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NORTH AMERICAN PINNIPEDS

History of the North American Pinnipeds: a Monograph of the Walruses, Sea-Lions, Sea-Bears, and Seals of North America. By J. A. Allen, Assistant in the Museum of Comparative Zoology at Cambridge. (Washington: Government Press, 1880.)

THIS bulky octavo volume forms No. 12 of the miscellaneous publications of the Department of the Interior, United States Geological and Geographical Survey of the Territories, which is under the charge of F. V. Hayden. It is a most important contribution to the life-history of the species of American Pinnipeds, for which the zoologist as well as the merchant may well thank both Mr. Hayden and Mr. Allen.

It is not an easy task to analyse a closely-printed volume of nearly 800 pages, but still we trust to be able to give our readers some notion of the general contents of this interesting work. Of the mammals, leading an essentially aquatic existence, the furred and fin-footed group have always had an importance and interest for mankind. The existing Pinnipeds constitute three very distinct families—these are the Walruses, the Eared Seals, and the Earless Seals. The first two are far more nearly allied than are either of these with the third. The Earless Seal is the lowest or most generalised group. The Walruses are really little more than thick clumsy fat forms of the Eared Seal group, with immensely developed canine teeth, and skulls modified so as to bear these. All the Pinnipeds have a high degree of brain development, and are easily domesticated under favourable conditions; they manifest strong social and parental affections, and they defend their young with great courage. They are, almost without exception, carnivorous, mostly feeding on fish, mollusks, and crustacea. While the Eared Seals are polygamous, the males greatly exceeding the females in size, the Walruses and the Earless Seals are thought to be monogamous, and there is very little difference between the size of the sexes. The polygamous species usually resort in large numbers to favourite breeding-grounds, the young are born on dry ground, and are at first unable to swim; while the monogamous forms do not so uniformly resort to particular breeding-grounds on land, and they leave the water only for short intervals. As a group the Pinnipeds are very distinctly characteristic of the Arctic, Antarctic, and temperate portions of the globe; very few range into tropical waters, and only one species can be said to be strictly tropical. While the Seals, Eared and Earless, are abundantly represented on both sides of the Equator, the Walruses are only to be found within the colder portions of the Northern Hemisphere. Of the family of the Walruses but two living species belonging to the genus Odobænus are known, the one, *O. rosmarus*, being the Atlantic Walrus; the other, *O. obesus*, the Pacific Walrus. The history of both species is here given at length: first a full synonymy is given; then the general history, accompanied by figures; then habits, products, food, and enemies. Among the figures given are those of Elliott of the head of the Pacific species, which give an idea of the uncouth facial aspect and of the strangely-wrinkled skin; but it is a pity that none of Elliott's representations of an adult form were reproduced from his work on Alaska, published in 1879, and of which only one hundred and twenty-five copies were printed. Capt. Cook's description of this species is still one of the best extant—a species that may soon disappear if the annual slaughter of ten to twelve thousand animals is allowed to continue.

The number of genera and species among the group of the Eared Seals has fluctuated immensely even within the last ten years. The views of Gray and Peters have repeatedly changed on this subject, "greatly," the author writes, "in the case of Gray, out of proportion to the new material he had examined." In Peters' latest enumeration he gives thirteen species: five are Hair Seals, or Sea-lions, eight are Fur Seals, or Sea-bears. Mr. Allen enumerates nine—two with doubt. Five are Hair and four Fur Seals. A good deal of this discrepancy doubtless arose from writers not having learnt to distinguish the sexes, and from their not making due allowance for the great changes in contour and details of structure that result in the skulls of these animals from age. The most striking fact in respect of the distribution of the Eared Seals is their entire absence from the waters of the North Atlantic. The Fur and Hair Seals have nearly the same geographical distribution; but though commonly found frequenting the same shores, they generally live apart. They are about equally and similarly represented on both sides of the equator, but are confined almost wholly to the temperate and colder latitudes. The Hair Seals have coarse hard stiff hair, and are wholly without soft under-fur, the abundant presence of which in the Fur Seals it is which makes their skins so valuable as articles of commerce.

The Eared Seals are all gregarious and polygamous. Their breeding-places have received the strangely inappropriate name of "rookeries." The strongest males generally secure to their lot from twelve to fifteen females. During the breeding season the males remain wholly on land, and they will suffer death rather than stir from their chosen spot. They thus sustain for a period of several weeks a continual fast. Steller's account, given nearly a century ago, applies still to nearly all the species. The "sea-fur" of the furriers is obtained from these Eared Seals with the under-fur. Fortunately the destruction of the Fur Seals at the Aleutian Islands, where at one time these seals were killed at the rate of 200,000 a year, has now been placed under rigid restrictions, and the same systematic protection ought to be afforded to them at all their stations. In 1877 Mr. Elliott calculated that the number—owing to the Government regulations—of Seals on the Alaska Islands had increased so as to leave 660,000 breeding females to be added to the original stock, and that the total number would not be much less than 1,800,000.

The description of the Earless Seals forms nearly one half of the volume. The technical history of the group is given at length and is most interesting. The genus Phoca of Linneus embraced four species now placed in four distinct genera and in three families. Since then 103 distinct specific and varietal names have been bestowed upon what our author considers as sixteen species. These are located in three sub-families and placed in eleven genera. Copious synonymic details are given. Of the restricted genus Phoca, three—*P. vitulina*, *P. Groenlandica*, and *P. fœtida*—are marine, and frequent the northern oceans, never descending anywhere near to the equator. A fourth, *P. Caspica*, is found in the Aral and Caspian Seas, and a fifth, *P. Sibirica*, is from Lakes Baikel and Oron. *Monachus albiventer* occupies an intermediate position (Mediterranean, Madras, and Canary Islands) between these northern forms and the Antarctic species, such as *Macrorhinus leoninus*, *Ogmorrhinus leptonyx*, *Ommatophoca rossi*, and the like. All the species have strong social instincts, and are almost unsurpassed in their affection for their young. Most of them are gregarious; few of them are in the least ferocious; they are in general patient and submissive creatures, quite harmless to man. Fond of basking in sunshine, they spend a good deal of their time out of the water, on bank, rock, or ice. They are very voracious, eating fishes, or in lack of these, mollusks and crustacea. Strange though it may seem, the young seals take to the water reluctantly, and have to be actually taught to swim by their parents. The young of some species remain on the ice until they are from two to three weeks old, or until they have shed their first soft woolly coat of hair; their cry is more of a bark than a roar; that of the young is a kind of tender bleat, putting one in mind of the cry of a young child. Dr. Murie (*Proc.* Zool. Soc. London, 1870) has characterised three distinct modes of terrestrial locomotion among these Seals, from which it would appear that the Phocine Seals generally have considerable power of movement upon land.

The Seal-hunting districts are described at length; the oil and skins of these Seals having a large commercial importance. The Dundee sealers took in 1876 nearly 40,000*l*. worth. The habits of the various species form a most interesting portion of this division of the volume, and the author seems to have ransacked every treatise on the subject so as to make his own complete. This history of the North American Pinnipeds will long remain a perfect monograph of a valuable and important group of mammalia.

CATALOGUE OF NEWCASTLE LIBRARIES

Newcastle-upon-Tyne Public Libraries. Catalogue of the Books in the Central Lending Department. Compiled by W. John Haggeston, Chief Librarian. (Newcastle-upon-Tyne: 1880.)

NO portion of a book draws more heartfelt commendation or more earnest rebuke from a critic who has read it, not for the purpose of criticising, but for that of using its information, than the index. Only the reader who picks up a book for recreation and amusement feels at all independent of it; and even he appreciates its importance if any future reference is required. And if a good table of contents is so requisite in the case of a single book, how far more so must one be in a large library.

