.

The mathematician may now call this quantity, if he likes, the *mass* of the body; but the world at large uses the word *weight*, with the advantage of having the corresponding verb "to weigh," which the substantive "mass" does not possess: we are not yet accustomed to speak of a body "massing" 100 tons. The numerous circumlocutions to express one single idea in Prof. MacGregor's examples arise from the want of the verb "to mass."

The "extraordinary and peculiar" language is, then, that of the elementary text-books of Mechanics, which tell us that the *weight* of a body is the *force* with which it is attracted by the earth (Lodge, "Elementary Mechanics," p. 66).

It is true, as Sir Philip Magnus points out in his "Mechanics," § 46, that the word *weight* is made to do double duty, sometimes standing for *force* and sometimes for *mass*; and that these two significations must be carefully distinguished.

But the "ordinary he or she" would no more accept the "pull or heft required to lift a body" as a correct measure of the weight, than the Red Indian of to-day would accept the weight of the Hudson Bay factor's fist as one pound.

The theorist must then exert his ingenuity to invent a new word to express the *force* idea, to associate with the word *mass*, already invented by him; but to attempt to restrict the meaning of the word *weight* in a manner not usual in ordinary language can only lead to confusion. In any engineering, chemical, or ordinary journal we shall always find *weight* used in the sense of *mass*, as defined in the text-books of elementary dynamics; and even in these treatises we shall find in the parts on Statics the word *weight* used in its ordinary sense. For instance, on p. 196 of Dr. Lodge's "Mechanics," we find, Ex. 10, "A mass of wood (sp. gr. 0·6) is counterpoised by 105 correct grammes of iron (sp. gr. 7·5); find the mass of the wood (or its true weight *in vacuo*)."

Sometimes it is not possible to employ the balance to estimate the weight (or mass) of a body; as, for instance, when the chemist evolves a certain *weight* of hydrogen in a chemical combination, when the artillerist speaks of a gun *weighing* 110 tons, and when the astronomer "*weighs* the earth,"—in such cases the weight or mass, whichever it is called, is calculated as the product of the volume and the density: determine for example the weight of 1000 cubic feet of steel. The weight W (or mass M) is then found theoretically from the formula W (or M) = ρV, but really practically from the formula W = 62·4sV, where W or M is given in pounds, when V is given in cubic feet, and ρ is then called the density, and s the specific gravity (the *density relative to water*), and it is the specific gravity for which tables are given; but in the metric system W (or M) = ρV = sV, where W or M is given in grammes, when V is given in cubic centimetres, and the density ρ, and the specific gravity s, are then the same. But turn to the ordinary text-books, and we find these confusing equations—

$$W = Mg = g\rho V = sV,$$

where W is called the weight, M the mass, ρ the density, and s the specific gravity, followed often by a series of absurd examples on changes of units.

These relations are derived from the equation $W = Mg$, the source of all confusion in Dynamics, and it is gratifying to find from Prof. Mendenhall that a crusade against it is in progress in America.

It is needless to repeat here the objections against this equation, but it is easy to see how it arose.

Mathematicians now measure mass in pounds, so that the mass of a body is the number of pounds of matter in the body (*the weight* in the vernacular); and the equation $W = Mg$ means that the weight of M pounds is Mg poundals, according to their definition that "the weight of a body is the force with which it is attracted by the earth"; but this was not so originally.

Early writers on Dynamics, before Gauss invented the absolute unit of force, always employed the statical gravitational unit, and then if a weight of W pounds was acted on by a force of P pounds, the equation of linear motion was $\frac{W}{g}\frac{d^2x}{dt^2} = P$.

To avoid the necessity of writing and printing $\frac{W}{g}$, it was replaced by the letter M, and called the *mass*; the unit of mass being thus g pounds. But now the invariable quantity, the mass, is measured in terms of a variable unit, while the variable unit of force is the attraction of the earth on a 1-pound weight.

Although such words as "a force equal to the weight of the mass of 10 pound weights" do not occur in Prof. MacGregor's book, they are strictly derived from his own definitions; and so is the following, "the weight of 32 pound weights on the Earth is at the surface of Jupiter a force of 71 pounds' weight." I bring forward these illustrations to show that the fine distinction between "10 pound weights" and "10 pounds' weight" is not workable; and to show that the addition of the word *weight* to *pounds* does *not* convey the idea of *force* in ordinary language, and is not clear even in the language of the precisionists.

Nor can the equation $p = gpz$ in Hydrostatics be defended, as capable of expressing a pressure in pounds on the square foot (or more commonly on the square inch); for, if Prof. MacGregor applies this equation to a numerical example, he will find himself dividing by g in one operation, only to multiply by g in the next. The unreal character of these changes of units is apparent when we come to numerical examples; the defect of our dynamical teaching is that the student is so rarely brought before a practical numerical illustration on a large scale.

The rest of Prof. MacGregor's remarks I must answer very briefly, for fear of occupying too much space.

The *kilometre* was designed to be the centesimal minute of latitude, to replace the *geographical or sea mile*, which is the sexagesimal minute of latitude; the quadrant of the earth is therefore 10,000 kilometres, or 10^9 centimetres, and $90 \times 60 = 5400$ geographical or sea miles.

The cosmopolitan unit of speed at sea is the *knot*, which is a *velocity* of one geographical mile an hour; if 10 knots, spaced about 50 feet apart, pass over the taffrail in half a minute, the vessel is said to be going 10 knots. All civilized nations measure speed at sea in *knots*, in French *nœuds*, German *knoten*, Dutch *knoopen*, Italian *nodi*, Spanish *nudos*, &c. In precision *knots an hour* is on a par with *atmospheres per square inch*.

It is unfortunate that we have not yet reached uniformity in the use of the words *elongation* and *extension*. The French treatises, and our practical writers, Rankine, Unwin, &c., use *tension* and *extension*, *pressure* and *compression*, to denote simple longitudinal stresses and their corresponding strains; the ratio of *tension* to *extension*, or of *pressure* to *compression*, being the *modulus of elasticity*. This variation in terminology must be settled by some arbitrator, say Prof. Karl Pearson.

In conclusion, speaking on behalf of engineers and practical men, I beg to say that the treatment of the subjects of weight, mass, and force, in our ordinary text-books of Mechanics, is by no means clear or satisfactory, and requires careful revision.

Woolwich, May 4. A. G. GREENHILL.

Density and Specific Gravity.

IF Mr. Cumming's definition of *specific gravity* be accepted, the confusion, already serious enough, in the minds of beginners in physics between mass and weight will be much increased. Surely the best and clearest definitions of *density* and *specific gravity* are those given in Glazebrook and Shaw's "Practical Physics," p. 105. These make *density* a quantity having dimensions in mass and space, and *specific gravity* a pure number. There are many advantages in defining *specific gravity* as a ratio, and not the least among them is that the numbers in tables of specific gravities are independent of any system of units, while in a table of quantities having dimensions the numbers given depend on the system of units used. Thus the *density* of platinum would have to be given in an English table as 1343·75 pounds, or in a metrical table as 21·5 grammes. Again we should lose the very useful analogies between the definitions of *density* and *thermal capacity* and *specific gravity* and *specific heat*, to which I drew attention in a letter to NATURE, vol. xxxiii. p. 391.

Prof. Carey Foster seems to think it would be useful to have a table telling us the force with which unit volume of any body is attracted towards the earth, and that this should be called a table of *absolute* specific gravities. But I fail to see any advantage in this, for it is adding a totally new definition to be remembered, and one which would certainly create confusion in a beginner's mind; and the objection applies to this, that the numbers given would depend on the system of units used, to say nothing of the value of gravity at the place for which the table was calculated. Supposing even that the latter were ignored, it is not more troublesome to convert, with the aid of the known weight of unit volume of water, the specific gravity of any material into the weight of a given volume of it, than to convert a number given in one system of units into the number representing it in the system we may happen to be using.

If we are to take Mr. Cumming's definition as he expresses it, I would submit that a pound avoirdupois is a quantity of matter and not a force; and to say that the specific gravity of water is 62·5 *pounds avoirdupois* is simply taking the density of water and calling it specific gravity. *Pace* Mr. Greenhill and the engineers, it is hard enough to eradicate the notion that the quantity of stuff in a body and the force with which it is pulled towards the earth are one and the same without having the task made more difficult by our definitions.

50 City Road, E.C. HARRY M. ELDER.

The Cornish Blown Sands.

IN the description of the raised sea beach at Newquay, which Sir Henry De la Beche has given in his "Survey of Devon and Cornwall," he makes no reference to a curious feature observable in a part of the beach, and to which I should like to direct attention, with a view to obtaining some explanation of the cause of its formation. As far as I know, the appearance is only to be found at one spot, on what is known as Little Fistrel, to the westward of the town. It consists of a number of *cylinders* of indurated sand, separated from each other by thin walls, often only an inch or two thick, and forming the base of the cliff or bank, which is perhaps 10 or 15 feet high at the place. These cylinders rest upon a bed of rock (argillaceous slate?), which runs down from the bottom of the bank to the sea in a series of shelving ledges. The cylinders, which are locally known as *Pixie Holes*, weather out from the bank, but unfortunately few or none of them are now to be seen in a perfect state, their walls having been broken down by people scrambling up the bank, and also by quarrying operations, which I learn have recently been carried on close by. I am told that formerly the cylinders were very perfect, and often of large size; I myself have seen them, fifteen or sixteen years ago, standing up like little towers along the base of the cliff, and I have often sheltered myself perfectly from a shower of rain by standing in one and covering myself with my umbrella. I have recently had a photograph taken of the best group to be found, and a copy of this, together with a piece of the wall of one of the cylinders, is with Mr. Goodchild, of the Geological Survey, Jermyn Street, who will show it to anyone interested in the matter; the size of one of the cylinders photographed is 51 inches deep and 28½ inches in diameter.

R. H. CURTIS.

[The sand in question is well known to geologists as an example of blown sand agglutinated into a compact stone by carbonate of lime derived from the solution of calcareous organisms, which here on the surface consist largely of land-snails. The tubular cavities are no doubt due to the removal of the calcareous cement by percolating water, and are thus of the same nature as the pot-holes in chalk, and the cavernous holes and tunnels in hard limestone.—ED.]

Self-Induction in Iron Conductors.

MR. SUMPNER quotes (NATURE, May 10, p. 30), in support of the idea that iron conductors may have less self-induction than copper ones of the same dimensions, a suggestion of mine that

for very feeble magnetizing forces, iron may be diamagnetic That suggestion was confessedly speculative ; its basis was the notion that the Weber-Ampère electro-magnetic molecules suffer something akin to static friction when the process of magnetization attempts to bring them into alignment. Since it was thrown out, Lord Rayleigh has proved that the susceptibility of iron is constant, and has a fairly high positive value, for magnetic forces ranging from 0·03 to 0·04 C.G.S. downwards. Below the lowest force he has investigated, it is still conceivable that there may be a change in the susceptibility, but it is extremely improbable. In all likelihood, Lord Rayleigh's straight line in the curve of B and H or of I and H extends back to the origin. This at least is certain, that if there is any region at the beginning of magnetization within which the permeability is less than unity, or even no more than unity, it must be so infinitesimally narrow that its existence has no practical interest. For such magnetic forces as act on a lightning-conductor when a discharge is passing, iron is, beyond any question, strongly paramagnetic, and the self-induction with the iron conductor consequently greater than with the copper. J. A. EWING.

Dundee, May 11.

Notes on the Reproduction of Rudimentary Toes in Greyhounds.

AT the present writing, I have under my observation a fine male, light clay-coloured, smooth haired greyhound, which at certain intervals well illustrates the reproduction of the rudimentary digits of its feet, after they have been accidentally amputated. To-day this dog has growing on the inner aspects of both its fore and hind feet, and situated some 9 centimetres above the soles, on each limb, a strong rudimentary toe. If we choose, say, this toe on the right hind foot as an example of them all, we find it to be loosely attached, rather more than a centimetre long to the base of the claw, which latter is large and strong, powerfully curved, and fully as big as any of the claws on the foot phalanges. I further find that this toe has a well-marked pad on its under side, but careful examination fails to detect any bone in the proximal joint, from which I also infer that the ungual phalanx likewise lacks one, though this is not so easily determined without cutting through the horny theca forming the claw. About four months ago this dog was coursing hares over the prairie of this region, which chances to be overgrown with a stiff growth of sage-brush, about 2 feet to 3 feet high. The wiry stems of this plant, as the dog bounded among them, snipped off all four of these rudimentary digits, close down to the leg in each case, as nicely as though it had been done with a knife, leaving linear wounds about half a centimetre long. Now, instead of the lips of these wounds healing across, as one would naturally suppose they would, they immediately form the basis, in each case, for the growth of another rudimentary clawed toe, fully as perfect as the one which originally sprang from the same site. These subsequent growths take about three months to attain their full size again, when they are very likely to be removed by a similar process, and once more grow out as before, and so on indefinitely.

From several points of view, this case, as occurring in a vertebrate so high in the scale as a dog, has interested me very much indeed, and I further find that it is no uncommon thing to meet with greyhounds that have never possessed these rudimentary pollices and halluces, and it is fair to presume that in this race they are gradually disappearing.

R. W. SHUFELDT.

Fort Wingate, New Mexico, March 28.

Dreams.

IN discussing the differences between dreams and real life, Schopenhauer expresses the opinion that the distinction between these two activities of our representative power consists merely in the possibility of the representations of real life being connected in an uninterrupted successive series, while dreams resemble the separate pages of a book torn asunder, and put together again in complete confusion. Some personal observations of my own do not quite agree with this view. I have watched my dreams for some years, and have remarked that many of them are connected with one another in separate series. It happens to me very often that my dreams consist of a series of representations logically developed (although sometimes the logic is absurd) from other series of representations dreamed long before. It would be interesting to know if anyone else has observed anything of this kind. A. BIALOVESKI.

Oostkamenogorsk, Western Siberia, April 6.

"Antagonism."

MR. COLLINS (NATURE, May 3, p. 7) claims that Mr. Herbert Spencer anticipated Sir Wm. Grove and Prof. Huxley in the expression of the idea of *antagonism*. I think that priority to all of them must be given to the author of Ecclesiasticus in the Apocrypha, who says (chap. xlii., verse 24), "All things are double, one against the other. He hath made nothing imperfect." THOMAS WOODS.

Parsonstown, May 13.

SUGGESTIONS ON THE CLASSIFICATION OF THE VARIOUS SPECIES OF HEAVENLY BODIES.[1]

V.

Classification into Species.