We have here a new catalogue of a new library, a selection of 20,000 volumes of books chosen for their readable value only (which perhaps justifies the omission of all dates of publication of the books, which would be a fault in a catalogue of most libraries), and consequently we may look to it as a model of what a catalogue should be. And we shall not be disappointed. It is drawn up on the same scientific principles worked out so fully in Dr. Billing's catalogue of the U.S. Surgeon-General's Office, which we noticed lately; and these so well worked out too, that really it is a table of contents of the library; the matter contained in the volumes of the latter as well as their titles are all laid before us. Each work is entered under the author's name, under the title, and, in cases where that title is compound, under each of the subjects it may include. Under the heading of each principal subject treated a reference is again given to the work with its library number, and so numerous are these cross references that on an average every volume throughout the library appears four times over. Indefinite titles are rectified by a summary being given, in a smaller type, of the matters discussed.

Catalogues which limit themselves rigidly to the contents of the title-page abandon all attempts at completeness, since many titles do not even pretend to express the subjects of the book (need we cite Mr. Ruskin's?), and many equally fail in the attempt. As the field of literature increases, and not even a librarian can keep himself acquainted with the ground gone over by all the books under his care, a subject-catalogue as well as an author- and title-catalogue becomes a necessity, and, if it is well drawn up, though it may cost both money and time, they will be well spent. Volumes that appear unattractive enough to the general reader, and are far too numerous for the ordinary student to search through, become suddenly, through a subject-catalogue, of the greatest value to both of them. The books in a library whose contents are thus laid open to its frequenters will be read with profit much greater than would a considerable fraction more books whose title-page was all the introduction their readers had to them.

And the saving of time when it is completed will be immense. It will save the time of the librarian by preventing hundreds of inquiries being made at all, and still more by strengthening the hands of his assistants, who will be capable of working his catalogue to the utmost and answering a very large proportion of such inquiries as are made by readers who may be awkward at it; it will save the time of the busy man, who wants his information at once; it will save the time of the student who wants the most recent information which he can get; and it will save the time of all by making fewer changes of books necessary.

All this is doubly important in a Free Library, because, as any one taking an interest in these institutions will have marked, those of its readers who do not confine themselves to novels seldom take out books for the mere pleasure of reading, as the higher classes do. Reading has not yet become a recreation to them, but they go to the library as to a great encyclopædia to get information on certain subjects, often of the most technical character; and a catalogue that directs them to the very book they want doubles and trebles the value of the library to them. They have no time to read all the *critiques* and *résumés* of new books with which the press teems, and which make the style and contents of many such works familiar to readers of periodicals who may never have seen the works themselves. Where hundreds go in an evening for books it is impracticable to allow them access to the shelves of the library to select them; while in an ordinary bare list of titles it is impossible for them to judge which book in a column will be found the one most to their requirements.

Like Dr. Billings, our Newcastle librarian has fully worked out a most important branch of a subject-catalogue. Magazine literature in these days has become far too important to be treated by either a thrifty librarian or an inquiring student as "fugitive" and "ephemeral." All the newest science now appears first in journals, and all leaders of thought give their first expression of it in magazines and reviews. In this new catalogue therefore we are much pleased to see that not only is each volume of all important periodicals entered separately with its list of articles, but, as we have said, under the head of each subject a reference is given to all of such articles as bear upon it. By this means students who have read a standard work published a few years ago upon any subject will be not only guided but stimulated into reading the latest researches or theories which these publications contain. It is perhaps going beyond our subject, but we cannot help noticing how convenient for this important purpose a card-catalogue at a library is; in which cards containing the subject of each article down to the last number of all the magazines have been dropped into their places. Such an arrangement would make many students feel a printed catalogue to be ancient by the time it was published.

The selection of books as a whole is admirable—though of course few selections have been made under such favourable circumstances. We are rather surprised in so large a list to note the absence of books like Boyd Dawkins's "Cave-Hunting" and "Early Man in Britain," Clifford's "Lectures and Essays," Croll's "Climate and Time," Moseley's "Naturalist on board the *Challenger*," and Sir Wyville Thomson's book; Hæckel's "History of Creation" and "Evolution of Man"; Schliemann's "Troy" and Cesnola's "Cyprus"; Wallace's "Geographical Distribution of Animals," &c. And if some of these are so costly as to be confined to the Reference Library, as is probably the case here, still we are sorry to miss Wallace's "Tropical Nature," and R. Jefferies ("The Gamekeeper at Home") with his series of books teaching men to open their eyes as they move about the fields and lanes.

The printing is a credit to both printer and editor. It is almost as funny as the "Ingoldsby Legends" to read "Life and Remains of *Dean* Hook," by Barham! but it is plainly a slip, and the smallest errors are very scattered.

The Rules and Regulations are clumsy to enforce, which indeed will probably not be attempted, at any rate for long. The annoyance of having to get a guarantor practically shuts out many whose hitherto idle life might have taken a fresh start if books had been put into their hands freely. We have been very pleased to see that several large libraries have done away with this irritating system without any loss of property, and it seems a step backwards when a new institution like this starts with more rigid and inconvenient rules than many others. Indicators are capital things in libraries to which each reader goes for his own book as at a university, but only very few of the hundreds who exchange books every night at a flourishing Free Library are at all able to work with them. Children are the usual messengers, not high enough to consult an Indicator of 20,000 volumes. It is an unmerciful rule that borrowers should return their books personally, and a downright unreasonable one that every book must be returned in a fortnight (Rule 17), NOT to be re-issued the same day (Rule 16), although we are told (p. vi.) that three-volume works are issued complete. Few Free Library readers can get through 600 or 800 pages in a fortnight. And surely it was not necessary to threaten each person who consults the catalogue with imprisonment *with whipping* if he defaces a book! It may be necessary to make such Draconian laws, but they should be brought forward to intimidate gross offenders, not flourished in the face of all whom we wish to attract. Such severe rules repel sensitive people, while from their very familiarity they lose their effect on the careless.

OUR BOOK SHELF

Botanische Jahrbücher für Systematik Pflanzengeschichte und Pflanzengeographie. Herausgegeben von A. Engler. Erster Band, zweites Heft. (Leipzig: Wilhelm Engelmann, 1880.)

THIS part includes four papers. The first is by W. O. Focke, on the natural divisions and geographical distribution of the genus Rubus. The characters chiefly discussed are:—1. Mode of growth or habit. 2. Forms of leaf which are very numerous: the duration of the leaf being also variable. 3. Characters derived from the stipules, which are considered of great value. 4. Inflorescence; and 5. the Structure of the flower. The number and size of the parts of the calyx and corolla vary, as also the colour of the corolla. The stamens vary in closely allied species, and while most of the species are hermaphrodite, some are unisexual. The structure of the gynœcium is very varied, the number of carpels being five or six in some, as in *R. dalibarda*, or above 100, as in *R. rosæfolius.* The hairs (trichomes) on the different parts of the plant are very numerous and remarkable for the variety of structure shown; no other group, except perhaps some Solanaceæ, approaching the Rubi in this particular. In regard to the geographical distribution the most important points are:—1. The characteristic difference in the Rubi of Eastern Asia and Europe. 2. The predominance of European forms in the Atlantic, and of East Asian forms on the Pacific side of America. 3. The occurrence of south Chinese and north Indian types in Mexico and Peru. These peculiarities Focke would explain on geological grounds.

The second paper is by Franz Buchenau on the distribution of Juncaceæ over the world. The author gives a complete list of the species of the genera Juncus: Luzula, Rostkovia, Marsippospermum, Oxychloë, Distichia, and Prionium, and a table showing their distribution into regions nearly corresponding to those of Grisebach.

Koehne, in the third paper, gives the first portion of a monograph of the Lythraceæ, including a key to twenty-one genera. He admits and then describes thirty-one species with numerous varieties of Rotala (Ammania, Linn., Benth., and Hooker).

The last paper is by Engler. Contributions to the knowledge of the Araceæ, in which he describes some new Araceæ from the Indian Archipelago and Madagascar, and also directs attention to the cultivation of *Zamioculcas Loddigesii* from the detached leaflets of the remarkable pinnate leaf of the plant. A swelling occurs at the base of the leaflet, and in a few days a small tuber is produced which develops two buds, below each of which roots are formed. The plant has been propagated in this way by Herr Hild of the Kiel Botanic Garden.