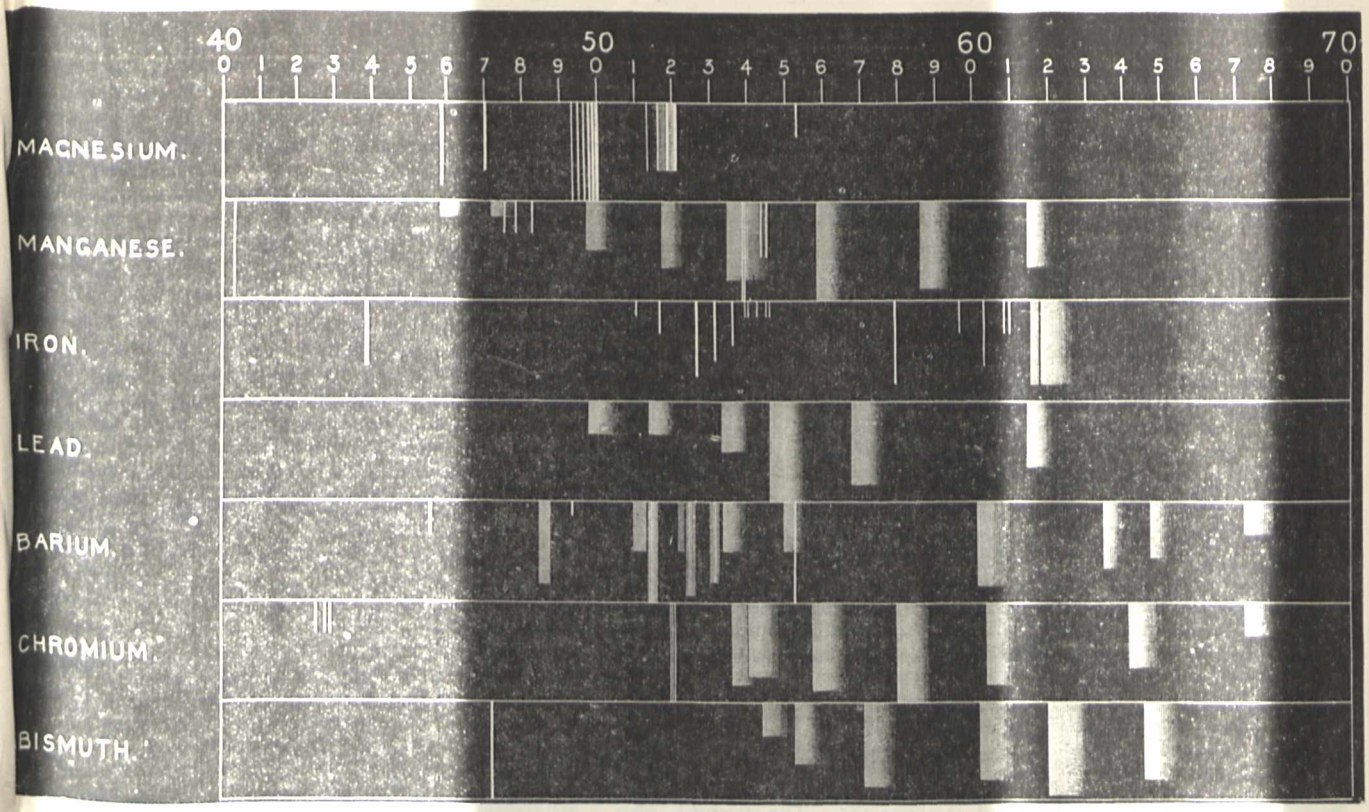
WE are now in a position to apply all that has gone before in a summarized statement of the various spectral changes, including those connected with hydrogen, which take place not only in these objects studied by Dunér, but in those others to which I have referred as forming the true beginning of the group.

The following statement, however, must not be taken as anything else than a first approximation to the real criteria of specific differences. I am convinced that further thought is required on it, and that such further thought will be well repaid.

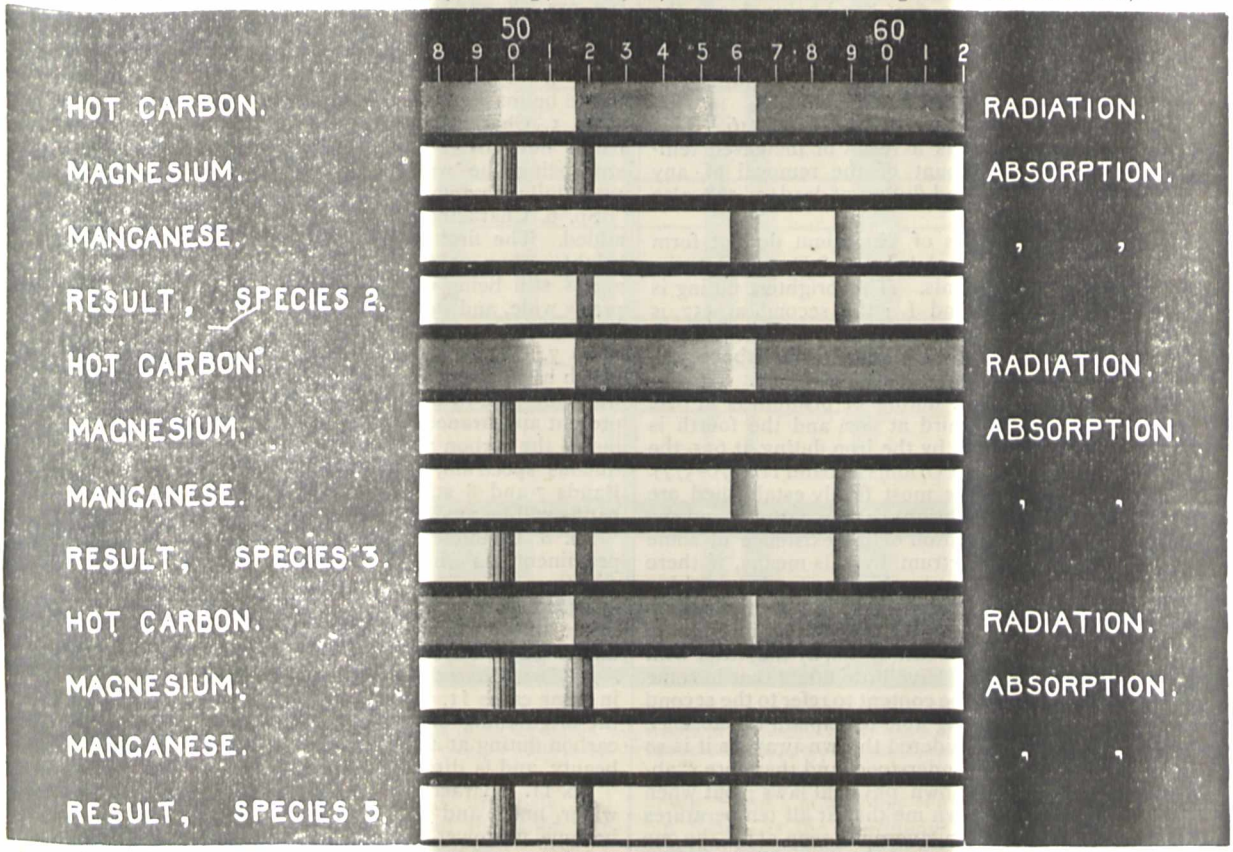
The Sequence of the Various Bands in the Spectra of the Elements indicated by Bodies of the Group.

In comparing the spectrum of an element which has been mapped in the laboratory with the absorption bands in the spectrum of a "star," we need only consider those bands and flutings which stand out prominently and are the first to flash out when there is only a small quantity present. Thus, in the flame spectrum of barium there is an almost continuous background of flutings with a few brighter bands in the green, and it is only important to consider the *bands*, as the flutings would mainly produce a general dimming of the continuous spectrum. In order to show at a glance what portions of the spectrum of an element it is most important for us to consider in this discussion, I have reconstructed the map of low-temperature spectra which I gave in my previous paper, with reference to those elements which are indicated in the spectra of bodies of Group II. Five orders of intensities are represented, the longest lines, flutings, or bands being the brightest. The lines, flutings, or bands in the lowest horizon, in the case of each element, are those which are seen at the lowest temperature, and which are the first to appear when only a small quantity of substance is present. Those in the upper horizons are the faintest, and are only seen when the temperature is increased, or a considerable amount of the substance is volatilized. The map shows that if there are any indications of magnesium, for instance, in bodies of low temperatures, the fluting at 500 will be seen, possibly without the other flutings or lines. The first indications of manganese will be the fluting at 558, and so on. Again, on account of the masking effect of the spectrum of one element upon that of another, we may sometimes have an element indicated in a star spectrum, not by the brightest band or fluting in its spectrum, but by the second or even third in brightness ; this, of course, only occurs when the darkest band falls on one of the brightest flutings of

[1] The Bakerian Lecture, delivered at the Royal Society on April 12, by J. Norman Lockyer, F.R.S. Continued from p. 35.



...cen in the spectra of the elements which are indicated in bodies of Group II. The map is intended ...
...nds, and flutings, the lines, &c., seen in the lowest horizon being those seen at the lowest tempera...



...in width of the flutings of carbon upon the integrated spectra of carbon radiation, and magn...
...fferent species of bodies of Group II. The carbon radiation alone would give bright bands, ...
...t if the bright and dark bands fall in the same regions of the spectrum, the result will be ...
...ding to the relative quantities of radiating and absorbing substances present. Thus, in spec...
...arbon fluting at 517, but as the quantity of carbon diminishes, it appears as an absorption band.

carbon, or upon a dark band in the spectrum of some other element. In the former case the dark band will be cancelled or masked; in the latter case the two absorptions will be added together, and form a darker band of a different shape.

The Question of Masking.

If we consider the masking effects of the bright carbon flutings upon the absorption spectrum of each of the elements which, according to the results obtained, enter into the formation of Dunér's bands, we have the following as the main results:—

Magnesium.—There are two flutings of magnesium to be considered, the brightest at 500 and the other at 5201. In the earlier stages of Dunér's stars only the fainter one at 5201 is visible, but the absence of the brightest at 500 is accounted for by the masking effect of the bright carbon fluting starting at 517. As the carbon fades, the 517 fluting narrows and the absorption of magnesium 500 becomes evident.

Manganese.—The two chief flutings of manganese are at 558 and 586, the former being the brightest fluting in the spectrum. The *second* fluting is seen in all of Dunér's stars. The first fluting, 558, however, does not appear as an absorption fluting until the radiation fluting of carbon starting at 564 has narrowed sufficiently to unmask it. It is thus easy to understand why, in some stars, there should be the second fluting of manganese without the first.

Barium.—The spectrum of barium consists of a set of flutings extending the whole length of the spectrum, and standing out on this as a background are three bright bands; the brightest band is at 515, the second is at 525, and the third, a broader band, is about 485. The *second* band is recorded as an absorption band in Dunér's stars, the apparent absence of the *first* band being due to the masking effect of the bright carbon at 517. The third band at 485 probably forms a portion of band 9. A fourth band, at 533, and the three brightest flutings at 602, 635, and 648 are also seen in *a* Orionis.

Lead.—The brightest fluting of lead is at 546. This first appears in species 5, as a result of increased temperature, and not on account of the removal of any previous mask. The second fluting of lead, at 568, also appears in two cases.

Chromium.—The flutings of chromium do not form portions of the ten principal bands of Dunér, but the brightest are seen in *a* Orionis. The brightest fluting is at 580, and this forms band I.; the second, at 557, is masked by the manganese fluting at 558, and the third at 536 is seen as line 2. The chromium triplet about 520, which is visible in the bunsen, is seen as line 3.

Bismuth.—The brightest fluting of bismuth is at 620, the second is at 571, the third at 602, and the fourth is at 646. The first is masked by the iron fluting at 615, the second is probably seen in *a* Orionis as band II. (570-577).

The points I consider as most firmly established are the masking effects of the bright carbon flutings and the possibility of the demonstration of the existence of some of the flutings in the spectrum by this means, if there were no other. There are two chief cases, the masking of the "nebula" fluting 500 by the bright carbon fluting with its brightest, less refrangible edge at 517, and that of the strongest fluting of Mn = Mn(1) 558, by the other with its brightest edge at 564. I have little doubt that in some quarters my anxiety not to be content to refer to the second fluting of Mn without being able to explain the absence of the first one, will be considered thrown away, as it is so easy to ascribe any non-understood and therefore "abnormal" spectrum to unknown physical laws; but when a special research had shown me that at all temperatures at which the flutings of manganese are seen at all, the one at 558 retained its supremacy, I felt myself quite justified in ascribing its absence in species 1-4 to the cause I have assigned, the more especially as the Mg fluting which is visible even in the nebula followed suit.

The Characteristics of the Various Species.

I append the following remarks and references to the number of the bodies in Dunér's catalogue, in which the specific differences come out most strongly, to the tabular statement. I also refer to some difficulties.

Sp. 1. The characteristic here is the almost cometary condition. All three bright carbon flutings generally seen in comets are visible; 474 standing out beyond the end of the dull blue continuous spectrum of the meteorites, 516 masking Mg 500, and 564 masking Mn(1) 558. The bands visible in the spectra of bodies belonging to this species will therefore be Mn(2) 586, and Mg(2) 521; band 9 will be so wide and pale that it would most likely escape detection. It is very doubtful whether any of the bodies the spectra of which have hitherto been recorded can be classed in this species, but laboratory work assuredly points to their existence; it will therefore be extremely interesting if future observations result in their discovery. It is possible, however, that No. 150 of Dunér's list belongs to this species, but the details are insufficient to say with certainty. His description is as follows:—"150. Il me parait y avoir une bande étroite dans le rouge, et une plus large dans le vert" (p. 55).

Sp. 2. Characteristics: appearance of Fe. The number of bands now visible is three—namely, 2, 3, and 7. The iron comes out as a result of the increased temperature. Mg(1) and Mn(1) are still masked by the bright carbon flutings, and there is still insufficient luminosity to make the apparent absorption band 9 dark enough to be noticed.

Sp. 3. Characteristics: appearance of Mg 500, which has previously been masked by the carbon bright fluting 517. 8 and 7 are now the darkest bands in the spectrum, 37.

Sp. 4. Characteristics: appearance of Pb(1) 546, *i.e.* band 5. This, if present in the earlier species at all, would be masked by the bright carbon at 564.

Sp. 5. Characteristics: Mn(1) is now unmasked. The bands now visible are 2, 3, 4, 5, 7, and 8, the two latter still being the widest and darkest, because they are essentially low-temperature phenomena.

Sp. 6. Characteristic: band 6, *i.e.* Ba(2), 525, is now added. The first band of Ba at 515 is masked by the bright carbon at 517. The bands now visible are 2-8, 7 and 8 still being widest and darkest. They will all be pretty wide, and they will be dark because the continuous spectrum will be feebly developed.

Sp. 7. Characteristics: appearance of band 9. This, which has been already specially referred to, has been too wide and pale to be observed in the earlier species. Its present appearance is due to the narrowing and brightening of the carbon at 474 and the brightening of the continuous spectrum, the result being a greater contrast. Bands 7 and 8 still retain their supremacy, but all the bands will be moderately wide and dark.

Sp. 8. Characteristics: all the bands 2-9 are more prominent, so that 7 and 8 have almost lost their supremacy.

Sp. 9. Characteristic: appearance of band 1, the origin of which has not yet been determined. All the bands are well seen, and are moderately wide and dark.

Sp. 10. Characteristics: appearance of band 10, and in some cases 11. These become visible on account of the brightening of the carbon B fluting and the hydrocarbon fluting at 431. The spectrum is now at its greatest beauty, and is discontinuous.

Sp. 11. Characteristics: the bands are now becoming wider, and 2 and 3 are gaining in supremacy; 7 and 8 become narrower on account of the increased temperature. 1 and 10 are only occasionally seen in this species.

Sp. 12. Characteristics: with the expansion of the continuous spectrum towards the blue, band 9 becomes very narrow, and cannot be observed with certainty. The other bands, with the exception of 7 and 8, are becoming wider and paler, while 2 and 3 still gain in supremacy.

Sp. 13. Characteristics: 9 has now entirely disappeared, 2 and 3 still retaining their supremacy.

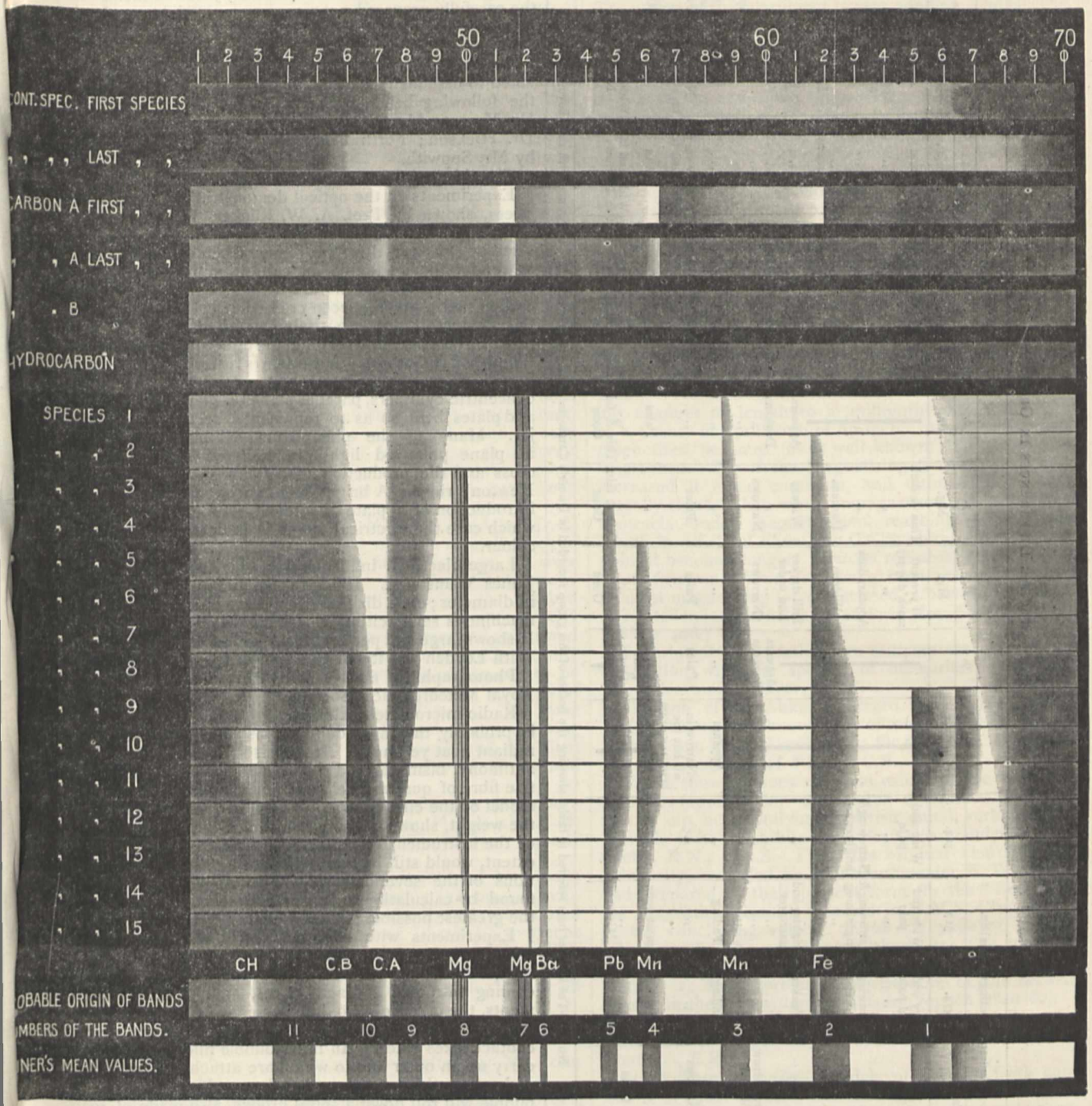


FIG. 10.—Map showing the spectra of the various species of the bodies of Group II., and the probable origin of the bands. The carbon flutings are widest in the first species, and gradually narrow until, in the last species, only a trace of 517 remains. The length of the continuous spectrum gradually increases as the carbon flutings narrow. The carbon B^1 fluting, and the hydrocarbon fluting are only seen in species 8 to 12.

Sp. 14. Characteristics: all the bands are pale and narrow; 2 and 3 will still be darkest, but the difference will not be so great as in the species preceding.

Sp. 15. Characteristics: in ordinary members of this group, 2 and 3 now alone remain visible: they are wide, but feeble, as the continuous spectrum which has been rapidly developing during the last changes is now strong.

TABLE A.—Specific Differences in Group II.

Species	Radiation flutings of carbon.					Absorption flutings.											Whether hydrogen lines.
	Hydrocarbon, 431.	Carbon B, 461.	474.	517.	564.	10.	9.	8. Mg.	7. Mg.	6. Ba.	5. Pb(1).	4. Mn(1).	3. Mn(2).	2. Fe.	1.	
1			Very wide and pale	Wide and pale	Wide and pale			If present mask'd by 517	Thin & dark			Present but mask'd by 564	Thin and pale	Absent		Yes
2			"	"	"			"	"			"	"	Appears thin and pale		No
3			Narrowing & brightening	Narrowing & brightening	Narrowing & brightening			Appears dark	"			"	"	"		No
4			"	"	Very narrow			Widens	Darkens		Appears dark	Unmasked dark	Darkens	Darkens		No
5			"	"				"	"		"	"	"	"		No
6			Weaker	Brighter and narrower	"			Still darker and wider	Widens	Appears	"	"	"	"		No
7	Very narrow	Very narrow	"	"	"		Appears	"	"	Darkens	Widens	Widens	Widens	Widens	Appears	No
8	Widens	Widens	"	"	"		Darkens	Narrows	Narrows	"	"	"	"	"	Still present	No
9			"	"	"		Strong	"	"	"	"	"	"	"	Fading	Yes, bright and variable (possibly dark in α Orionis)
10	"	"	Fading	Fading	"	Appears	"	"	"	"	"	Pales	Now very broad and faint	Now very broad and faint		?
11	Narrows	Narrows	"	"	"	Narrow in all but the brightest stars	Pales	Pales	Pales	"	Pales					
12	Gone	"	"	Almost gone	"	Disappears	Almost gone	"	"	Pales	"	"	Pales	Pales	Gone	No
13		Gone	Gone	? Gone	Gone		Gone	"	Thin & faint	Thin & faint	Thin & faint	Thin & faint	Wide and faint	Wide and faint		No
14								"	Gone	Gone	Gone	Gone	Narrows	Narrows		No
15								Gone					"	"		No

Note.—The lecturer here referred to tables showing the bodies of this group recorded in Dunér's Catalogue arranged in species, in accordance with the above scheme.

(*To be continued.*)

THE ROYAL SOCIETY CONVERSAZIONE.

THE first *conversazione* of the season was held on May 9, and was very numerously attended. More pains than ever seemed to have been bestowed on the arrangements, and the results entirely justified them. As the carefully prepared programme covers eighteen closely printed pages, we can only give a very summary account of the most important demonstrations and exhibits.

Following recent precedents, the meeting-room was devoted to demonstrations by means of the electric lantern, the following being given: image of electric spark, by Dr. Marcet; Mr. Poulton's teeth of Ornithorhynchus, by Dr. Hickson; Forth Bridge, by Mr. Baker; collieries, by Mr. Sopwith.

The chief exhibits in the other rooms were as follow:—

Experiments on the optical demonstration of electrical stress, shown by Prof. A. W. Rücker, F.R.S., and Mr. C. V. Boys. These experiments are similar to those devised by Dr. Kerr, the arrangements being modified so as to render them suitable for exhibition in public. Conductors of various forms are immersed in bisulphide of carbon and placed between crossed Nicol prisms. When the conductors are oppositely electrified the medium is thrown into a state of stress, and the light which had been extinguished by the analyzing prism is restored. The various forms of conductors employed are—parallel cylinders, concentric cylinders, parallel planes, a plane and cylinder, and plates bent so as to represent a section of a Leyden jar. Many of the phenomena exhibited by crystals in plane polarized light are imitated—*e.g.* the black cross and the production of colours similar to those in Newton's rings. A bright field can be maintained by the introduction of a plate of selenite between the Nicols, in which case the electrical stress is indicated by change of colour.

Large electrical influence machine, exhibited by Mr. James Wimshurst. It has twelve disks of 2 feet 6 inches in diameter; each disk carries sixteen metal sectors. The machine is self-exciting in any condition of atmosphere. It shows large and perfect brush discharge at its terminals. With Leyden jars it will give sparks 13⅜ inches in length.

Photographs of flashes of lightning, exhibited by the Royal Meteorological Society.

Radio-micrometer, exhibited by Mr. C. V. Boys. This is probably the most delicate instrument for measuring radiant heat yet made. It consists of a circuit made of antimony, bismuth, and copper hung by an exceedingly fine fibre of quartz in a strong magnetic field. A scale model of the circuit, twenty times the size or 8000 times the weight, shows the construction of the suspended part of the instrument. The fibre, if magnified to the same extent, would still be finer than spun glass. The proportions of the several parts are those which have been found by calculation (confirmed by experiment) to give the greatest possible delicacy.

Experiments with soap-bubbles, also shown by Mr. Boys. These experiments are arranged to show chiefly the power of an air-film to prevent two bubbles from coming into real contact. Thus, among other experiments, the outer of two bubbles may be pulled out until it squeezes the inner one into a long oval, but no real contact takes place. An inner bubble filled with gas will carry up an outer one to which are attached a wire ring and other things without really touching it at all. A bubble will roll down a spiral groove, also made of soap-film, or jump one or two steps at a time down a spiral staircase made of soap-film, without touching the spiral film or being injured in the least. Some of the experiments show the effects of diffusion, of vibration, of magnetism, or of electricity upon bubbles or groups of bubbles.

Maps and diagrams illustrative of the recent work of the Geological Survey in the North-West Highlands, exhibited by the Director-General of H.M. Geological

Survey. The maps, on the scale of 6 inches to a mile, show the remarkable geological structure of the west of Sutherland. A series of enormous dislocations runs in a southerly direction from the mouth of Loch Eriboll to Skye. By these disruptions the most ancient rocks have been torn up from great depths, and have been launched bodily westwards, sometimes for several miles. The displaced masses now rest upon other shifted portions or upon wholly undisturbed rocks, and the extraordinary structure is presented of vertical and highly inclined strata, with their unconformable junctions standing upon gently inclined and much younger rocks. The diagrams are taken across some of the more typical parts of the district, and give some idea of the physical problems presented by this region, which undoubtedly exhibits the most complicated geological structure in the British Isles.

Sections and specimens illustrating the recent borings in the Delta of the Nile, exhibited by Prof. J. W. Judd, F.R.S., on behalf of the Delta Committee. The whole of the samples obtained in these borings have now reached the Royal Society, and the examination of the materials reveals some facts of great geological interest. The alterations and mixtures of blown sand and Nile alluvium were found to continue down to the depth of 121 feet from the surface and 95 feet below the level of the Mediterranean. At that depth a remarkable change in the deposits took place, and beds of gravel containing both pebbles and subangular fragments of quartzite, chert, compact limestone, with some metamorphic and igneous rocks, were found; and similar beds occur at intervals down to the greatest depth reached. Up to the present time no contemporaneous organic remains have been found in these deposits.

Fossil plants from Ardtun in Mull, exhibited by Mr. J. Starkie Gardner. These plants are from a small patch of limestone beneath the gravels and silts of an old river course sealed up in the great trap flows of Western Scotland. The limestone is rather below the leaf-bed found at Ardtun by the Duke of Argyll, and directly overhangs the sea, the cliffs beneath being columnar and worn into caverns. The plants were until recently believed to be Miocene, but are now recognized to be very low down in the Eocene—*vide* recent writings of Sir W. Dawson and the Marquis de Saporta. The same plants ranged over Greenland and North America during the Tertiary, perhaps not synchronously, and an allied flora seems to exist at the present day in China and Japan.

Photographs illustrating experiments in mountain-building, exhibited by Mr. Henry M. Cadell, H.M. Geological Survey of Scotland. These have already been referred to in NATURE.

Set of thermometers specially constructed by Casella for use by Mr. Symons in determining the present temperature of the mineral springs in the Pyrenees, exhibited by Mr. G. J. Symons, F.R.S.; and Immisch's avitreous thermometer, constructed for the above investigation. This thermometer is absolutely perfect, its verification at Kew, before and after its use in the Pyrenees, being 0°·0 at all points from 50° to 130°.

An apparatus for determining the hardness of metals or other substances, exhibited by Mr. Thomas Turner.

Robertson's writing telegraph, exhibited by Mr. John M. Richards.

A Coulomb-meter, exhibited by Prof. George Forbes, F.R.S. This consists essentially of a conductor of iron wire in the form of a spiral, or a double ring with cross wires. Above the conductor a set of vanes is pivoted. This consists of a circular disk of mica with a hole in the centre in which is fixed a paper cone carrying at its apex a pinion with a concentric ruby cup. Round the circumference of the mica disk eight small cylinders of pith are fixed at equal distances, and eight vanes inclined at 45° to the mica disk are attached to the pith cylinders, these vanes being made of the thinnest mica. This set of vanes is supported by the ruby cup resting on a steel point fixed to the base of the instrument. The pinion engages with the first wheel of a train of wheelwork actuating the indexes, which show upon dials the number of revolutions made by the vanes. The action of the instrument is very simple. The electric current passing through the iron conductor creates heat, which sets up a convection current in the air, and this causes the vanes to rotate about the vertical axis and drive the clockwork. The number of revolutions indicated on the dials is, through a considerable range of currents, an exact indication of the number of coulombs or ampere-hours which have passedth rough the conductor. The friction of the ruby cup on the pivot determines the smallest current which can be accurately measured, and the friction of the clockwork is barely perceptible. The resistance of a meter to read from 1 ampere upwards is 0·02 ohm.

Electrical translucent balloon for flashing signals by night, invented and exhibited by Mr. Eric Stuart Bruce.

The new iridio-platinum incandescent gas-burner (Lewis and Sellon's patents), exhibited by Messrs. Johnson, Matthey, and Co.

Apparatus for measuring the changes produced by magnetization in the dimensions of rods and rings of iron and other metals, exhibited by Mr. Shelford Bidwell, F.R.S. The instrument exhibited is capable of measuring changes of length to a millionth of a millimetre or a twenty-five-millionth of an inch. An *iron* rod when magnetized becomes (as is well known) at first slightly lengthened. But if the magnetizing force is sufficiently increased it again contracts, and ultimately becomes actually shorter than when unmagnetized. A *cobalt* rod contracts under magnetization, reaching a minimum length in a field of about 500 C.G.S. units, beyond which point it becomes longer. A *nickel* rod also contracts; the limit of its contraction not having been reached with the greatest magnetizing forces yet used. *Bismuth* is slightly elongated in intense fields. (See Proc. Roy. Soc., vol. xliii., 1888, p. 406.)

Experiments illustrating low-temperature spectra, in connection with the spectra of meteorites, shown by Mr. J. Norman Lockyer, F.R.S.

Skeleton of an Akka, a Negro tribe from Central Africa, the smallest known race of men. (Height exactly 4 feet.) Sent by Dr. Emin Pasha for the British Museum, and exhibited by Prof. Flower, C.B., F.R.S.

Charts showing lines of equal values of the magnetic elements (epoch 1880)—declination or variation, inclination or dip, horizontal force (British units), vertical force (British units)—exhibited by Staff-Commander E. W. Creak, R.N., F.R.S. From the original charts at the Admiralty, compiled by Staff-Commander E. W. Creak, and prepared in their present form for the "Report on the Magnetical Results obtained in H.M.S. *Challenger*," in the concluding volume of the "Voyage of H.M.S. *Challenger*." The small maps show—(1) The track of H.M.S. *Challenger* where magnetic observations were made. (2) The approximate distribution of the secular change in the declination or variation (epoch 1840–80).