The Fishes of Great Britain and Ireland. By Dr. Francis Day, F.L.S., &c. (London: Williams and Norgate, 1880.)

THIS work is to be issued in nine parts, of which the first, containing sixty-four pages of text and twenty-seven plates, is now published. Waiting until the completion of the work for a more extended notice, we may for the present mention that in it the author purposes to give a natural history of the fishes known to inhabit the seas and fresh waters of the British Isles, with remarks on their economic uses and on the various modes of their capture, and that an introduction to the study of fishes in general is promised.

The synonymic lists of the species are given in great detail; the descriptive diagnoses treat of internal peculiarities as well as of external form; a good many interesting details appear under the headings of Habits, Means of Capture, Baits, Uses. The plates are from drawings by the author, and are very excellent.

A Manual of the Infusoria. By W. Saville Kent, F.L.S. (London: David Bogue, 1880.)

THIS sometime promised work has now advanced so far in its publication as the third part; when completed it will merit a somewhat lengthened notice, as the most important work on the subject which has issued from the British press. It is intended to include a description of all known flagellate, ciliate, and tentaculiferous Protozoa, British and foreign, and an account of the organisation and affinities of the Sponges. Each part (roy. 8vo in size) contains over 140 pages and eight plates. The general get-up of the work is magnificent, rather too much so for the poor student, already weighed down by the burden of the parts of Stein's "Infusionsthiere," but very pleasant for the book fancier, and forming an imposing shrine wherein to inclose the records of these early-life forms.

The first five chapters (pp. 1-194) are introductory, treating of the general history of the group: on the subkingdom Protozoa, on the nature and organisation of the Infusoria, on spontaneous generation, on the nature and affinities of the sponges. The sixth chapter treats of the systems of classifications of the Infusoria, adopted by various authorities, from the time of O. F. Müller to the present date. The seventh chapter commences the systematic description of the Flagellata. The third part, just published, carries the work as far as the 432nd page and to the twenty-fourth plate.

A Complete Course of Problems in Practical Plane Geometry . . . with an Introduction to Elementary Solid Geometry. A New, Revised, and Enlarged Edition. By J. W. Palliser. (London: Simpkin, Marshall, and Co., 1881.)

THIS is a cheap manual, the cost of which can be easily met by any artisan desirous of studying the subject, while at the same time its contents enable it to fully satisfy the wants of all examinees in first, second, and third grade and similar papers of the Science and Art Department Examinations. The figures are very clearly drawn, well showing given, constructional and required lines; the form of the page enables four propositions to be fully treated of with the accompanying figures in four spaces on each page. In the constructions we do not look for novelty, but we have conciseness and great clearness generally prevailing. Here and there elegance of expression is sacrificed to brevity ("for all the Government examinations, the requirements of which this is a text-book, the same rules will apply, with exception of Nos. 1 and 6"). We have detected only three points which call for our notice: in Prop. 12 it strikes us as being simpler to use the same radius throughout, thus doing away with the necessity of taking two cases, as Mr. Palliser does; in Prop. 37, *note*, it is necessary to add *how* the point is obtained; in Prop. 212 the letter E is made to do double duty in the proof. We can confidently recommend the book.

Bericht über die Thätigkeit der Botanischen Section der Schlesischen Gesellschaft im Jahr 1877. Erstattet von Prof. Dr. Ferdinand Cohn.

MOST of the papers in this part are in abstract; a few however are given at some length, and are of considerable interest. The additions to the phanerogamous Flora of Silesia and the record of new localities for rare plants occupy a considerable part of the pamphlet. Perhaps the most interesting paper is that on the Date-palm and Palm-forest at Elche in Spain, by General von Schweinitz. The palms there grow to a height of from seventy-five to eighty feet. The plants grow for about 100 years, then become stationary, and next decay. Each tree bears from the fifth year two to five bunches of fruit, each with from 500 to 600 dates, the weight of dates yielded by one tree being sometimes three centners. Many of the papers in this part are contributed by Goeppert and Cohn, and deal with all departments of botany. Dr. Thalheim describes a series of models of diatoms made in paraffin and glycerine soap, which exhibited the structure of all the chief groups of this order of plants.

LETTERS TO THE EDITOR

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

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

Dr. Carnelley's Hot Ice

THE remarkable observation made by Dr. Carnelley that ice in a vacuum is very permanent, even though surrounded by and apparently in contact with very hot bodies, has caused him to suppose and maintain that the ice itself is at a high temperature; a supposition which has been apparently confirmed by preliminary calorimetric determinations. This proposition has naturally met with a good deal of scepticism, and certainly requires ample and cautious verification; but I venture to think that there is nothing in it contradictory to our present knowledge of the properties of matter, though if verified (as, for the reasons to be stated, I fully believe it will be) it constitutes an important addition to that knowledge.

The notions which have occurred to me have made the essential part of the phenomenon so much clearer to myself that I fancy they will not be uninteresting to your readers.

By the term "vapour-tension" at a given temperature I mean, as I believe is usual, the pressure at which a liquid and a vapour can exist permanently together at that temperature, or the maximum pressure which the vapour is able to exert at that temperature, or the vapour pressure under which a liquid ceases to evaporate, or the total pressure at which it begins to boil. By the term "boiling-point" I mean the temperature of a liquid under a total pressure equal to its vapour-tension.

Now in order that a solid may sublime or pass directly into the vaporous condition without melting, it must be either at a temperature below the melting-point, so that no liquid attempts to form, or else at such a temperature that any liquid formed shall instantly evaporate; which it would certainly do if it were above the boiling-point, that is if the total pressure on it were less than the vapour tension.

A solid, under either of these circumstances, gives off vapour from its free surface at a rate depending on, but not necessarily proportional to, the supply of heat; for there is no definite subliming point for a solid, any more than there is a definite evaporating point for a liquid, so that the temperature of the solid need not remain constant. When a liquid is evaporating, the more you heat it the faster it evaporates, but not at a compensating rate, and the temperature rises as well: if this be true for a liquid, much more will it be true for a solid, whose evaporation is always more encumbered, partly, no doubt, because its evaporating surface is a fixture. The only limit to the rise of temperature of a liquid is its boiling, but if this be prevented it may get superheated; and, unless the solid boil (*i.e.* disintegrate internally) it can become superheated to any extent. The possibility of this internal disintegration we will examine directly, but at present we will consider it practically *nil*.

Let us grant then that a subliming solid always rises in temperature if heated at a sufficient rate, and Dr. Carnelley's proposition follows.

We have seen that no liquid can exist at temperatures below its freezing- or above its boiling-point, so that if we wish to prevent the possibility of its existence, we need only make these two points coincide. This can always be done by diminishing the pressure, for the boiling-point of all substances is greatly affected by changes of pressure, while the freezing-point is only slightly altered, and even, in the case of ice, in the opposite direction.

Start then with the solid below its melting-point, and reduce the pressure on it till the boiling-point coincides with, or passes below the melting-point. There is now no region where liquid can exist, and the solid must therefore sublime; but, by our supposition, a subliming solid if heated will get hot, hence the solid may now assume any temperature you please; and the hotter it gets the more pressure may be brought to bear upon it without causing it to melt, *i.e.* the pressure may be allowed to increase to anything short of the vapour-tension at the new temperature. If heated sufficiently, then the whole atmospheric pressure may be let in, and no melting will occur. All that is necessary is that heat shall be supplied at a sufficient rate to compensate for the rapid evaporation (which however will not be so rapid as in the vacuum), and to prevent its temperature falling to the boiling-point; for if it reached this, part (or all) would quickly liquefy, and the whole fall to (or towards) the melting-point.

Thus we have the remarkable proposition that if, by the process of lowering the boiling-point to coincide with or pass below the melting-point, we manage to get ice across the gap which ordinarily separates these two points, it may be heated to 120° or to any other temperature; and that when at 120° it will be permanent, and will not melt even under the whole pressure of the atmosphere. To prevent its melting you must keep on heating it: if allowed to cool to 100°, five-eighths of it will be instantly crushed to water, and the whole will be at 0° (assuming, what is not likely to be correct, that the specific heat of hot ice is ½).