Photographs of the polar axis of a 5-foot telescope, December 1887, January 1888, exhibited by Mr. A. A. Common, F.R.S.

Sir William Thomson's models of foam or froth consisting of equal bubbles, exhibited by Prof. G. H. Darwin, F.R.S. Each bubble is a curvilinear fourteen-faced space. If a single bubble be dissected from the mass, it is found to be derived from the regular octahedron (two square pyramids base to base) by truncating the six solid angles. Thus the eight faces of the octahedron give rise to eight curvilinear hexagons, and the six solid angles to six solid curvilinear squares. In the foam three films meet at 120 at each edge, and of the three which meet two are hexa-

gons and one is a square. (See *Phil. Mag.*, vol. xxiv., 1887, p. 503.)

Model of maximum pressure anemometer, designed by Mr. Whipple, Superintendent of Kew Observatory, exhibited by the Kew Committee. In this instrument eight small metal disks, each of 0·01 foot in area, are supported vertically against the wind by levers weighted in accordance with the various pressures of the wind on Beaufort's, or some other accepted scale of force. A vane keeps their surfaces normal to the wind's direction. By their displacement the maximum wind pressure during any desired period is registered. The large perforated disk against which they are pressed serves the purpose of removing the indicating disks beyond the action of the eddies of the wind playing round the edges of the plate.

Specimens of gold showing the effect of small quantities of impurity on the fracture of the metal, exhibited by Mr. W. C. Roberts-Austen, F.R.S.

Miners' electric safety-lamps, exhibited by the Schanschieff Electric Light and Power Company. (1) A three-cell lamp capable of giving 1½ candle-power for 9 hours. Each cell contains 5 fluid ounces of solution, and consumes ⅝ pound of zinc in 48 hours. The light is more than four times more powerful than that of the Clanny oil lamp, and its working cost is ⅛*d.* per shift of 9 hours, or 3¾*d.* per week. The weight when fully charged is about 3¼ pounds. The elements consist of carbon and zinc, and the excitant is a mercurial solution of Mr. Schanschieff's invention. (2 and 3) Four-cell batteries, one round and one square. Each cell contains 5 fluid ounces of solution, and at a cost of 1*d.* furnishes a light of nearly 2 candle-power for 9 hours. The weight when fully charged is 4½ pounds. (4) A four-cell reversible battery, *i.e.* put in or out of action by reversing it. The charge consists of 24 ounces of solution, and giving a light of 2 candle-power will burn from 10 to 12 hours at a cost of 1*d.* The batteries can be used for many purposes other than mining-lamps, viz. for microscopical purposes, house-lighting, photography, diving, railway-lighting, gun-firing, gas-works, &c.

THE ZOOLOGICAL SOCIETY OF AMSTERDAM.

THE celebration of the jubilee of the Zoological Society of Amsterdam (*Natura Artis Magistra*), on Tuesday and Wednesday, May 1 and 2, passed off with great *éclat*. Dr. Westerman, who has been Director of the Gardens for more than fifty years, may well be congratulated on the success of the jubilee *fêtes;* and the vigour with which he spoke at the banquet on May 1, and again at the distribution of honours on Wednesday, shows that his eighty years sit lightly upon him. One of the most interesting features of the jubilee commemoration was the performance of a festival cantata, specially composed for the occasion by Mr. De Langa, and this had to be repeated on Thursday for the benefit of half the members of the Society, for whose accommodation the enormous concert-room proved insufficient on the opening day. All the streets in the vicinity of the Zoological Gardens were gaily decorated with flags, and the rooms of the Society were ornamented in the day-time by a mass of gorgeous flowers and at night with brilliant illuminations. After the reception of the guests by the Committee on Tuesday morning, an adjournment was made to the King's Saloon, which was densely crowded, to hear an address from Prof. Stockvis. Luncheon followed, and then the cantata was given in the concert hall, and in the afternoon the new Ethnographical Museum was formally opened. The excellent way in which the collections had been arranged was generally remarked, and the Curator, Mr. Pleyte, was warmly congratulated. The public spirit which characterizes modern Amsterdam will doubtless soon cause this new Museum to become famous, as there is a vast field for research among the Netherland possessions in the East Indies. At the banquet in the evening, covers were laid for nearly 200 persons, and after the usual toasts, the health of the Queen of England was drunk by the assembled company with the greatest enthusiasm, and was responded to by Mr. Bowdler Sharpe, of the British Museum, who spoke in English, and took the opportunity of thanking the Dutch nation for the hospitality which he and his countrymen always received from the Netherlanders, to which he could testify from an experience of over twenty years. Speeches were also given by the Ministers of Finance and of the Interior, the Burgomaster of Amsterdam, and others; and the company then adjourned to witness a torchlight procession of students, who sent a deputation of their Senate to congratulate the venerable Director and the Committee of the Society. The young President of the Students' Senate, Mr. Van Schevichaven, made a most eloquent address, and was enthusiastically received. On Wednesday, May 2, a special reception of the Committee was held to confer diplomas on the new honorary members, and Prof. Hubrecht, of Utrecht, Dr. Jentink, the Director of the Royal Museum of Natural History at Leyden, and Mr. Büttikofer, of the same Museum, were the first recipients; being followed by Mr. A. D. Bartlett, the Superintendent of our Zoological Gardens in the Regent's Park, and Mr. Bowdler Sharpe. Amongst those who were unable to be present, but to whom the honorary membership of the Society was given, were Prof. Flowers, Dr. A. B. Meyer, &c. The large bronze medal of the Society was conferred on Mr. Charles Jamrach and Mr. G. A. Frank for services rendered in the formation of zoological collections, as well as on several other well-known zoologists. Mr. Jansen, the Librarian of the Society, and Mr. F. E. Blaauw, the Secretary, also received medals and diplomas. The latter gentleman has a large private menagerie, and is an enthusiastic supporter of the Society. Simultaneously with the festival celebration, the Society has issued a jubilee number of its *Bijdragen tot de Dierkunde*, containing several important memoirs, of which the following is a list:—(1) The opening address of Prof. Stockvis. (2) Mr. Maitland's review of the Society and its work, with a plan of the Gardens. (3) An account of the aquarium with 2 plates, by Dr. C. Kerbert, the Curator. (4) A list of all the animals which have lived in the Gardens from 1838 to 1888 by Mr. K. N. Swierstra. (5) A list of the birds of the Netherlands, by Mr. H. Koller, with an enumeration of the specimens in the Society's collection. (6) Description of a new species of *Proechidna* (*P. villosissima*) and an account of *Canis jubata*, by Prof. Max Weber: this article is illustrated by 2 plates. (7) A list of the *Macrolepidoptera* of Holland, by Dr. J. T. Oudemans. The Gardens of the Society seemed to be in flourishing condition, and the collections of Cranes and Antelopes were as remarkable as ever.

NOTES.

THE ceremony at Utrecht on May 28 to celebrate the seventieth birthday of Prof. Donders, and his consequent retirement from his Professorship, will comprise a formal presentation, at 1.30 p.m., of the sum collected, together with the roll of subscribers, and a public dinner at 5.30 p.m. After the ceremony of presentation the Professor will name the scientific purpose to which he proposes that the fund shall be applied. The complete list of subscribers from this country is to be seen in our advertising columns on page xviii. Any subscriber may verify the amount of his subscription by applying to Mr. Brailey, 11 Old Burlington Street, where the audited list may be seen. The total amount collected here is £280 11*s.* 10*d.* Prof. Humphry, Dr. Hughlings

Jackson, Mr. Hutchinson, and Mr. Brailey have been invited to attend as delegates to represent the subscribers, and it is hoped that many others may be able to attend, and by their presence do honour to Prof. Donders.

THE meeting of the National Academy of Sciences, lately held at Washington, seems to have been remarkably successful. According to *Science*, the most important papers read at the meeting were, the orbits of aërolites, by Prof. H. A. Newton; preliminary notice of the object, methods, and results of a systematic study of the action of definitely related chemical compounds upon animals, by Profs. Wolcott Gibbs and Hobart Amory Hare; and report of progress in spectrum photography, and note on the spectrum of carbon and its existence in the sun, by Prof. H. A. Rowland. Prof. Newton, in his paper, submitted the two following propositions:—(1) The meteorites which we have in our collections, and which have been seen to fall, were originally (as a class, and with a very small number of exceptions) moving about the sun in orbits that had inclinations to the ecliptic of less than 90°; that is, their motions in the solar system were direct and not retrograde. (2) The reason why we have only this class of stones in our collections is not a reason wholly, or even mainly, dependent on the habits of men; nor on the times when men are out of doors; nor on the places where men live; nor on any other principle of selection acting at or after the arrival of the stones at the ground. Either the stones which are moving across the earth's orbit in the solar system move in general in direct orbits, or else, for some reason, the stones which have retrograde orbits do not in general come through the air to the ground in solid form.

TWO gold medals were presented at this meeting: the Lawrence Smith gold medal to Prof. Newton for his study of meteors; the Henry Draper gold medal to Prof. E. C. Pickering for researches in stellar photography. On the evening on which these presentations were made the following obituary memoirs were read: on the late Prof. Henry Draper, of New York, by Prof. G. F. Barker, of the University of Pennsylvania; on Prof. Watson, of the University of Michigan, by Prof. Comstock; on Capt. J. B. Eady, by Mr. W. Sellers, of Philadelphia.

WE are glad to see that the National Association for the Promotion of Technical Education is hard at work, and that it is likely to do excellent service to the cause it supports. In reply to circulars sent out in August and September 1887 a good deal of information has been provided from various industrial centres, which it is hoped may form the basis of a fairly complete report as to what is being done for technical education in the United Kingdom at the present time. Meetings have been held in a good many towns, and in some cases branches or corresponding Associations have been established. The Association is also issuing a series of publications, each consisting of a page or two, and presenting in a clear, popular style some important aspect of the subject. Some of these papers are sold at sixpence, others at a shilling, per hundred, and we may hope that large numbers of them will be widely circulated. In a series of more elaborate publications the Association has included the admirable address delivered by Prof. Huxley at a meeting held in the Town Hall, Manchester, on November 29 last.

COLONEL TURNER'S Report on the present state of the borings in the Delta of the Nile has been received at the Royal Society. The total result of the whole operations is to prove that no rock exists at a depth of 345 feet at Zagazig; at a depth of 45 feet at Kasr-el-Nil; at 84 feet at Kafr-Zayat; or at 73 feet at Tantah.

THE May number of the Kew Bulletin contains an interesting paper, giving an account of the attempts that have been made to introduce ipecacuanha into India, and the successful cultivation of the plant in the Straits Settlement. There are also valuable papers on Brazilian gum arabic, Trinidad coffee, patchouli, Cochin China vine, Madagascar ebony, and Shantung cabbage.

ABOUT a year ago the Botanical Department, Jamaica, began to issue Bulletins. Six numbers have been sent to us, and each of them contains some contribution or contributions worthy of attention. The compilers very wisely keep local industrial needs steadily in view.

IN a Report on the province of Florence, just laid before Parliament, Mr. Colnaghi, British Consul-General, says that meteorological stations, both public and private, are now established at the following places in the province:—Florence (5), Fiesole, Vallombrosa, Prato, Pistoia, Scandicci, Empoli, Fiorenzuola, Castaletti, and thermo-pluviometrical stations at S. Miniato, Mercatale (in Rocca San Casciano), Pontassieve, and Barberino di Mugello. Amongst the more important of these, he mentions the Observatory of the Royal Museum of Physical Science, that attached to the medical section of the Reale Istituto di Studi Superiori, chiefly devoted to the study of the variations of the atmosphere, and the Osservatorio Ximeniano, which is, at the same time, astronomical, meteorological, and seismical, and is under the direction of the Fathers of the Scuole Pie. For many years, he adds, experiments have been made by Prof. F. Meucci, of the Observatory of the Royal Museum of Physical Sciences, for the purpose of ascertaining the correlation of meteorological phenomena with the productiveness of the soil, and a series of Reports have been published. In 1880 the Royal Tuscan Society of Horticulture established, in its experimental garden at Florence, a Meteorological and Physical Observatory, by means of which the relation existing between the vegetation of plants and the meteoric phenomena can be studied. The Royal Astronomical Observatory of Florence is established at Arcetri, and is under the direction of Prof. Tempel.

VOLUME X. of the *Repertorium für Meteorologie*, issued by the Imperial Academy of Sciences of St. Petersburg, and edited by Dr. H. Wild, contains, among other interesting discussions, one upon the anticyclones in Europe, by Dr. P. Brounow. He has investigated by means of synoptic charts the barometrical maxima which passed over Europe in the years 1876–79, with especial reference to their movements and their causes—questions which up to the present time have received but little attention, although they are intimately connected with the movements of cyclonic areas. The number of the maxima whose paths are drawn on the charts, are most frequent in August, and least so in July and March; and, generally speaking, their motion is towards east-south-east, while their motion towards the north-westerly portion of the compass is very rare. Among the chief results of his inquiry may be mentioned that the prevalent movement of the maxima does not coincide with that of the barometric minima, but deviates from it by an angle of 67½°. There appears to be no important difference in the mean velocity of their motion in different seasons, and although they move more slowly than the depressions, the difference of velocity is not so great as is generally assumed. Their origin is attributed to two principal causes: (1) terrestrial radiation, and (2) the proximity of two or more barometric minima. The work is accompanied by sixteen charts, from which the author concludes that the maxima advance generally in the direction in which the lowest temperature exists, and that the lower the temperature sinks the quicker the centre of the maximum advances, without reference to the season of the year.

AN important addition to the chemistry of the element tellurium is contributed by MM. Berthelot and Fabre to the May number of the *Annales de Chimie et de Physique*. They find that this metalloid, one of the most remarkable links between the

non-metals and true metals, is capable of existing in three distinct allotropic forms. Besides the well-known crystalline form, exhibiting so strongly the metallic lustre, the form in which one always obtains it by volatilization in an atmosphere of hydrogen, it may be obtained by precipitation in two very different amorphous varieties. One of these is the product of the reduction of tellurous or telluric acids by sulphurous acid, and the other is formed when solutions of the alkaline tellurides are exposed to the oxidizing action of the air. Both these amorphous varieties are dark-coloured powders very liable to oxidation in the air, and only to be obtained pure by working in an atmosphere of nitrogen. The physical difference between the two is most strikingly shown, however, by their thermo-chemical behaviour. All three varieties are rapidly dissolved by a mixture of bromine and bromine water, and during the reaction in case of both the crystalline variety and the amorphous form obtained by oxidation of tellurides 33·4 heat units are evolved, while in case of amorphous tellurium derived by reduction with sulphurous acid only 21·3 units are disengaged. There was no mistake as to the purity of this latter kind, for it was completely converted to crystals on sublimation in a current of hydrogen. Hence it follows that one of the precipitated forms of tellurium corresponds to the crystalline state, and the other possesses an entirely different physical nature. It is curious, moreover, that all three modifications have the same specific heat. These interesting facts render the analogy between sulphur, selenium, and tellurium still more complete. MM. Berthelot and Fabre have also discovered a new and far superior method of preparing telluretted hydrogen. They first pass vapour of tellurium over metallic magnesium heated in a current of hydrogen, and afterwards treat the magnesium telluride thus formed with dilute hydrochloric acid in an apparatus previously filled with an atmosphere of nitrogen. The telluretted hydrogen, which is obtained in a very pure state by this new method, is very unstable, decomposing on standing in a tube over mercury even in the dark, coating the interior with tellurium and leaving its own volume of hydrogen. Decomposition is immediate in contact with moist air. In conclusion, the French chemists show that the combination of the elements of the sulphur group with hydrogen is attended with a beautifully graduated series of thermal changes, from water with heat of formation + 59 units down to telluretted hydrogen with − 35 units.

Science gives an interesting account of a magnificent ethnographical collection from Alaska, brought together by Lieut. Emmon. It has been presented to the American Museum of Natural History in New York, and forms a valuable supplement to the Powell collection from British Columbia, in the same Museum. While the latter includes principally specimens of Haida and Tsimpshian origin, the objects in the new collection come from the territory of the Tlingit, in whose country Lieut. Emmon spent more than five years. The collection includes a large number of masks. They are especially valuable, as Lieut. Emmon took great pains to ascertain the meaning of the masks, which thus became a rich source of information for the student of ethnology. A comparison of these masks with others collected on Vancouver Island and in Dean Inlet shows that the style of North-West American art, although uniform in general outlines, has its specific character in various localities. The imitation of animal forms is much closer here than in the southern regions, where the forms are more conventional, certain attributes of the animal alone being added to human figures. Another and a very interesting peculiarity of these masks is to be found in the figures of animals attached to the faces. The Eskimo tribes of Southern Alaska carve their masks in the same fashion, numerous attachments belonging to each. This is another proof of the influence of Indian art upon that of the Eskimo. The figures attached to the faces refer, as a rule, to certain myths ; and the like is true of the Eskimo masks and their characteristic wings and figures. A considerable number of masks show deep hollow eyes and sunken cheeks. They represent the heads of dead men. Masks with thick lips and beards, and eyebrows made of otter skin, represent the fabulous Kushtaka, the otter people, of which many tales and traditions are told. Another remarkable mask is that of the mosquito. This is of special interest, as the mosquito is among the southern tribes the genius of the cannibal ; and as cannibalistic ceremonies are not known to be practised by the Tlingit, it may be assumed that the myth referring to the mosquito is found in a somewhat altered form among the Tlingit.

We learn from *Science* that a Bill providing for the establishment of a zoological park in Washington has been introduced into the United States Senate. The Bill creates a Commission, which is directed to secure one hundred acres of land bordering on Rock Creek, about one mile from the city, to prepare the grounds and erect suitable buildings upon it. The park is then to be transferred to the regents of the Smithsonian Institution for their future custody and care. The site indicated is one of the most beautiful in the District of Columbia. It is composed of rolling ground, with the beautiful Rock Creek flowing through it, and it is adjacent to Woodley Park, one of the most charming of the recent additions to Washington. A street-railway to it is already projected.

The United States Bureau of Education has issued an elaborate report of the proceedings of the Department of Superintendence of the National Educational Association at its meeting at Washington from March 15 to 17, 1887. The volume includes addresses and papers by some of the most eminent American authorities on questions relating to education.

The people of Cleveland, where the American Association for the Advancement of Science will meet in August, have already begun to prepare for the meeting, which is expected to mark an epoch in the history of the city. At a recent meeting of citizens, summoned for the purpose of appointing various local committees, an interesting address on the history of the Association and its objects was delivered by Prof. F. W. Putnam, the Peabody Professor of American Archæology and Ethnology in the University of Harvard, and Permanent Secretary of the Association since 1873.

According to the *Colonies and India*, the Government of South Australia have issued Part 8 of a work on "The Forest Flora of South Australia," which is said to be the best illustrated publication ever issued in the colony. Mr. Brown, Conservator of Forests, under whose direction the book is brought out, supplies the letterpress descriptions of the plants pictorially represented.

The American publishers, Messrs. D. C. Heath and Co., have in the press a book of "Chemical Problems," by Drs. Grabfield and Burns, of the Massachusetts Institute of Technology.

A fourth edition of Prof. G. Henslow's "Botany for Beginners" (Stanford) has just been issued. In this little book Prof. Henslow p ovides a short course of elementary instruction in practical botany, for junior classes and children.

At the anniversary meeting of the Hertfordshire Natural History Society, held on February 21 last, Mr. F. Maule Campbell, the President, delivered an interesting address on the means of protection possessed by plants. This address is printed in the Transactions of the Society, and has now been issued separately.

The London Geological Field Class, under the direction of Prof. H. G. Seeley, begins the summer excursions on Whit Monday, May 21, and will continue them on Saturday afternoons thereafter up to July 14. The following are among some

of the places which will be visited : Leatherhead and Boxhill, to examine the gorge of the Mole in chalk ; Maidstone and the vicinity, for gravels ; Woolwich and Reading beds, chalk gault, and lower greensand ; Erith and Crayford, for river gravels ; Grays (in Essex), Northfleet, and Oxsted, for studies in chalk ; and other places besides. Intending students should apply for tickets at once, as only a limited number are issued. Application forms may be had from Mr. W. P. Collins, 157 Great Portland Street.

THE additions to the Zoological Society's Gardens during the past week include a Blue and Yellow Macaw (*Ara ararauna*), from South America, presented by Mrs. Warrand ; two White Ibis (*Eudocimus albus*), from South America, deposited ; two Black-backed Geese (*Sarcidiornis melanonota* ♂ ♀), from India, purchased ; a Puma (*Felis concolor*), two Long-fronted Gerbilles (*Gerbillus longifrons*), a Hog Deer (*Cervus porcinus*), a Sambur Deer (*Cervus aristotelis* ♂), born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *MAY* 20-26.

(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 May 20

Sun rises, 4h. 2m.; souths, 11h. 55m. 21·0s.; sets, 19h. 50m. : right asc. on meridian, 3h. 50·6m. ; decl. 20° 8′ N. Sidereal Time at Sunset, 11h. 45m.

Moon (Full on May 25, 14h.) rises, 13h. 0m. ; souths, 19h. 49m.; sets, 2h. 23m.* : right asc. on meridian, 11h. 44·2m. ; decl. 6° 3′ N.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	° ′
Mercury..	4 25 ...	12 43 ..	21 1 ...	4 37·3 ...	23 42 N.
Venus ...	3 35 ...	11 0 ..	18 25 ...	2 54·0 ...	15 26 N.
Mars ...	15 7 ...	20 49 ...	2 31*...	12 44·8 ...	4 12 S.
Jupiter ...	19 49*...	0 7 ...	4 25 ..	15 59·5 ...	19 33 S.
Saturn ...	8 27 ...	16 22 ...	0 17*...	8 16·7 ...	20 22 N.
Uranus...	15 16 ...	20 55 ...	2 34*...	12 50·8 ...	4 43 S.
Neptune..	4 13 ...	11 57 ...	19 41 ...	3 51·8 ..	18 31 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).

May.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.	
			h. m.	h. m.	°	°
20 ...	B.A.C. 3996 ...	6 ...	19 0 near approach		142	—
21 ...	*b* Virginis...	6 ...	0 57 ...	1 44 ...	139	254
24 ...	*η* Libræ ...	6 ...	22 52 ...	23 23 ...	128	184
25 ...	*θ* Libræ ...	4½ ...	3 45 ...	4 39† ...	85	322
26 ...	B.A.C. 5700 ...	6½ ...	4 14 ..	4 44 ...	175	236

† Below horizon at Greenwich.

May.	h.	
21 ...	2 ...	Jupiter in conjunction with and 0° 2′ north of *β* Scorpii.
21 ...	23 ...	Mars in conjunction with and 4° 32′ south of the Moon.
22 ...	5 ...	Jupiter in opposition to the Sun.
23 ...	11 ...	Mars stationary.
25 ...	7 ...	Jupiter in conjunction with and 3° 34′ south of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4 ...	81 16 N. ...	May 22,	1 17	*m*
S Persei	2 14·8 ...	58 4 N. ...	,, 22,		*m*
W Virginis	13 20·3 ...	2 48 S. ...	,, 26,	3 0	*m*
U Coronæ	15 13·6 ...	32 3 N. ...	,, 25,	2 55	*m*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,, 23,	1 22	*m*
S Sagittæ	19 50·9 ...	16 20 N. ...	,, 25,	3 0	*m*
R Sagittæ	20 9·0 ...	16 23 N. ...	,, 23,		*m*
T Vulpeculæ ...	20 46·7 ...	27 50 N. ...	,, 23,	2 0	*M*
δ Cephei	22 25·0 ...	57 51 N. ...	,, 25,	2 0	*m*

M signifies maximum ; *m* minimum.

GEOGRAPHICAL NOTES.

AT Monday's meeting of the Royal Geographical Society Lieut. F. E. Younghusband gave an account of his journey across Central Asia, from Manchuria and Peking to Kashmir and the Mustagh Pass. This is the most important paper which has been read at the Society during the present session, and the journey one of the most remarkable ever made, considering its length, the time taken—April to November, 1887—and the novelty and value of the results. We have only space to refer briefly to Lieut. Younghusband's observations on the Mustagh Pass, which he has been the first European to cross. He crossed the Gobi Desert to Hami by a route lying between those of Marco Polo and Mr. Ney Elias. His observations in the Gobi are of much interest. The clearness and dryness of the atmosphere were remarkable. Everything became parched up, and so charged with electricity that a sheepskin coat or blanket, on being opened out, would give out a loud crackling noise, accompanied by a sheet of fire. At the western end of the Hurku Hills, beyond the Galpin Gobi—the most sterile part of the whole Gobi—is a most remarkable range of sand-hills. It is about 40 miles in length, and is composed of bare sand, without a vestige of vegetation of any sort on it, and in places it is as much as 900 feet in height, rising abruptly out of a gravel plain. With the dark outline of the southern hills as a background, this white, fantastically-shaped sand-range presents a very striking appearance. It must have been formed by the action of the wind, for to the westward of this range is an immense sandy tract, and it is evident that the wind has driven the sand from this up into the hollow between the Hurku Hills and the range to the south, thus forming these remarkable sand-hills. It was near this region that traces of the wild camel were met with, and both wild asses and wild horses seen. As far as Hami the country continues to be mainly desert. From Hami, Lieut. Younghusband went on to Yarkand, and by the Yarkand River to the Karakorum Range, which he meant to cross by the Mustagh Pass. The difficulties, owing to the enormous glaciers, the rugged nature of the mountains, and great height of the pass, were very great for Mr. Younghusband, his men, and his ponies. The glaciers here are of enormous size, and Mr. Younghusband has added considerably to the information obtained by Colonel Godwin-Austen, who surveyed the region to the south of the pass twenty-six years ago. "The appearance of these mountains," Lieut. Younghusband stated, "is extremely bold and rugged as they rise in a succession of needle peaks like hundreds of Matterhorns collected together ; but the Matterhorn, Mont Blanc, and all the Swiss mountains would have been two or three thousand feet below me, while these mountains rose up in solemn grandeur thousands of feet above me. Not a living thing was seen, and not a sound was heard ; all was snow and ice and rocky precipices ; while these mountains are far too grand to support anything so insignificant as trees or vegetation of any sort. They stand bold and solitary in their glory, and only permit man to come amongst them for a few months in the year, that he may admire their magnificence and go and tell it to his comrades in the world beneath." After some extremely difficult prospecting, Lieut. Younghusband made up his mind to cross the old and long-abandoned Mustagh Pass, instead of the new one. "Next morning," he stated, "while it was yet dark, we started for the pass, leaving everything behind, except a roll of bedding for myself, a sheepskin coat for each man, a few dry provisions, and a large tea-kettle. The ascent to the pass was quite gentle, but led over deep snow in which we sank knee-deep at every step. We were now about 19,000 feet above the sea-level, and quickly became exhausted. In fact, as we got near the summit, we could only advance a dozen or twenty steps at a time, and we would then lean over on our alpenstocks, and gasp and pant away as if we had been running up a steep hill at a great pace. But it was not till midday that we reached the summit, and then on looking about for a way down we could see none. Huge blocks of ice had fallen from the mountains which overhang the pass, and had blocked up the path by which travellers used formerly to descend from it, and the only possible way now of getting to the bottom was by crossing an icy slope to a cliff, which was too steep for a particle of snow to lodge on it, even in that region of ice and snow. From this we should have to descend on to some more icy slopes which could be seen below. . . . We had first to cross the icy slope ; it was of smooth ice and very steep, and about thirty yards below us it ended abruptly, and we could see

nothing over the edge for many hundreds of feet. As Wali hewed the steps we advanced step by step after him, leaning back against the slope, all the time facing the precipice, and knowing that if we slipped (and the ice was very slippery, for the sun was just powerful enough to melt the surface of it), we should roll down the icy slope and over the precipice into eternity. After a time we reached *terra firma* in the shape of a projecting piece of rock, and from here began the descent of the cliff. We had to let ourselves down from any little ledge, taking every step with the greatest possible care, as the rock was not always sound; and once a shout came from above, and a huge rock, which had been dislodged, came crashing past me and as nearly as possible hit two of the men who had already got some way down. At the bottom of the cliff we came to another steep ice-slope." After eighteen hours of this task the party were glad to lie down for a few hours' rest. At daybreak next morning they were on their legs again, and after a few hours' travelling emerged on to the great Baltoro Glacier, which was explored by Colonel Godwin-Austen in 1852, when making the Kashmir survey. They travelled all that day, and for two days more, till they reached Askoli, a little village on the Braldo River, surrounded by trees and cultivated lands.

Lieut. Younghusband remarked as follows on the Altai Mountains:—"These mountains are perfectly barren, the upper portion composed of bare rock and the lower of long gravel slopes formed of the debris of the rocks above. In such an extremely dry climate, exposed to the icy cold winds of winter and the fierce rays of the summer sun, and unprotected by one atom of soil, the rocks here, as also in every other part of the Gobi, crumble away to a remarkable extent, and there being no rainfall sufficient to wash away the debris, the lower features of the range gradually get covered with a mass of debris falling from the upper portions, and in the course of time a uniform slope is created, often 30 or 40 miles in length, and it is only for a few hundred feet at the top that the original jagged rocky outline is seen." Again, with regard to Chinese Turkistan:—"If you could get a bird's-eye view of Chinese Turkistan, you would see a great bare desert surrounded on three sides by barren mountains, and at their bases you would see some vivid green spots, showing out sharp and distinct like blots of green paint dropped on to a sepia picture. In the western end round Kashgar and Yarkand the cultivation is of greater extent and more continuous than in the eastern half, where the oases are small and separated from each other by 15 or 20 miles of desert. These oases are, however, extraordinarily fertile, every scrap of land that can be cultivated is used up, and every drop of water is drained off from the stream and used for irrigation." At the conclusion of Monday's meeting of the Royal Geographical Society, General J. T. Walker proposed, and Sir Henry Rawlinson seconded, that the peak in the Karakorum known as K2, 28,500 feet high, be baptized Mount Godwin-Austen—a proposal heartily approved by the meeting.

The Paris Geographical Society has awarded gold medals to the Rev. P. Roblet, for his map of Madagascar; to MM. Bonvalot, Capus, and Pépin, for their journeys in Kafiristan and the Pamir; to M. Chaffanjon, for his exploration of the sources of the Orinoco.

General Prjevalsky will start in August next on his fourth journey in Central Asia. His ultimate destination will be Lhassa, the capital of Tibet, and he will be equipped for two years' travel. He will be accompanied by an escort of twenty-eight persons, including twelve Cossacks, and two scientific companions, Lieut. Robrowsky and Sub-Lieut. Koslow.

THE PYGMY RACES OF MEN.[1]

II.