There is still the question of the possibility of internal melting or sublimation to be considered.

Now I suppose that if a solid is perfectly homogeneous, a change of state in its interior would with great difficulty occur, and the solid might readily be superheated. But an excess of pressure at any point, such as would be produced by a bubble of air, would readily determine a melting-centre. In Prof. Tyndall's ice-flower experiment the nuclei are probably minute bubbles of air, and the ice walls of the cavities so produced are subject to the pressure of this air in addition to that of the vapour; and accordingly melting sets in and spreads. But Dr. Carnelley's ice is formed *in vacuo*, so that no air-bubbles are possible, and the only nuclei that can properly exist are little bubbles of enclosed vapour; and these, I imagine, can scarcely be absent. Let us inquire then what can happen in the case of one of these bubbles when the temperature of the ice is raised either by radiation or conduction. Initially, while the temperature is constant, the vapour is saturated; but no liquid is formed because this temperature is below the melting-point. When heat is applied, the ice, being less diathermanous than the vapour, will get heated first, and so long as the temperature keeps rising it will always be a little hotter than the vapour, which consequently is not quite saturated, and the pressure it exerts is less than the "vapour-tension" (*i.e.* the temperature is above the boiling point), and no water can be formed. The cavity will of course enlarge by sublimation, but very slowly, much more slowly in fact than outside, if a vacuum is there artificially maintained.

But if cooling be permitted the ice will cool the fastest; and the vapour at once becomes over-saturated and condenses. The temperature is now below the boiling-point, and liquefaction instantly sets in and rapidly spreads, the ice consuming its own heat in the process.

Internal disintegration therefore will not occur while the temperature is rising, but it will set in at a great pace if it be allowed to become stationary or to fall, unless there be an utter absence of nuclei. If the temperature rises very high the pressure of the internal vapour will of course be great, and ultimately might even be able to burst the ice, but this would scarcely occur under several atmospheres.

It would be interesting if Dr. Carnelley would kindly try the following experiments:—

1. Heat ice *in vacuo* with a pressure gauge, and, still heating it, stop the passage to the condenser so that the pressure is allowed to accumulate, and note the pressure and temperature when collapse occurs.

2. Heat ice up to any temperature, and, still maintaining a good vacuum, remove the supply of heat, and see if the ice does not collapse.

3. Heat the ice up to 120°, and, still heating it, let in the atmosphere gently (but make the air come in through hot pipes, or it will melt the ice), and see if the ice does not last rather longer than it would have done in the vacuum, because the evaporation will be more obstructed. But if the second experiment succeed, the temperature must never be allowed to fall much or to remain stationary long.

Finally, it is important to point out explicitly that the Carnelley experiment has no bearing on the change of the melting-point of ice with pressure. Our knowledge on this point remains as it was, viz. that the value of $\frac{d\theta}{dp}$ about zero centigrade is $-\cdot 0071$; that is to say, the melting-point rises and falls about ·0071° centigrade per atmosphere of pressure decrease or increase.

Of course this number is not absolutely constant, but its variation with pressure is very slight, and moreover has no bearing on the Carnelley experiment, as was naturally but erroneously supposed by Prof. Pettersson in the *Berichte* (18), and I believe also by Prof. Ayrton at the Chemical Society, though I had not the pleasure of hearing his remarks.

University College, London OLIVER J. LODGE

Note.—With reference to the above second experiment and the reasoning which suggested it, it is important to remark that I have all along assumed that the vapour-tension of ice at any temperature is precisely the same as that of water at the same temperature. But Prof. Foster considers it possible that the vapour-tension of ice may be less than that of water, and would hence explain the permanence of vapour inside an ice-cavity without attending to whether the temperature were rising or falling, provided it were not falling too fast. This would be a most important fact to discover and verify; but I think the Carnelley experiment in its present form does not inform us concerning its truth or falsity.

Another thing it may be interesting to note is the rate of variation of boiling-point with pressure at different temperatures, which can be calculated on thermodynamic principles (after Prof. James Thomson) from empirical data for the latent heat of steam, and for the density of saturated steam at any temperature.

It is, at the temperature θ and the pressure p,—

$$\frac{d\theta}{dp} = \frac{\theta^2}{273 \times \cdot 008 \times (796\cdot 2 - \cdot 695\,\theta)\,J\,p},$$

a fraction which has the value 28 at 100° C., and 2180 at 0° C.: these numbers represent the rate of rise or fall of boiling-point in centigrade degrees per atmosphere increase or decrease.

Integrating this equation, we get the value of the vapour-tension p of water in atmospheres (megadynes per square centimetre) at any absolute temperature θ, viz:—

$$\log p = 9\cdot 1728 \left\{ \cdot 695 \log \frac{373}{\theta} + 796\cdot 2 \left(\frac{1}{373} - \frac{1}{\theta} \right) \right\},$$

the logarithms being to the base e.

On the Spectrum of Carbon

I HAVE a great respect for Dr. Watts's spectroscopic work, nevertheless the experiments he has described in NATURE, vol. xxiii. p. 197, appear to me singularly inconclusive for the purpose for which he has adduced them. How could any one expect to get a tube of gas free from hydrocarbons when the joints were of india-rubber and melted paraffin? I have long since found it necessary to forego rubber joints if I would exclude hydrogen. Salet has shown that the hydrocarbons from the blowpipe-flame used in sealing in wires, &c., and the last traces of dust, can only be removed from tubes by burning them out in a current of oxygen. But more than this, I have found that even with joints all made by fusion of the glass it was well nigh impossible to get rid entirely of hydrogen. Mr. Crookes has, I believe, found that the last traces of moisture adhering to glass can only be expelled by heating to the softening point of the glass. This tallies with my own experience. In a series of experiments on the ultra-violet water spectrum I had occasion to photograph the spectra of sparks in sundry gases wet and dry, and found that in gases which had been passed through a tube full of phosphoric anhydride the water-spectrum still appeared strongly. Even when the gas had been passed very slowly through two tubes each half a meter long filled with calcium chloride, and then through a similar tube full of phosphoric anhydride, and the part of the tube where the wires were sealed had been heated strongly for a long time, while the current of gas was passing, traces of the water spectrum still often appeared. But Dr. Watts did not see the hydrogen lines in his tube. My difficulty has always been to avoid seeing them when the pressure of the gas was sufficiently reduced and a large condenser used with the induction coil. True: tubes of gas may not always show them even when hydrogen is known to be present. The spark takes a selected course of its own, and does not always light up all that is in the tube. Carbonic oxide does not generally show oxygen lines, and in tubes exhausted by a Sprengel pump the lines of mercury do not usually appear until the pumping has been carried far. A real test would be to see whether when the spark gives the line-spectrum of carbon the hydrogen lines do not also appear. The experiment with naphthaline Prof. Dewar and I have repeated and discussed elsewhere, so I will say no more on it than this, that purity in regard to chemicals is a relative rather than an absolute quality, and that it is only from a long series of experiments chosen with a view to eliminate the effects of accidents of all kinds that any safe induction in this kind of spectroscopy can be reached.

Cambridge, January 4 G. D. LIVEING

[To save time we submitted Prof. Liveing's letter to Mr. Watts, who sends the following reply.—ED.]

I SEE no reason why india-rubber stoppers may not be used in the construction of an apparatus to be filled with a gas *at atmospheric pressure*, or nearly so. The case would be altogether different if we were concerned with the construction of a vacuum tube, and I take it that most of these statements of the difficulty of getting rid of the last traces of moisture and of hydrocarbons adhering to the glass refer to cases where the pressure is to be only a few millimetres. But when a current of cyanogen at atmospheric pressure, made from dried mercuric cyanide, is passed through a U-tube filled with phosphoric anhydride, the gas is surely dry to all intents and purposes (I do not say that the glass would not give off traces of moisture, &c., if the pressure were to be reduced to an extreme point); at least there can be so little hydrogen present in the tube that to ascribe the spectrum given by the tube to the hydrogen present in it is to adopt an extreme hypothesis, which must be supported by cogent experimental evidence before it can be accepted.