LIKE all other human beings existing at present in the world, however low in the scale of civilization, the social life of the Andamanese is enveloped in a complex maze of unwritten law or custom, the intricacies of which are most difficult for any stranger to unravel. The relations they may or may not marry, the food they are obliged or forbidden to partake of at particular epochs of life or seasons of the year, the words and names they may or may not pronounce: all these, as well as their traditions, superstitions, and beliefs, their occupations, games, and amusements of which they seem to have had no lack, would take far too long to describe here; but, before leaving these interesting people, I may quote an observation of Mr. Man's, which, unless he has seen them with too *couleur-de-rose* eyesight, throws a very favourable light upon the primitive unsophisticated life of these poor little savages, now so ruthlessly broken into and destroyed by the exigencies of our ever-extending Empire.

"It has been asserted," Mr. Man says, "that the 'communal marriage' system prevails among them, and that 'marriage is nothing more than taking a female slave'; but, so far from the contract being regarded as a merely temporary arrangement, to be set aside at the will of either party, no incompatibility of temper or other cause is allowed to dissolve the union; and while bigamy, polygamy, polyandry, and divorce are unknown, conjugal fidelity till death is not the exception but the rule, and matrimonial differences, which, however, occur but rarely, are easily settled with or without the intervention of friends." In fact, Mr. Man goes on to say, "One of the most striking features of their social relations is the marked equality and affection which subsists between husband and wife," and "the consideration and respect with which women are treated might with advantage be emulated by certain classes in our own land."

It should also be mentioned that cannibalism and infanticide, two such common incidents of savage life, were never practised by them.

We must now pass to the important scientific question, Who are the natives of the Andaman Islands, and where, among the other races of the human species, shall we look for their nearest relations?

It is due mainly to the assiduous researches into all the documentary evidence relating to the inhabitants of Southern Asia and the Indian Archipelago, conducted through many years by M. de Quatrefages, in some cases with the assistance of his colleague M. Hamy, that the facts I am about to put before you have been prominently brought to light, and their significance demonstrated.

It is well known that the greater part of the large island of New Guinea, and of the chain of islands extending eastwards and southwards from it, including the Solomon Islands, the New Hebrides, and New Caledonia, and also the Fijis, are still inhabited mainly by people of dark colour, frizzly hair, and many characters allying them to the Negroes of Africa. These constitute the race to which the term Melanesian is commonly applied in this country, or Oceanic Negroes, the "Papouas" of Quatrefages. Their area at one time was more extensive than it is now, and has been greatly encroached upon by the brown, straight-haired Polynesian race with Malay affinities, now inhabiting many of the more important islands of the Pacific, and the mingling of which with the more aboriginal Melanesians in various proportions has been a cause, among others, of the diverse aspect of the population on many of the islands in this extensive region. These Papouas, or Melanesians, however, differ greatly from the Andamanese in many easily defined characters; which are, especially, their larger stature, their long, narrow, and high skulls, and their coarser and more Negro-like features. Although undoubtedly allied, we cannot look to them as the nearest relations of our little Andamanese.

When the Spaniards commenced the colonization of the Philippines, they met with, in the mountainous region in the interior of the Island of Luzon, besides the prevailing native population, consisting of Tagals of Malay origin, very small people, of black complexion, with the frizzly hair of the African Negroes. So struck were they with the resemblance, that they called them "Negritos del Monte" (little Negroes of the mountain). Their local name was Aigtas, or Inagtas, said to signify "black," and from which the word Aëta, generally now applied to them, is derived. These people have lately been studied by two French travellers, M. Marche and Dr. Montano; the result of their measurements gives 4 feet 8¾ inches as the average height of the men, and 4 feet 6½ inches the average for the women. In many of their moral characteristics they resemble the Andamanese. The Aëtas are faithful to their marriage vows, and have but one wife. The affection of parents for children is very strong, and the latter have for their father and mother as much love and respect. The marriage ceremony, according to M. Montano, is very remarkable. The affianced pair climb two flexible trees placed near to each other. One of the elders of the tribe bends them towards each other. When

[1] A Lecture delivered at the Royal Institution on Friday evening, April 13, 1888, by Prof. Flower, C.B., LL.D., F.R.S., Director of the Natural History Departments of the British Museum. Continued from p. 45.

their heads touch, the marriage is legally accomplished. A great *fête*, with much dancing, concludes the ceremony.

It was afterwards found that the same race existed in other parts of the archipelago, Panay, Mindanao, &c., and that they entirely peopled some little islands—among others, Bougas Island, or "Isla de los Negros."

As the islands of these eastern seas have become better known, further discoveries of the existence of a small Negroid population have been made in Formosa, in the interior of Borneo, the Sandal Islands (Sumba), Xulla, Bourou, Ceram, Flores, Solor, Pantar, Lomblem, Ombay, the eastern peninsula of Celebes, &c. In fact, Sumatra and Java are the only large islands of this great area which contain no traces of them except some doubtful cross-breeds, and some remains of an industry which appears not to have passed beyond the Age of Stone.

The Sunda Islands form the southern limit of the Negrito area; Formosa, the last to the north, where the race has preserved all its characters. But beyond this, as in Lew-Chew, and even the south-east portion of Japan, it reveals its former existence by the traces it has left in the present population. That it has contributed considerably to form the population of New Guinea is unquestionable. In many parts of that great island, small round-headed tribes live more or less distinct from the larger and longer-headed people who make up the bulk of the population.

But it is not only in the islands that the Negrito race dwelt. Traces of them are found also on the mainland of Asia, but everywhere under the same conditions: in scattered tribes, occupying the more inaccessible mountainous regions of countries otherwise mainly inhabited by other races, and generally in a condition more or less of degradation and barbarism, resulting from the oppression with which they have been treated by their invading conquerers; often, moreover, so much mixed that their original characters are scarcely recognizable. The Semangs of the interior of Malacca in the Malay peninsula, the Sakays from Perak, the Moys of Annam, all show traces of Negrito blood. In India proper, especially among the lowest and least civilized tribes, not only of the central and southern districts, but even almost to the foot of the Himalayas, in the Punjab, and even to the west side of the Indus, according to Quatrefages, frizzly hair, Negro features, and small stature, are so common that a strong argument can be based on them for the belief in a Negrito race forming the basis of the whole pre-Aryan, or Dravidian as it is generally called, population of the peninsula. The crossing that has taken place with other races has doubtless greatly altered the physical characters of this people, and the evidences of this alteration manifest themselves in many ways; sometimes the curliness of the hair is lost by the admixture with smooth straight-haired races, while the black complexion and small stature remain; sometimes the stature is increased, but the colour which seems to be one of the most persistent of characteristics, remains.

The localities in which these people are found in their greatest purity, either in almost inaccessible islands, as on the Andamans, or elsewhere in the mountainous ranges of the interior only; their social positions and traditions, wherever they exist—all point to the fact that they were the earliest inhabitants; and that the Mongolian and Malay races on the east, and the Aryans on the west, which are now so rapidly exterminating and replacing them, are later comers into the land, exactly as, in the greater part of the Pacific Ocean, territory formerly occupied by the aboriginal dark, frizzly-haired Negroid Melanesians has been gradually and slowly invaded by the brown Polynesians, who in their turn, but by a much more rapid process, are being replaced by Europeans.

We now see what constitutes the great interest of the Andamanese natives to the student of the ethnological history of the Eastern world. Their long isolation has made them a remarkably homogeneous race, stamping them all with a common resemblance not seen in the mixed races generally met with in continental areas. For although, as with most savages, marriages within the family (using the term in a very wide sense) are most strictly forbidden, all such alliances have necessarily been confined to natives of the islands. They are the least modified representatives of the people who were, as far as we know, the primitive inhabitants of a large portion of the earth's surface, but who are now verging on extinction. It is, however, not necessary to suppose that the Andaman Islanders give us the exact characters and features of all the other branches of the race. Differences in detail doubtless existed—differences which are almost always sure to arise whenever races become isolated from each other for long periods of time.

In many cases the characters of the ancient inhabitants of a land have been revealed to us by the preservation of their actual remains. Unfortunately we have as yet no such evidence to tell us of the former condition of man in Southern Asia. We may, however, look upon the Andamanese, the Aëtas, and the Semangs, as living fossils; and by their aid conjecture the condition of the whole population of the land in ancient times. It is possible, also, to follow Quatrefages, and to see in them the origin of the stories of the Oriental pygmies related by Ctesias and by Pliny.

We now pass to the continent of Africa, in the interior of which the pygmies of Homer, Herodotus, and Aristotle have generally been placed. Africa, as is well known, is the home of another great branch of the black, frizzly-haired, or Ethiopian division of the human species, who do, or did till lately, occupy the southern two-thirds of this great continent, the northern third being inhabited by Hamite and Semite branches of the great white or Caucasian primary division of the human species, or by races resulting from the mixture of them and the Negroes. Besides the true Negro, there has long been known to exist in the southern part of the continent a curiously modified type, consisting of the Hottentots, and the Bushmen—Bosjesmen (men of the woods) of the Dutch colonists—the latter of whom, on account of their small size, come within the scope of the present subject. They lead the lives of the most degraded of savages, dwelling among the rocky and more inaccessible mountains of the interior, making habitations of the natural caves, subsisting entirely by the chase, being most expert in the use of the bow and arrow, and treated as enemies and outcasts by the surrounding and more civilized tribes, whose flocks and herds they show little respect for when other game is not within reach. The physical characters of these people are well known, as many specimens have been brought to Europe alive for the purpose of exhibition. Their hair shows the extreme of the frizzly type, being shorter and less abundant than that of the ordinary Negro; it has the appearance of growing in separate tufts, which coil up together into round balls compared to "peppercorns." The yellow complexion differs from that of the Negro, and, combined with the wide cheek-bones and form of the eyes, so much recalls that of certain of the pure yellow races that some anthropologists are inclined to trace true Mongolian affinities and admixture, although the extreme crispness of the hair makes such a supposition almost impossible. The width of the cheek-bones and the narrowness of the forehead and the chin give a lozenge shape to the front view of the face. The forehead is prominent and straight; the nose extremely flat and broad, more so than in any other race, and the lips prominent and thick, although the jaws are less prognathous than in the true Negro races. The cranium has many special characters by which it can be easily distinguished from that of any other. It has generally a very feminine, almost infantile, appearance, though the capacity of the cranial cavity is not the smallest, exceeding that of the Andamanese. In general form the cranium is rather oblong than oval, having straight sides, a flat top, and especially a vertical forehead, which rises straight from the root of the nose. It is moderately dolichocephalic or rather mesaticephalic, the average of the index of ten specimens being 75·4. The height is in all considerably less than the breadth, the average index being 71·1. The glabella and infra-orbital ridges are little developed except in the oldest males. The malar bones project much forwards, and the space between the orbits is very wide and flat. The nasal bones are extremely small and depressed, and the aperture wide; the average nasal index being 60·8, so they are the most platyrhine of races.

With regard to the stature, we have not yet sufficient materials for giving a reliable average. Quatrefages, following Barrow, gives 4 feet 6 inches for the men, and 4 feet for the women, and speaks of one individual of the latter sex, who was the mother of several children, measuring only 3 feet 9 inches in height; but later observations (still, however, insufficient in number) give a rather larger stature: thus Topinard places the average at 1·404 metre, or 4 feet 7½ inches; and Fritsch, who measured six male Bushmen in South Africa, found their mean height to be 1·444 metre, or nearly 4 feet 9 inches. It is probable that, taking them all together, they differ but little in this respect from the Andamanese, although in colour, in form of head, in features, and in the proportions of the body, they are widely removed from them.

There is every reason to believe that these Bushmen represent the earliest race of which we have, or are ever likely to have, any knowledge, which inhabited the southern portion of the African continent, but that long before the advent of Europeans upon the scene, they had been invaded from the north by Negro tribes, who, being superior in size, strength, and civilization, had taken possession of the greater part of their territories, and mingling freely with the aborigines, had produced the mixed race called Hottentots, who retained the culture and settled pastoral habits of the Negroes, with many of the physical features of the Bushmen. These, in their turn, encroached upon by the pure-bred Bantu Negroes from the north, and by the Dutch and English from the south, are now greatly diminished, and indeed threatened with the same fate that will surely soon befall the scanty remnant of the early inhabitants who still retain their primitive type.

At present the habitat of the Bushman race is confined to certain districts in the south-west of Africa, from the confines of the Cape Colony, as far north as the shores of Lake Ngami. Further to the north the great equatorial region of Africa is occupied by various Negro tribes, using the term in its broadest sense, but belonging to the divisions which, on account of peculiarities of language, have been grouped together as Bantu. They all present the common physical characteristics typical of the Negro race, only two of which need be specially mentioned here—medium or large stature, and dolichocephalic skull (average cranial index about 73·5).

It is at various scattered places in the midst of these, that the only other small people of which I shall have to speak, the veritable pygmies of Homer, Herodotus, and Aristotle, according to Quatrefages, are still to be met with.[1]

The first notice of the occurrence of these in modern times is contained in "The strange adventures of Andrew Battell of Leigh in Essex, sent by the Portugals prisoner to Angola, who lived there, and in the adjoining regions near eighteen yeares" (1589 to 1607), published in "Purchas his Pilgrimes" (1625), lib. vii. chap. iii. p. 983 :—

"To the north-east of *Mani-Kesock*, are a kind of little people, called *Matimbas;* which are no bigger than Boyes of twelve yeares old, but very thicke, and live only upon flesh, which they kill in the woods with their bows and darts. They pay tribute to *Mani-Kesock*, and bring all their elephants' teeth and tayles to him. They will not enter into any of the *Maramba's* houses, nor will suffer any to come where they dwell. And if by chance any *Maramba* or people of *Longo* pass where they dwell, they will forsake that place, and go to another. The women carry Bows and Arrows as well as the men. And one of these will walk in the woods alone and kill the Pongos with their poysoned Arrows."

Battell's narrative, it should be said, is generally admitted as having an air of veracity about it not always conspicuous in those of travellers of his time. In addition to the observations on the human inhabitants, it contains excellent descriptions of animals, as the pongo or gorilla, and the zebra, now well known, but in his day new to Europeans.

Dapper, in a work called "Description de la Basse Ethiopie," published at Amsterdam in 1686, speaks of a race of dwarfs inhabiting the same region, which he calls *Mimos* or *Bakke-Bakke*, but nothing further was heard of these people until quite recent times. A German scientific expedition to Loango, the results of which were published in the *Zeitschrift für Ethnologie*, 1874, and in Hartmann's work, "Die Negritier," obtained, at Chinchoxo, photographs and descriptions of a dwarf tribe called "Baboukos," whose heads were proportionally large and of roundish form (cephalic index of skull, 78 to 81). One individual, supposed to be about forty years of age, measured 1·365 metre, rather under 4 feet 6 inches.

Dr. Touchard, in a "Notice sur le Gabon," published in the *Revue Maritime et Coloniale* for 1861, describes the recent destruction of a population established in the interior of this country and to which he gives the name of "Akoa." They seem to have been exterminated by the M'Pongos in their expansion towards the west. Some of them, however, remained as slaves at the time of the visit of Admiral Fleuriot de Langle, who in 1868 photographed one (measuring about 4 feet 6 inches high) and brought home some skulls, which were examined by Hamy, and all proved very small and sub-brachycephalic.

[1] The scattered information upon this subject was first collected together by Hamy in his "Essai de co-ordination des Matériaux récemment recueillis sur l'ethnologie des Négrilles ou Pygmées de l'Afrique équatoriale," *Bull. Soc. d'Anthropologie de Paris*, tome ii. (ser. iii.), 1879, p. 73.

Another tribe, the M'Boulous, inhabiting the coast north of the Gaboon River, have been described by M. Marche as probably the primitive race of the country. They live in little villages, keeping entirely to themselves, though surrounded by the larger Negro tribes, M'Pongos and Bakalais, who are encroaching upon them so closely that their numbers are rapidly diminishing. In 1860 they were not more than 3000; in 1879 much less numerous. They are of an earthy-brown colour, and rarely exceed 1·600 metre in height (5 feet 3 inches). In the rich collections of skulls made by Mr. R. B. Walker and by M. Du Chaillu, from the coast of this region, are many which are remarkable for their small size and round form. Of many other notices of tribes of Negroes of diminutive size, living near the west coast of Equatorial Africa, I need only mention that of Du Chaillu, who gives an interesting account of his visit to an Obongo village in Ashango-land, between the Gaboon and the Congo; although unfortunately, owing to the extreme shyness and suspicion of the inhabitants, he was allowed little opportunity for anthropological observations. He succeeded, however, in measuring one man and six women; the height of the former was 4 feet 6 inches, the average of the later 4 feet 8 inches.[1]

Far further into the interior, towards the centre of the region contained in the great bend of the Congo or Livingstone River, Stanley heard of a numerous and independent population of dwarfs, called "Watwas," who, like the Batimbas of Battell, are great hunters of elephants, and use poisoned arrows. One of these he met with at Ikondu was 4 feet 6½ inches high, and of a chocolate brown colour.[2] More recently Dr. Wolff describes under the name of "Batouas" (perhaps the same as Stanley's Watwas), a people of lighter colour than other Negroes, and never exceeding 1·40 metres (4 feet 7 inches) high, but whose average is not more than 1·30 (4 feet 3 inches), who occupy isolated villages scattered through the territory of the Bahoubas, with whom they never mix.[3]

Penetrating into the heart of Africa from the north-east, in 1870, Dr. George Schweinfurth first made us acquainted with a diminutive race of people who have since attained a considerable anthropological notoriety. They seem to go by two names in their own country, *Akka* and *Tikki-tikki*, the latter reminding us curiously of Dapper's Bakke-bakke, and the former, more singularly still, having been read by the learned Egyptologist, Mariette, by the side of the figure of a dwarf in one of the monuments of the early Egyptian Empire.

It was at the court of Mounza, king of the Monbuttu, that Schweinfurth first met with the Akkas. They appear to live under the protection of that monarch, who had a regiment of them attached to his service, but their real country was further to the south and west, about 3° N. lat. and 25° E. long. From the accounts the traveller received they occupy a considerable territory, and are divided into nine distinct tribes, each having its own king or chief. Like all the other pygmy African tribes, they live chiefly by the chase, being great hunters of the elephant, which they attack with bows and arrows.

In exchange for one of his dogs, Schweinfurth obtained from Mounza one of these little men, whom he intended to bring to Europe, but who died on the homeward journey at Berber. Unfortunately all the measurements and observations which were made in the Monbuttu country by Schweinfurth perished in the fire which destroyed so much of the valuable material he had collected. His descriptions of their physical characters are therefore chiefly recollections. Other travellers—Long, Marno, and Vossion—though not penetrating as far as the Akka country, have given observations upon individuals of the race they have met with in their travels. The Italian Miani, following the footsteps of Schweinfurth into the Monbuttu country, also obtained, by barter, two Akka boys, with the view of bringing them to Europe. He himself fell a victim to the fatigues of the journey and climate, but left his collections, including the young Akkas, to the Italian Geographical Society. Probably no two individuals of a savage race have been so much honoured by the attentions of the scientific world. First at Cairo, and afterwards in Italy, Tebo (or Thibaut) and Chairallah, as they were named, were described, measured, and photographed, and have been the subjects of a library of memoirs, their bibliographers including the names of Owen, Panceri, Cornalia, Mantegazza, Giglioli and Zannetti, Broca, Hamy, and de Quatrefages. On their arrival in Italy, they were presented to the King and Queen, introduced into the

[1] "A Journey to Ashango-land," 1867, p. 325.
[2] "Through the Dark Continent," vol. ii.
[3] *La Gazette Géographique*, 1887, p. 153, quoted by Quatrefages.

most fashionable society, and finally settled down as members of the household of Count Miniscalchi Erizzo, at Verona, where they received a European education, and performed the duties of pages.

In reply to an inquiry addressed to my friend Dr. Giglioli, of Florence, I hear that Thibaut died of consumption on January 28, 1883, being then about twenty-two years of age, and was buried in the cemetery at Verona. Unfortunately no scientific examination of the body was allowed, but whether Chairallah still lives or not I have not been able to learn. As Giglioli has not heard of his death, he presumes that he is still living in Count Miniscalchi's palace.

One other specimen of this race has been the subject of careful observation by European anthropologists—a girl named Saida, brought home by Romolo Gessi (Gordon's lieutenant), and who is still, or was lately, living at Trieste as servant to M. de Gessi.

The various scattered observations hitherto made are obviously insufficient to deduce a mean height for the race, but the nearest estimate that Quatrefages could obtain is about 4 feet 7 inches for the men, and 4 feet 3 inches for the women, decidedly inferior, therefore, to the Andamanese. With regard to their other characters, their hair is of the most frizzly kind, their complexion lighter than that of most Negroes, but the prognathism, width of nose, and eversion of lips characteristic of the Ethiopian branch of the human family are carried to an extreme degree, especially if Schweinfurth's sketches can be trusted. The only essential point of difference from the ordinary Negro, except the size, is the tendency to shortening and breadth of the skull, although it by no means assumes the "almost spherical" shape attributed to it by Schweinfurth.

Some further information about the Akkas will be found in the work, just published, of the intrepid and accomplished traveller in whose welfare we are now so much interested, Dr. Emin Pasha, Gordon's last surviving officer in the Soudan, who in the course of his explorations spent some little time lately in the country of the Monbuttu. Here he not only met with living Akkas, one of whom he apparently still retains as a domestic in his service, and of whose dimensions he has sent me a most detailed account, but he also, by watching the spots where two of them had been interred, succeeded in obtaining their skeletons, which, with numerous other objects of great scientific interest, safely arrived at the British Museum in September of last year. I need hardly say that actual bones, clean, imperishable, easy to be measured and compared, not once only, but any number of times, furnish the most acceptable evidence that an anthropologist can possess of many of the most important physical characters of a race. There we have facts which can always be appealed to in support of statements and inferences based on them. Height, proportions of limbs, form of head, characters of the face even, are all more rigorously determined from the bones than they can be on the living person. Therefore the value of these remains, imperfect as they unfortunately are, and of course insufficient in number for the purpose of establishing average characters, is very great indeed.

As I have entered fully into the question of their peculiarities elsewhere, I can only give now a few of the most important and most generally to be understood results of their examination. The first point of interest is their size. The two skeletons are both those of full-grown people, one a man, the other a woman. There is no reason to suppose that they were specially selected as exceptionally small; they were clearly the only ones which Emin had an opportunity of procuring; yet they fully bear out, more than bear out, all that has been said of the diminutive size of the race. Comparing the dimensions of the bones, one by one, with those of the numerous Andamanese that have passed through my hands, I find both of these Akkas smaller, not than the average, but smaller than the smallest; smaller also than any Bushman whose skeleton I am acquainted with, or whose dimensions have been published with scientific accuracy. In fact, they are both, for they are nearly of a size, the smallest normal human skeletons which I have seen, or of which I can find any record. I say normal, because they are thoroughly well grown and proportioned, without a trace of the deformity almost always associated with individual dwarfishness in a taller race. One only, that of the female, is sufficiently perfect for articulation. After due allowance for some missing vertebræ, and for the intervertebral spaces, the skeleton measures from the crown of the head to the ground exactly 4 feet, or 1·218 metre. About half an inch more for the thickness of the skin of the head and soles of the feet would complete the height when alive. The other (male) skeleton was (judging by the length of the femur) about a quarter of an inch shorter.

The full-grown woman of whom Emin gives detailed dimensions is stated to be only 1·164 metre, or barely 3 feet 10 inches.[1] These heights are all unquestionably less than anything that has been yet obtained based upon such indisputable data. One very interesting and almost unexpected result of a careful examination of these skeletons is that they conform in the relative proportions of the head, trunk, and limbs, not to dwarfs, but to full-sized people of other races, and they are therefore strikingly unlike the stumpy, long-bodied, short-limbed, large-headed pygmies so graphically represented fighting with their lances against the cranes on ancient Greek vases.

The other characters of these skeletons are Negroid to an intense degree, and quite accord with what has been stated of their external appearance. The form of the skull, too, has that sub-brachycephaly which has been shown by Hamy to characterize all the small Negro populations of Central Africa. It is quite unlike that of the Andamanese, quite unlike that of the Bushmen. They are obviously Negroes of a special type, to which Hamy has given the appropriate term of *Negrillo*. They seem to have much the same relation to the larger longer-headed African Negroes that the small round-headed Negritos of the Indian Ocean have to their larger longer-headed Melanesian neighbours.

At all events, the fact now seems clearly demonstrated that at various spots across the great African continent, within a few degrees north and south of the equator, extending from the Atlantic coast to near the shores of the Albert Nyanza (30° E. long.), and perhaps, if some indications which time will not allow me to enter into now (but which will be found in the writings of Hamy and Quatrefages), even further to the east, south of the Galla land, are still surviving, in scattered districts, communities of these small Negroes, all much resembling each other in size, appearance, and habits, and dwelling mostly apart from their larger neighbours, by whom they are everywhere surrounded. Our information about them is still very scanty, and to obtain more would be a worthy object of ambition for the anthropological traveller. In many parts, especially at the west, they are obviously holding their own with difficulty, if not actually disappearing, and there is much about their condition of civilization, and the situations in which they are found, to induce us to look upon them, as in the case of the Bushmen in the south and the Negritos in the east, as remains of a population which occupied the land before the incoming of the present dominant races. If the account of the Nasamonians related by Herodotus is accepted as historical, the river they came to, "flowing from west to east," must have been the Niger, and the northward range of the dwarfish people far more extensive twenty-three centuries ago than it is at the present time.

This view opens a still larger question, and takes us back to the neighbourhood of the south of India as the centre from which the whole of the great Negro race spread, east over the African continent, and west over the islands of the Pacific, and to our little Andamanese fellow subjects as probably the least modified descendants of the primitive members of the great branch of the human species characterized by their black skins and frizzly hair.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In a recent discussion on the proposed appropriation of the whole of the Botanic Gardens site for Natural Science Departments, it seemed to be generally agreed that the Mechanical Department ought to be removed from a locality where it must cause vibrations injurious to microscopical or physical research. The suggested removal of the Herbarium to the Botanic Gardens was disapproved of by the Professor and his Assistant-Curator. The proposed appropriation of the present Chemical Rooms for Pathology was generally approved. Mr. J. W. Clark emphatically condemned the present Museum of Human Anatomy and Surgery as a discredit to the University. Prof. Hughes further put in a claim that the Geological Museum should extend to the extreme east of the site, and that the erection of the buildings should be begun at once.

[1] In his letters Emin speaks of an Akka man as "3 feet 6 inches" high, though this does not profess to be a scientifically accurate observation, as does the above. He says of this man that his whole body was covered by thick, stiff hair, almost like felt, as was the case with all the Akkas he had yet examined.

The first Harkness Scholarship for Geology and Palæontology is to be awarded in June next; names of candidates are to be sent in by May 31 next. Candidates must be Bachelors of Arts of not more than two-and-a-half years' standing.

The Sheepshanks Astronomical Exhibition will be awarded next December, at Trinity College. It is open to all undergraduates of the University, but the person elected must become a member of Trinity College. The conditions may be learnt from Dr. Glaisher, Trinity College.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 26.—"On the Development of the Electric Organ of *Raia batis*." By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by J. Burdon Sanderson, F.R.S.

The paper consists of a short description of the electric organs found in the skate genus, and of an account of the development of the electric organ of the common grey skate (*Raia batis*).

It is shown that while in some skates (*e.g.*, *Raia batis*) the organ is made up of disk-shaped bodies, in others (*e.g.*, *Raia fullonica*) it consists of numerous cup-shaped structures provided with long or short stems.

The disks (with the development of which the paper chiefly deals) consist essentially of three layers, viz. (1) an electric plate in front in which the nerves end; (2) a striated layer which supports the electric plate; and (3) an alveolar layer, posterior to which is a thick cushion of gelatinous tissue. Each disk is formed in connection with a muscular fibre. In young embryos there is no indication of an electric organ, but in an embryo 6 or 7 cm. in length, some of the muscular fibres at each side of the notochord are found in process of conversion into long slender clubs having their heads nearest the root of the tail.

The club-stage having been reached, the muscular fibre next assumes the form of a mace, and, later, the anterior end further expands to form a relatively large disk, while the remainder of the original fibre persists as a slender ribbon-shaped appendage. As the head of the club enlarges to form a disk, it passes through an indistinct cup-stage, which somewhat resembles the cups of the adult *Raia fullonica*, hence it may be inferred that in *Raia fullonica* the organ has been arrested in its development. The conversion of the muscular fibre into a club is largely caused by the increase, at its anterior end, of muscle-corpuscles. These corpuscles eventually arrange themselves, either in front of the head of the club, to give rise to the electric plate, or they migrate backwards to form at the junction of the head of the club with its stem the alveolar layer. The striated layer, which is from the first devoid of nuclei, seems to be derived from the anterior striated portion of the club.

The gelatinous tissue between the disks, and the connective tissue investing them, are derived from the embryonic connective tissue corpuscles, which exist in great numbers around the clubs and developing disks.

May 3.—"On the Relations of the Diurnal Barometric Maxima to certain Critical Conditions of Temperature, Cloud, and Rainfall." By Henry F. Blanford, F.R.S.

The author refers to an observation of Lamont's that the diurnal barometric variation appears to be compounded of two distinct elements, viz. a wave of diurnal period, which is very variable in different places, and which appears to depend on the horizontal and vertical movements of the atmosphere and changes in the distribution of its mass, and a semi-diurnal element which is remarkably constant and seems to depend more immediately on the action of the sun. Then, referring to the theory of the semi-diurnal variation, originally put forward by Espy, and subsequently by Davies and Kreil, the author points out that the morning maximum of pressure approximately coincides with the instant when the temperature is rising most rapidly. This is almost exactly true at Prague, Yarkand, both in winter and summer, and in winter months at Melbourne. At the tropical stations, Bombay, Calcutta, and Batavia, and at Melbourne in the summer, the barometric maximum follows the instant of most rapid heating by a shorter or longer interval; and the author remarks that this may probably be attributed to the action of convection, which must accelerate the time of most rapid heating near the ground surface; while the barometric effect, if real, must be determined by the condition of the atmosphere up to a great height. With reference to Lamont's demonstration of the failure of Espy's theory, a condition is pointed out which alters the data of the problem, viz. the resistance that must be offered to the passage of the pressure-wave through the extremely cold and highly attenuated atmospheric strata, whose existence is proved by the phenomena of luminous meteors.