But if the defect of the experiment be in the use of india-rubber there can be no great difficulty in constructing the apparatus entirely of glass, and if we are to give up the view that the groups δ (5165 to 5082) and γ (5635 to 5478) are due to carbon, it must be shown that they are not present in the spectrum of the spark in cyanogen at atmospheric pressure when sufficient precautions are taken to obtain the gas pure. I have never examined the spectrum of the spark in cyanogen without seeing them, and have every confidence that Prof. Liveing will still find them there after he has taken all the precautions he may think necessary.

But admitting for the sake of argument the justice of Prof. Liveing's contention that the cyanogen in my experiment contained a trace of hydrogen and that the naphthalin contained a trace of nitrogen, then this seems to be the theory offered for our acceptance—that the spark in nitrocarbon gas containing a trace of hydrogen gives the lines of hydrocarbon, and that the spark in hydrocarbon gas containing a trace of nitrogen gives the lines of nitrocarbon. Does Prof. Liveing hold *both* of these hypotheses to be reasonable? W. M. WATTS

Geological Climates

THE letter of Prof. Haughton in last week's NATURE so bristles with figures and calculations that some of your readers may feel a little puzzled and may be unable to detect the fallacies that lurk among them. The question is far too large a one to be fully discussed in your columns. I shall therefore confine myself to pointing out the erroneous assumptions and false inferences which vitiate all the learned Professor's calculations, having done which my own theory will remain, so far, intact.

The whole argument against me is based upon an "ideal ice-cap," extending from the Pole to lat. 60°. A considerable but unknown thickness is given to this imaginary field of ice, and it is then calculated that the three great ocean streams, even if admitted to the Arctic area in the manner I suggest, would not get rid of this mass of ice. There are however several important misconceptions and illogical deductions underlying the whole argument, and when these are exposed the results, however accurately worked out, become completely valueless.

We first have it stated that if heat and cold were uniformly distributed over the Polar regions the whole would be permanently frozen over, and an ice-cap be formed of great but varying thickness, diminishing from the Pole to about lat. 60°. But even this preliminary statement is open to serious doubt; for ice cannot be formed without an adequate supply of water, and over a large part of the Polar area no more snow falls than is annually melted by the sun and by warm southerly winds blowing over the heated land-surfaces of Asia and America. Admitting however that any such ice-cap could be formed, it would certainly not form in *one year* but by the accumulations of a long series of years; and any estimate of the *total* heat required to melt it has no bearing whatever on the *annual* amount that would be sufficient, since this depends solely on the average thickness of the ice *annually* formed, of which Prof. Haughton says nothing whatever.

The amount of rainfall in the Arctic regions (mostly in the form of snow) is certainly very small. It is estimated by Dr. Rink to be only twelve inches in Greenland, and this is probably far above the average. All that falls on the inland plains of Asia, Europe, and America is however melted or evaporated by the action of the sun and air far from the influence of the Gulf Stream. The thickness of ice formed annually over the whole area of the Arctic Ocean I have no means of estimating. In open water in very high latitudes it may be considerable, but perennial ice-fields can only increase very slowly. I should therefore very much doubt if the thickness of ice now formed annually over the whole Arctic area averages nearly so much as five feet; and Prof. Haughton himself calculates that our own Gulf Stream is now capable of melting this quantity.

The first assumption, therefore—that the amount of heat required to be introduced into the Arctic regions in order to raise their mean temperature above the freezing-point is "accurately measured" by the amount required to melt an "ice-cap" covering the whole area to a thickness of several hundred feet—is grossly erroneous; and it is so because it takes the hypothetical *accumulated* effects of *many years* Arctic cold under altogether impossible conditions, and then estimates the amount of heat required to melt this whole accumulation in *one year!*

But we find a second and equally important error, in the assumption (involved in all Prof. Haughton's arguments and figures) that all the ice of the alleged "ideal ice-cap" must be melted by that portion of the Gulf Stream which actually enters the Polar area, where its temperature is taken to be 35° F. or only 3° above the melting point of ice. A large quantity of the Arctic ice, however, even now floats southward to beyond lat. 50° in both the Atlantic and Pacific, and is melted by the warmer water and atmosphere and the hotter sun of these lower latitudes. Now, as it is an essential part of my theory that much of Northern Asia and North America were under water at those early periods when warm climates prevailed in the Arctic regions, it is clear that whatever Arctic ice was then formed would have a freer passage southwards, and as the south-flowing return currents would then have been more powerful and more extensive than at present, a much larger proportion of the ice would have been melted by the heat of temperate instead of by that of Arctic seas.

Prof. Haughton admits that the Kuro Siwo and the Mozambique currents together, if they entered the Polar seas, would be equal to the melting of a layer of ice more than thirteen feet thick over the whole area down to lat. 70°. But if our own Gulf Stream is sufficient to get rid of the whole of the ice that now forms annually—as Prof. Haughton's figures show that it would probably be, and as it would be still more certainly were Greenland depressed, thus ceasing to be the great Arctic refrigerator and ice-accumulator—then the heat of the other two currents would be employed in raising the temperature of the Arctic seas above the freezing-point; and if we take the area of the water as about equal to that of the land, we shall have heat enough to raise the whole Arctic ocean to a depth of full 180 feet more than 20° F., or to a mean temperature of 52° F., and as this would imply a still higher surface temperature it is considerably more than I require.

Unless therefore Prof. Haughton can prove that the amount of ice now forming *annually* in the Polar regions is *very much more* than an average of five feet thick over the whole area, his own figures demonstrate my case for me, since they prove that the rearrangement of land and sea which I have suggested would produce a permanent mild climate within the Arctic circle and proportionally raise the mean temperature of all north-temperate lands.

Briefly to summarise my present argument:—Prof. Haughton's fundamental error consists in assuming that the true way of estimating the amount of heat required in order to raise the temperature of the Polar area a certain number of degrees is,—first, to suppose an accumulation of ice indefinitely *greater* than actually exists, and then to demand heat enough to melt this accumulation *annually*. The utmost *possible* accumulations of ice in the Arctic area, during an indefinite *number of years*, and under the most *adverse physical conditions* imaginable, are to be all melted in *one year;* and the heat required to do this is said to be the "accurate measure" of that required to raise the temperature of the same area about 20°, at a time when there were no such great accumulations of ice and when all the physical conditions *adverse* to its *accumulation* and *favourable* to its *dispersal* were immensely more powerful than at present!

When this fundamental error is corrected, it will be seen that Prof. Haughton's calculations are not only quite compatible with my views, but actually lend them a strong support.

ALFRED R. WALLACE

By the courtesy of Mr. Ingram I am enabled to say that the tree at Belvoir supposed to be *Araucaria Cunninghami* is in reality, as surmised by Capt. King, *Cunninghamia sinensis.* The *Cunninghamia* is a native of Southern China, whence it has been introduced into Japan. In this country it was originally grown under glass, but, as the instance at Belvoir illustrates, such protection is not absolutely requisite. The tree is however somewhat tender, and so far as I know has never produced its cones in this country in the open air.

As to the Bamboos hardy in this country, it may be well to warn those who are not familiar with the plants not to expect to see the gigantic and rapidly-growing grasses that go under this name in the tropics. Rarely indeed do they attain in this country the dimensions even of the *Arundo donax*, so familiar to travellers in Italy. As accuracy of nomenclature is proved in this and the foregoing instance to be a matter of much moment, it may be well to say on the authority of the late General Munro that the Himalayan plant commonly grown in gardens as *Arundinaria falcata* is more correctly called *Thamnocalamus Falconeri*, that the *Bambusa gracilis* of gardens is the true *Arundinaria falcata* of the Himalayas, and that the Japanese *Bambusa metaké* is *Arundinaria japonica.* General Munro's monograph of this group is to be found in the twenty-sixth volume of the *Transactions* of the Linnean Society, part 1, 1868, while his remarks on the cultivated species may be found in recent volumes of the *Gardeners' Chronicle*, particularly in vol. vi. 1876, p. 773.