With respect to the evening maximum of pressure, it is pointed out that very generally, and especially in India, and also at Melbourne, there is a strongly-marked minimum in the diurnal variation of cloud between sunset and midnight, which, on an average, as at Allahabad and Melbourne, coincides with the evening maximum of the barometer. A similar coincident minimum, even more strongly marked, characterizes the diurnal variation of the rainfall at Calcutta and Batavia in their respective rainy seasons. In the author's opinion these facts seem to point to a compression and dynamic heating of the cloud-forming strata, and he points to the existence of a small irregularity in the diurnal temperature curves of Prague, Calcutta, and Batavia, which may possibly be due to such action. It is further remarked that the evening maximum about coincides with the time when the evening fall of temperature, after a rapid reduction between 6 or 7 and 10 p.m., becomes nearly uniform in rate, and it is suggested that the former may possibly be determined by the check of the rate of collapse of the cooling atmosphere. But it is observed that both the morning and evening waves of pressure probably involve other elements than the forced waves, and are in part rhythmic repetitions of previous waves.

Geological Society, April 25.—W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—Report on the recent work of the Geological Survey in the North-West Highlands of Scotland, based on the field-notes and maps of Messrs. Peach, Horne, Gunn, Clough, Hinxman, and Cadell. Communicated by Dr. A. Geikie. At the outset a review was given of the researches of other observers, in so far as they forestalled the conclusions to which the Geological Survey had been led. Reference was made to the observations of Macculloch, Hay Cunningham, C. W. Peach, and Salter; to the prolonged controversy between Sir Roderick Murchison and Prof. Nicol; to the contributions of Hicks, Bonney, Hudleston, Callaway, Lapworth, Teall, and others. It was shown that Nicol was undoubtedly right in maintaining that there was no conformable sequence from the fossiliferous quartzites and limestones into the eastern schists. It was also pointed out that the conclusions of Prof. Lapworth regarding the nature and origin of the eastern schists involve an important departure from Nicol's position, and are practically identical with those obtained independently by the Geological Survey. The results of the recent survey work among the Archæan rocks may be thus summarized: (1) the eruption of a series of igneous rocks of a basic type in which pegmatites were formed; (2) the development of rude foliation in these masses, probably by mechanical movement, and their arrangement in gentle anticlines and synclines, the axes of which generally run N.E. and S.W.; (3) the injection of igneous materials, mainly in the form of dykes, into the original gneisses, composed of (*a*) basalt rocks, (*b*) peridotites and palæopicrites, (*c*) microcline-mica rocks, (*d*) granites; (4) the occurrence of mechanical movements giving rise to disruption-lines trending N.W. and S.E., E. and W., N.E. and S.W.; (5) the effects of these movements on the dykes were to change the basalt-rocks into diorites and hornblende-schists, the peridotites and palæopicrites into talcose schists, the microcline-mica rocks into mica schists, and the granites into granitoid gneiss; (6) the effects on the gneiss resulted in the formation of sharp folds trending generally N.W. and S.E., the partial or complete reconstruction of the original gneiss along the old foliation-planes, and finally the development of newer schistosity more or less parallel with the prominent disruption-lines. There is an overwhelming amount of evidence to prove that all these various changes had been superinduced in the Archæan rocks in pre-Cambrian time. After reviewing the facts bearing on the denudation of the Archæan land-surface, the order of succession and thickness of the Cambrian strata were given, from which it is apparent that the deposits gradually increase in thickness as we pass southwards from Durness to Loch Broom. Prior to the deposition of the Silurian sediments the Cambrian strata were folded and extensively denuded. By these means various Cambrian outliers were formed far to the east of the present limits of the formation. The order of succession of the Silurian strata along the line of complicated structure from

Eriboll to Ullapool was described, reference being made to the further subdivision of the "Pipe-rock" and the Ghrudaidh Limestones (Group I. of Durness section). None of the richly fossiliferous zones of Durness is met with along this line, as they occupy higher horizons. An examination of the fossils recently obtained by the Geological Survey from the Durness Limestones confirms Salter's conclusions that they are distinctly of an American type, the Sutherland quartzites and limestones being represented by the Potsdam Sandstones and Calciferous Sand Group of North America. After the deposition of the limestones, the Cambrian and Silurian strata were pierced by igneous rocks, mainly in the form of sheets, producing important alterations in the sedimentary deposits by contact-metamorphism, the quartzites becoming crystalline, and the limestones being converted into marble. When this outburst of volcanic activity had ceased, terrestrial displacements ensued on a stupendous scale. By means of powerful thrusts the Silurian strata were piled on each other, and huge slices of the old Archæan platform, with the Cambrian and Silurian strata resting on it, were driven westwards for miles. With the view of illustrating the extraordinary complications produced by these movements, a series of horizontal sections was described, drawn across the line between Eriboll and Ullapool. The evidence relating to regional metamorphism was next referred to, from which it is obvious that with each successive maximum thrust there is a progressive amount of alteration in the displaced masses, as the observer passes eastwards to the higher thrust-planes. Eventually the Archæan gneiss is so deformed that the pre-Cambrian foliation disappears and is replaced by new divisional planes; the Cambrian grits and shales are converted into schists; the Silurian quartzites into quartz-schists; the limestones become crystalline; the sheets of intrusive felsite, diorite, and granitoid rock pass into sericite schist, hornblende-schist, and augen-gneiss respectively. These researches furnish a vast amount of evidence in support of the theory that regional metamorphism is due to the dynamical and chemical effects of mechanical movement acting on crystalline and clastic rocks. It is also clear that regional metamorphism need not be confined to any particular geological period, because in the N.W. Highlands, both in pre Cambrian time and after the deposition of the Durness Limestone (Lower Silurian), crystalline schists and gneiss were produced on a magnificent scale. After the reading of this Report, the Survey was congratulated on its work by the President, Prof. Lapworth, Prof. Judd, and other speakers.—On the horizontal movements of rocks, and the relation of these movements to the formation of dykes and faults, and to denudation and the thickening of strata, by Mr. William Barlow.—Notes on a recent discovery of *Stigmaria ficoides* at Clayton, Yorkshire, by Mr. Samuel A. Adamson.

Zoological Society, April 30.—Fifty-ninth Anniversary Meeting.—Prof. Flower, F.R.S., President, in the chair.—After the Auditors' Report had been read, and some other preliminary business had been transacted, the Report of the Council on the proceedings of the Society during the year 1887 was read by Mr. P. L. Sclater, F.R.S., the Secretary of the Society. It stated that the number of Fellows on January 1, 1888, was 3104, showing a decrease of 42 as compared with the corresponding period in 1887. A large number of valuable communications received at the usual scientific meetings held during the session of 1887 had been published in the annual volume of Proceedings, which contained 730 pages, illustrated by 55 plates. Besides this, one part of the twelfth volume, viz. Part C, of the Society's quarto Transactions, illustrated by seven plates, had been issued, and several other parts of Transactions were in a forward state. The volume of the *Zoological Record* for 1886 had been sent out in the month of January of this year to about 140 subscribers. The new edition of the Library Catalogue, spoken of in the last Annual Report as ready for issue had been published last summer. Two important additions had been made to the buildings in the Society's Gardens during the past year. The first of these, the wolves' and foxes' dens, which were commenced in 1886, had been erected by the Society's staff, under the supervision of Mr. Trollope, by whom the plans were drawn, and completed in November last. The second addition was a new aviary for flying birds which had been erected on the waterfowls' lawn, opposite the eastern aviary. This aviary is 105 feet long, 62 feet broad, and 27 feet high in the centre of the roof, which is formed of galvanized wire. The visitors to the Society's Gardens during the year 1887 had been altogether 562,898; the corresponding number in 1886 was 639,674. Mr. F. E. Beddard, Prosector to the Society, had been appointed Davis Lecturer for the present year, and had commenced a course of ten lectures on "Reptiles, living and extinct." These lectures were a continuation of a series given last year in connection with the London Society for the Extension of University Teaching. The number of animals in the Society's collection on the 31st of December last was 2525, of which 735 were mammals, 1331 birds, and 459 reptiles. Amongst the additions made during the past year, 13 were specially commented upon as of remarkable interest, and in most cases representing species new to the Society's collection. About 29 species of mammals, 21 of birds, and 3 of reptiles, had bred in the Society's Gardens during the summer of 1887. The Report concluded with a long list of the donors and their various donations to the Menagerie during the past year.—A vote of thanks to the Council for their Report was then moved by Dr. David Sharp, seconded by Mr. Robert McLachlan, and carried unanimously.—The Report having been adopted, the meeting proceeded to elect the new Members of Council and the Officers for the ensuing year. The usual ballot having been taken, it was announced that Dr. John Anderson, F.R.S., F. Du Cane Godman, F.R.S., John W. Hulke, F.R.S., Osbert Salvin, F.R.S., and Lord Walsingham, F.R.S., had been elected into the Council in place of the retiring members, and that Prof. Flower, C.B., F.R.S., had been re-elected President, Mr. Charles Drummond, Treasurer, and Dr. Philip Lutley Sclater, F.R.S., Secretary to the Society, for the ensuing year.—The meeting terminated with the usual vote of thanks to the Chairman, proposed by Lord Arthur Russell, seconded by Prof. G. B. Howes, and carried unanimously.

Mineralogical Society, May 8.—Prof. Bonney, F.R.S., Treasurer, in the chair.—The following papers were read:—Notes on some minerals from the Lizard, by Mr. J. J. H. Teall.—Contributions to the study of pyrargyrite and proustite, with analyses by Mr. G. T. Prior, by Mr. H. A. Miers.—On Cornish dufrenite, by Prof. E. Kinch.—On a peculiar variety of hornblende from Mynydd Mawr, Carnarvonshire; on a picrite from the Clicker Tor District, by Prof. T. G. Bonney, F.R.S.

PARIS.

Academy of Sciences, May 7.—M. Janssen, President, in the chair.—Note on the introduction of the element of mean averages in the interpretation of the results of statistical returns, by M. J. Bertrand. A demonstration is offered of the following theorem: Whatever be the number of urns (ballot-boxes and the like) and their composition, the law of discrepancies is the same for a single urn of given composition; but this urn will not yield the desired mean average. Hence in order to compare the results of statistical returns with those of abstract calculation two different urns must be assumed, the mean results being assimilated to the drawings made from the first, and the discrepancies to the results yielded by the second.—New theory of the equatorial *coudé* (continued), by MM. Lœwy and Puiseux. In this paper an explanation is given of the special processes applicable to the equatorial region, and of the physical methods employed to estimate the flexion of the axes. In a final paper the results will be given which have already been obtained in the application of this theory to the equatorial *coudé* of the Paris Observatory.—On the convergence of a continuous algebraic fraction, by M. Halphen. Three years ago the author communicated to the Academy the results of his researches concerning continuous fractions, which serve to develop the square root of a polynome of the third degree. In the present paper he extends his investigations to the case of a continuous fraction obtained by developing the function $f(x) = \frac{\sqrt{F(y)} - \sqrt{F(x)}}{y - x}$, where F indicates a polynome of the fourth or of the third degree.—On M. Massieu's characteristic functions in thermodynamics, by M. H. Le Chatelier. It is shown that these functions may be presented under a form somewhat different from that which they are usually made to assume, but which is more convenient for practical purposes.—On the variation of the specific heat of quartz with the temperature, by M. Pionchon. From the experiments the results of which are here tabulated it appears that from about 400° to 1200° C. the specific heat of quartz is constant and equal to 0·305. Thus the increase in the specific heat of this mineral is entirely confined to the interval between 0° and 400° C., a result which presents several points of interest in connection with M. Joubert's researches on the optical properties of the same substance.—On the theory of diamag-

netism, by M. R. Blondlot. The author's experiments tend completely to confirm M. Ed. Becquerel's views regarding the mutual relations of paramagnetic and diamagnetic bodies. It is shown that these views are in no way affected by Tyndall's experiment, which fails to prove the existence of diamagnetic polarity, and which is perfectly explicable by Becquerel's theory.—On the electric phenomena produced by the ultra-violet rays, by M. Auguste Righi. In connection with M. Stoletow's recent communication on this subject, the author points out that several of the results here given were previously announced by him in a note presented to the Academy dei Lincei on March 4, and printed at the time.—On the acid phosphites of the alkaline metals, by M. L. Amat. To the acid phosphite of ammonia $(PO_3HO)NH_4O,HO$, previously prepared by him, the author here adds the corresponding salts of potassa and soda $(PO_3HO)KO,HO$ and $(PO_3HO)NaO,HO$, and explains their method of preparation.—On the crystalline form of the trithionate of soda, by M. A. Villiers. The author has succeeded in obtaining crystals of this substance, the measurements of which are here given.—On terpinol, by MM. G. Bouchardat and R. Voiry. It is shown that certain derivatives of the terebenthenes generally supposed to be identical with List's terpinol are really of different composition, although presenting some marked analogies with that substance.—M. G. Demeny describes a number of instruments which he has devised for the purpose of accurately determining the exterior form of the thorax, the extent of the respiratory movements, the profiles and sections of the trunk, and the volume of air inhaled and exhaled. The last-mentioned is described as a self-registering "spirometer."

BERLIN.

Physical Society, April 20.—Prof. du Bois-Reymond, President, in the chair.—Prof. Vogel communicated the results of his researches on the spectrum of carbon. In recent times the spectra of all the carbon compounds have been recognized as being those due to carbon itself, the sole exception being in the case of cyanogen, whose spectrum was considered to be that of the compound, not of carbon itself. The speaker had therefrom investigated the spectrum of cyanogen, with the help of photography. He obtained a spectrum which was marked, from the red to the ultra-violet, by very characteristic lines. The spectrum of a Bunsen burner was next photographed, and it was found that its first three lines coincide in all respects with those of the spectrum of cyanogen; in addition a series of lines lying between the above and also in the blue were found to be identical in both spectra. On the other hand, the two bands in the blue and ultra-violet were absent in the spectrum of the compounds of carbon and hydrogen, being replaced by a series of very characteristic double lines. Prof. Vogel next photographed the spectrum of carbonic oxide, and found that its more highly refracted portion corresponded completely with that of cyanogen. The bands in the blue and ultra-violet were particularly well marked, whereas the less highly refracted half of this spectrum did not correspond with that of cyanogen. Finally, the light emitted by the electric arc was photographed, and its spectrum resembled in all respects that of cyanogen. The speaker drew the conclusion from these observations that in all four cases he was really dealing with the spectrum of carbon. The differences in the several spectra are not dependent upon differences of temperature, inasmuch as the temperature of a Bunsen flame is higher than that of cyanogen, and notwithstanding this the latter gave a more highly developed and complicated spectrum. The speaker was much more inclined to assume the existence of modifications of carbon, of which one yields its spectrum in the Bunsen flame, the other in the flame of carbon monoxide, the two spectra being met with united in those of cyanogen and the electric arc respectively. In photographs of the solar spectrum, the dark background on which the line G is conspicuous shows such a marked correspondence with narrow bands in all the above four spectra that the existence of carbon in the sun must necessarily be assumed.—Prof. Vogel then spoke on colour-perceptions, which he explained by means of experiments. It is well known that when a colour-chart is seen illuminated by the light of a sodium flame it appears colourless: the yellow appears to be pure white, and the other colours appear gray, graduating into black. This result is not observed with other monochromatic light, such as that of thallium or strontium. The speaker was, however, able to produce the same result by means of coloured glasses, whether red, green, or blue; those colours always appeared to be white or very bright which most strongly reflected the light with which the colour-chart was illuminated, all the other colours appearing to be either gray or black. When a second monochromatic light was added to a previous one, such as blue to a yellow light, then definite colour-sensations were observed, which increased in number when a third source of monochromatic light was superadded to the other two. Prof. Vogel laid great stress on the perception of white by monochromatic illumination of a uniformly coloured field of view. He was not prepared to give any explanation of the phenomena, but simply to bring them to notice, with the intention of investigating them further.

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