The simultaneous flowering of *Thamnocalamus Falconeri* a few years ago in all parts of Europe created much attention, and was indeed a remarkable illustration of hereditary tendency manifested under very varied climatal conditions. The flowering of this grass was by no means looked on with unmixed gratification, as it entailed as a consequence the death or protracted enfeeblement of the plant.

A visit to Kew or to any of our larger nurseries will suffice to show that there are other Bamboos (that is, grasses belonging to the group *Bambuseæ*, if not true Bambusas) which are hardy enough to withstand even such rigorous winters as those of 1878-9 and 1879-80.

MAXWELL T. MASTERS

Climate of Vancouver Island

THE letters on this subject which have appeared in NATURE (vol. xxiii. pp. 147, 169), have reminded me of a "Prize Essay on Vancouver Island. By Charles Forbes, Esq., M.D., M.R.C.S.Eng., Surgeon Royal Navy," which was published by the Colonial Government in 1862. It consists of sixty-one closely-printed octavo pages and eighteen pages of Appendix; the latter containing several Tables on the Meteorology of the Colony.

The following is a portion of the "Abstract of Meteorological Observations, taken at the Royal Engineer Camp, New Westminster, during the year 1861, by order of Col. R. C. Moody, R.E., Commanding the Troops. Lat. 49° 12′ 47″ N., Long. 122° 53′ 19″ W." (p. 3, Appendix):—

Max. temp. of air in shade	at	9.30 a.m.,	July	9,	74·3° F.
,,	,,	,,	3.30 p.m.	,,	84·0 ,,
Mean	,,	,,	9.30 a.m.		48·8 ,,
,,	,,	,,	3.30 p.m.		52·2 ,,
Min.	,,	,,	9.30 a.m.,	Jan. 21,	20·0 ,,
,,	,,	,,	3.30 p.m.,	Dec. 23,	24·0 ,,
Min. temp. on grass on January 21	...	...	...	...	10·0 ,,

All the observations were made at 9.30 a.m. and 3.30 p.m. daily throughout the year.

WM. PENGELLY

Torquay, January 6

Dimorphic Leaves of Conifers

IT is now generally believed that some of the varying forms assumed by individual plants or animals in the course of their development are as it were the reflex of an ancestral state of things. From this point of view the different forms of leaves assumed by some Araucarias, as well as by many other conifers, become of particular importance. The Retinosporas now so common in our gardens and on our balconies represent an immature stage of some Thuya, the proof of which statement is occasionally furnished by the plants which suddenly assume the foliage characteristic of that genus. In various species of juniper, notably in the Chinese juniper, two forms of leaf representing the juvenile and the adult condition occur together on the same branch.

Assuming that the juvenile, or "larval" forms, as they have been called, do really represent previous conditions in the history of the species, it might be expected that some of the fossil coniferæ would be characterised by the possession of this larval foliage to the exclusion of any other. But if I mistake not both forms of foliage have been met with in fossil as in recent conifers, and the pedigree of these plants is by so much the more pushed back.

The resemblance in the form and arrangement of the adult leaves in some Thuyas and allied plants to the disposition of the leaves in Selaginella should not be overlooked in this connection nor the close resemblance between the foliage of some species of Lycopodium proper and the "larval" leaves of many conifers as above referred to.

MAXWELL T. MASTERS

Dust and Fogs

THE meteorological conclusions of Mr. Aitken's important paper, published in NATURE, vol. xxiii. p. 195, will, if adopted without further examination, even temporarily, exercise an unfortunate influence upon the present attempts to rid the atmosphere of our large towns of their ever-recurring fogs, glooms, and mists, and those conclusions certainly are not supported by such evidence as we already have as to the production of fogs on a great scale, however much indicated by experiments in the laboratory. It is stated that, "It having been also shown that all forms of combustion, perfect and imperfect, are producers of fog nuclei, it is concluded that it is hopeless to expect that, adopting more perfect forms of combustion than those at present in use, we shall thereby diminish the frequency, persistency, or density of our town fogs." Now, first as to frequency: what are the facts with regard to localities differing in their methods or materials for producing heat? Every one living in or near London knows that fogs, thick mists, and dark days are far more frequent within than without its circumference, and experiment has shown that sunshine is both less frequent and much less intense within the metropolis. And, according to Mr. Aitken's theory, something of the same kind ought to be observed wherever large quantities of fuel are burned, whether smokeless or not. Thus, the large towns of the Continent, where wood and charcoal are in general use, would have their peculiar urban fogs. But they are free from any fogs beyond those which are common to the country. And Paris, before coal was much used, ought to have been distinguished by more frequent fogs than the surrounding country. But it was not so marked out. No oasis of fog prevailed there when the sun shone brightly beyond its precincts, as in our own capital. And Philadelphia, which burns anthracite, ought not to rejoice in a pure and transparent atmosphere.

Similarly, the South Wales coal and iron districts would be centres of fog-clouds and mist, like Birmingham and Newcastle. But they are as free from fog as the purely pastoral valleys of Wales.

Next, as to persistency. Early in the morning of January 31 last, in some districts of London the fog extended considerably above the tops of the houses, in others only about 10 or 20 feet from the ground in any intensity. Where the fog extended high the smoke mixed with it and produced a yellow fog, but where it remained low the smoke escaped into the upper air and drifted away, leaving a white fog below, so pure as to be a very unusual phenomenon at 10 a.m. in a London street. Now it was remarkable, that wherever the white fog prevailed in the morning, the sun soon obtained the mastery and dispelled it more or less, but in the smoke-obscured districts a dark yellow fog continued throughout the day.

White fogs may doubtless be exceedingly dense. But will not an admixture of smoke increase its density?

A humid atmosphere is not necessary for the production of mist and haze. The frequent long-continued prevalence of blue haze over the whole country, not excepting the east coasts, in the driest east winds of spring, would be a subject deserving investigation. They sometimes extend to a height much above the tops of our highest mountains. Experiments such as those of Mr. Aitken will, we may hope, ultimately solve this problem of meteorology. R. RUSSELL

Low Temperature

THE reading of the thermometer here last night, January 15, 16, was the lowest ever recorded at this observatory in the course of thirty-three years. The reading was 4°·6 F., the previous minimum having occurred on December 24, 1860, when the mercury stood at 6°·7 F. S. J. PERRY

Stonyhurst Observatory, January 16

A "Natural" Experiment in Polarised Light

BREAK off a plate of ice and hold it between the sky and a pool of water. Its reflected image will show the beautiful colours due to polarised light. The incident rays should come from a part of the sky about 90° from the sun, and reflection should take place at the polarising angle for water, and the plate will probably require adjusting to bring out the maximum effect. Water, vaporous, solid, and liquid, thus furnishes us with polariser, crystal, and analyser. I do not remember to have read any account of this very simple experiment, for which Nature provides all the materials. CHAS. T. WHITMELL

9, Beech Grove, Harrogate, January 10

STATICS AND DYNAMICS OF SKATING

MANY years ago, when skating was but in its infancy, skates were made of bone, and if they could be made to stay on the feet they were considered to answer their purpose sufficiently well.

More recently iron runners with wooden beds came into use, and accuracy of adjustment on the foot, horizontally and longitudinally, was made easier by means of leather straps and a screw passing into the heel of the boot; and these adjustments, made haphazard, were quite sufficient for the skating of those days, namely forward skating.

Within the last twenty years however skating has made enormous strides, back skating becoming an essential qualification of a finished skater; and hence not only more perfect forms of skate are demanded from the maker, but also the adjustment of them on the boot becomes an important part of his duty.

There are three points to be attended to in the adjustment of the skate, besides the obvious one of placing the skate medially on the foot.

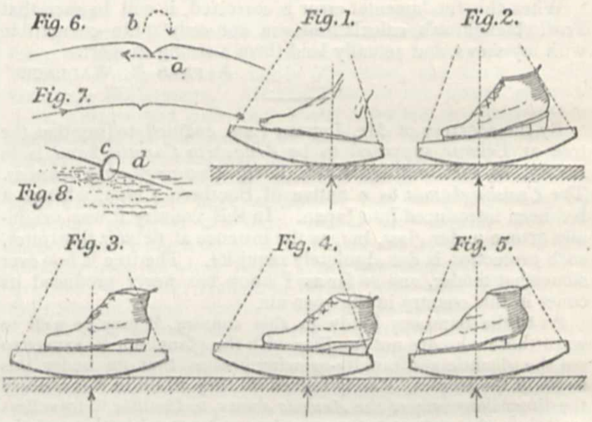
1. Height of foot off the ice where the greatest breadth of the sole of boot occurs.
2. Height of foot off ice at the heel.
3. Position of the skate longitudinally or lengthwise on the foot.

First. The height of the foot from the ice should be such as will enable the skater to lean over sufficiently when on a curve, and such that he may be able to get a powerful enough stroke. If he is too low the edge of the boot will come in contact with the ice in leaning overt and also in taking a stroke: a fall ensuing in the firs, case, and a disagreeable and dangerous overstrain in the second. To avoid these the sole of the boot should subtend an angle at the bottom of the runner of about 96 deg. *i.e.* for a sole $3\frac{1}{2}$ inches broad the edge of the runner should be $1\frac{1}{2}$ inch from the sole, instead of varying from $1\frac{7}{8}$ to $1\frac{1}{8}$ inch, which are the heights of skates commonly met with.

This angle of 96 deg. will be found to clear the ice in both striking and leaning over for most skaters, and any greater height than is given by this angle should not be used, as it is not necessary, and only throws an additional strain on the ankle.

Second. The height at the sole having been fixed, the next point is what should be the height at the heel? In fact is the foot to be parallel to the skate, or is it to rest on an incline?

Dove was the first person, in his "Skater's Monitor," published in Edinburgh in 1846, to write on the position of the skate on the foot, summing up his remarks by saying, "Level woods then are for shoes whose heels



and soles are equally prominent, but high heels must be sunk into the skate-woods." This was quite correct at that time, when back skating was little practised, and when the skate which was then worn was made very flat, in fact almost straight at and near the heel. Now, by universal consent for figure-skating, the iron is made a segment of a single circle from toe to heel, $7\frac{1}{2}$ feet being the radius. Yet, notwithstanding these changes, Vandervell and Witham, as lately as January, 1880, in their "Figure Skating," recommend the very same parallelism of the foot to the skate instead of parallelism of the top of the blade to the ice, as it should be for modern skating, as I shall subsequently show.

In Fig. 1 is shown the result of adopting Dove's or Vandervell and Witham's position, *i.e.* no heel. It might be thought that a person standing on a curve would balance comfortably at the middle of the curve, but this cannot be, for a person standing naturally on a level surface does not distribute the weight of his body equally over the length of his foot, but by far the greater part comes on the heel, and therefore the centre of pressure of his body is nearer the heel than the toe, and consequently if he is standing on a curve the curve must roll up in front and down behind till the upward pressure of the ice just passes through the centre of pressure of his body. The point of contact of the skate on the ice will therefore not only be much behind the centre of the skate, but will be a little behind the centre of pressure of his body when standing on a level surface, as he now rests on an incline. Of course the footstocks of the skates being too low behind would produce the same effect as too low a heel to the boot, *i.e.* throw the balance too far back.

Fig. 2 shows the position the skate will have on the ice if the heel is too high, *i.e.* the centre of pressure is thrown too far forward, and consequently the skate must roll up behind in order to get the proper balance.

In Fig. 3 is shown a skate in the proper position on the ice, *i.e.* with the heel raised so high as to throw the centre of pressure on the centre of the foot and skate.

The proper height of the heel of the boot to obtain this result will depend on whether the footstocks of the skates are level, as they ought to be, and the exact height will vary with different individuals, depending on whether they naturally stoop or lean well back, and probably also on the boots they are in the habit of walking in, and therefore can only be determined accurately by trial; but a half-inch heel is by no means too low for most persons.

Third. With regard to the adjustment of the skate longitudinally, Figs. 4 and 5 will show the obvious effects of not fixing the skate properly on the foot; in Fig 4 the skate being put too far forward, and in Fig. 5 too far back.

Having now shown how to procure the balance on any desired part of the skate, it only remains to be shown why the position of the skate, with the balance on the centre as in Fig. 3, is the proper one; and as the effects of the various positions are most evident in skating turns, I shall confine myself entirely to them, commencing by giving the theory of turns, which I believe has never been satisfactorily explained.

It is impossible in a few words to describe accurately and fully the forces which come into action in making a turn, but my object will be attained by describing what I consider the basis of the whole theory of turns, namely, that a turn is not a twist round of the body made by the skater at the moment of the turn, but the turning round of the body is the result of a reaction of the ice on the skater caused by his putting his skate (by rolling on to the toe or heel) in such a position as to make that part of the skate bite or grip the ice, producing a force opposite, though not directly opposed, to his direction of motion, but parallel to it. The direction of this reaction is shown by the arrow *a* in Fig. 6, and being exerted at some distance from the body, it necessarily tends to turn the body round in the direction of the arrow *b*. It will be evident that the greater the distance of the point of application of this force from the curve the skater is describing, the greater will be the *couple* tending to turn round the body.

This action can be shown by means of a disk of lead *c*, in Fig. 8, with a light rod through it. If this be made to roll on a table, and a force be applied to the rod at *d* by means of the finger, the action of reversing the body and preserving the same inclination will be distinctly shown. Suppose the skater then about to make a back turn, and that he balances near the heel of his skate as in Dove's plan, then, as he can only roll a very little further back, as he is already on the heel of his skate, the leverage, and hence the couple tending to turn him round, will be almost *nil*, the cusp he makes being of the shape shown in Fig. 7, instead of being of the shape shown in Fig. 6, and consequently if he is to turn round in time he must give his body a wrench round, which is of course very inelegant, and very difficult to accomplish. If the balance is on the heel the cusps of the forward turns are much larger than the cusps of the back turns, thereby tending to make the back turns more difficult than is necessary; but even with the balance on the centre of the skate back turns will be more difficult than forward turns, as the formation of our bodies prevents the bending up of the foot more than a few degrees, even with a boot off, whereas we can bend it down 40 deg. easily.

With the balance on the centre of the skate back turns can be performed without any wrench or swing of the leg—a thing that is physically impossible if the balance is on the heel, as it must be in Dove's or Vandervell and Witham's plan. CHARLES ALEX. STEVENSON

JOHN DUNCAN: THE ALFORD WEAVER AND BOTANIST

ON the last day of 1880 the University of Aberdeen was presented with a herbarium of 1131 specimens of the British Flora, gathered, preserved, named, and localised by an aged country weaver who lives near Alford in Aberdeenshire. He is no ordinary man, as the accumulation of such a botanical collection is alone sufficient to prove. It represents a portion only of the scientific labours of nearly fifty years—for much of these have been destroyed by time and the moth. This remarkable man, who is now a pauper on the parish which has been the scene of his unextinguishable scientific enthusiasm, should be better known to the scientific world, and a short sketch of his life and labours may not be unacceptable to the readers of NATURE.

John Duncan was born on December 24, 1794, so that he is now in his eighty-seventh year. His parents were very poor, and could afford him only the merest rudiments of even the three R's as then taught, for his education had to be sacrificed to the pressure of penury. He learnt to read by laboriously spelling his way through the text in church; his writing has ever been very rude, but distinct; and his spelling is such an example of the phonetic as would delight Mr. Pitman. He was early sent to work and became a "customer weaver," making into cloth the flax and wool sent to his home by his neighbours, and such he has remained ever since. He married early in life, and had a son and two daughters; but his wife died more than thirty years ago, and all his family have gone, he remaining as the sole survivor. During the greater part of his long life he has dwelt in the valley of the Don, near Alford, and for nearly thirty years in the same cottage at Droghsburn, in the pleasant hollow of the Leochel, five miles above that village. This cottage forms one end of a line of dwellings, the other belonging to a ditcher's family who prepare his simple meals. He occupies a single room, filled with the looms and other implements of his trade, open to the thatched roof, his bed resting on some deals laid across the rafters, and reached by means of a ladder. In this narrow space John Duncan has lived for twenty-eight years, a solitary man, in serene contentment, upright and religious, working laboriously for an honest living, cheered only by the friendship of a few, his love of books and his devotion to the study of plants, which he has prosecuted with a single-minded enthusiasm that is as rare as it is beautiful. I visited him about three years ago and spent two days in his company, having long wished to do so from what I had heard of him from his dearest friend and fellow student, Charles Black. I found him in good health, working hard at his craft with sturdy and admirable independence, visited only by a few disciples whom he had inspired with a love of himself and the plants, unknown, self-contained, and happy even on the verge of want. I examined his plants, talked of their history and the crowding memories they recalled of countless wanderings in their search, saw his books on botany, theology, and general literature, which are unusually numerous and costly for a poor man, conversed with him on many subjects, chiefly connected with his studies, and his intimacy with Charles, whose friendship is now the chief comfort of his age; and I left him charmed, inspired and rebuked by his life, character, enthusiasm and wise contentment, the result of unwearied devotion to higher pursuits.

Some interest in the solitary student was roused by an account I then gave of him. This account appeared in *Good Words* for April, May, and June, 1878, with pictures of himself and his cottage. It has recently been incorporated in whole into "Leaders of Men," by H. A. Page (Marshall, Japp, and Co., London); and he was visited by not a few kindly spirits whose open-handedness lightened somewhat the growing pressure of age and want. Since then he has worked at his loom, winning his daily bread with heroic struggle, till a short time ago, when decaying power and some paralytic touches, in his eighty-sixth year, compelled him reluctantly to give it up and remove from his small but honourable workshop and study to be kindly tended by the ditcher's widow. Many years ago his hard-won earnings—for he was always a most careful man—were dissipated through domestic causes over which he had no control, attended with heavy griefs. Since then his growing age has barely enabled him to live more than from hand to mouth, and now for some time he has had to do what must be inexpressibly keen to an independent soul like his, to accept from the parish a pauper's portion.

From his earliest days, when he used to play upon the green cliffs of the high conglomerate coast of Kincardine, John Duncan had an intense love of plants, and long before he began their scientific study collected them for their medicinal uses, guided by Culpepper's "Herbal." It was not till he was forty years of age, when he was introduced in 1835 to Charles Black, that he commenced the study of botany as a science. Charles was a remarkable man, of great individuality and ability, and though twenty years his junior, at once gained over him an ascendency of the best kind, and inspired him with an ardent friendship that has been the sweetest solace of his long solitude. He still lives as the gardener he was then, a botanist, geologist, ornithologist, numismatist, scientific student, theologian, and omnivorous reader at Arbigland in Dumfries, near the mouth of the Nith. When these two men met, Charles was settled as gardener near Alford, and under his guidance John at once began the systematic study of botany. They soon conquered the flora of the Vale of Alford; the curious peak of Ben-a-chie, where they found at an early date the *Rubus chamæmorus*, or cloudberry, being a favourite haunt. John, having his time, as a home weaver, more at his own command, by and by extended his excursions to greater distances, and before very long did the most of the county. The enthusiasm with which these two humble men prosecuted their studies was wonderful, the morning light often surprising them at their work of classifying, drying, and arranging their accumulating treasures. The want of text-books of the science was sorely felt by them, and excited them to ingenious devices to supply it; a certain country inn, for example, being frequented by them, not for convivial purposes, but to obtain a sight of "Hooker," which had belonged to the innkeeper's dead son. The details of John's continued studies under poverty, difficulty, and trial are interesting and honourable, but these cannot be given here. In order to extend his knowledge of botany and the flora of Scotland he used to take harvest work in different parts of the country, studying in succession the plants of each district, till he had in this way traversed the most of the land from Northumberland to Banff, except some parts of the West and the Highlands; bringing home specimens living and dead, planting the one in his own neighbourhood, and adding the other to his rapidly-increasing herbarium. His knowledge of plants was minute and scientific, and the abundant technical terms were used with ease and intelligently understood by the help of a Latin dictionary he had purchased for the purpose; nor was it confined to mere technicalities, but extended to an unusual acquaintance with their habits, history, and uses. His collection of botanical works is surprisingly large and valuable, all purchased by his own hard-won earnings. His memory being as strong as his use of the pen was weak, he did not write down any details of the plants thus collected, but he could tell all these when asked with unerring precision, as well as relate the varied incidents, interesting, humorous, happy or hard, connected with their discovery. The names and localities have however been successfully obtained from him and written down, by the help of one of his disciples, Mr. J. M. B. Taylor, of Aberdeen, who prepared the herbarium for the University.

John kept his collection neatly laid down in volumes made by himself of newspapers of the period, of tea paper, which he thought a good protection against moths, and of other homely materials scented with camphor. Many of them of course decayed or were destroyed during the forty and more years they were in his possession, but even after discarding all imperfect specimens there remained 1131 plants now fully named, localised, and arranged by Mr. Taylor from John's unfailing memory. They are divided in four books, put together by John himself.

1. A general collection of some 500 specimens including ferns arranged according to the Linnæan system, 100 of which are described by Prof. Dickie, author of the "Flora of Aberdeen, Banff, and Kincardine," as rare or very rare.

2. An almost perfect collection of the flora of the Vale of Alford, many of the plants now uncommon.

3. Specimens of about 50 of the grasses from the Alford district.

4. Specimens of some 50 of the Cryptogamia of the district, chiefly mosses and lichens.

John never possessed above a few of *the very rarest* of our British plants, not having visited the higher mountains and outlying regions where only such are found, but had been fortunate in obtaining a large number of local and very local, rare and very rare species. They were mainly found along the eastern half of the country from Banff to Northumberland, excluding the Highlands.

Such is a very slight sketch of the life and labours of this remarkable weaver. The presentation of his herbarium has revealed the sad fact that, independent and toil-worn as he has ever been, even to nigh eighty-six, he has been lately compelled to bear the pain and shame of depending on the parish for his daily bread. His books are of value, and would alone fetch a considerable sum; but these, the dear companions of his life, he cannot bring himself to part with, though now unable to enjoy more than a sight of them. His beloved plants he would not barter for heaps of gold, and he has therefore presented them to Aberdeen University, there, it is to be hoped, not only to do good educational work, but to exercise an inspiring impulse over many generations of students privileged to examine these far-fetched treasures.

An appeal has recently been publicly made in favour of the aged botanist, to enable him to spend his few remaining days in comfort and independence, supported by the free-will offerings of the scientific and generous, which have been amply won by scientific work admirably achieved. Scientific societies throughout the country could not better aid research than by recognising his merit, and making a contribution for such a worthy object. Shortly after my account of him in *Good Words* the Largo Field Naturalists' Club elected John an Honorary Member, and the same has been recently done by the Inverness Scientific Society and Field Club, which also made a donation to him of 5*l.*, examples that might be honourably followed by other societies. A lively interest has been excited in his case, and has been already substantially expressed. It is devoutly to be hoped that such a man will not be allowed to go down to his grave dishonoured and neglected.[1]

WILLIAM JOLLY

[1] Subscriptions may be sent to William Jolly, H.M. Inspector of Schools, Inverness.

THE INDO-CHINESE AND OCEANIC RACES—TYPES AND AFFINITIES[1]

IV.

HERE are the Raja of Gorontalo, N. Celêbes (Fig. 22), the chief of Sendegeassi, S. Nias, West Coast Sumatra (Fig. 23), and two natives of Jilolo (Fig. 24), all supposed to be more or less typical Malays whom it will be profitable to compare with Figs. 19, 20, 21, representing the Caucasian pre-Malay or Indonesian element in the Archipelago. In Fig. 25 we have Mohamed-Yamalal-Alam, Sultan of the Sulu Archipelago, who was compelled to accept Spanish supremacy in 1876. He is a pure Malay about thirty-four years old, like most of his subjects presenting a fine type far superior to that of the Malays of Malacca. Yet the Mongoloid element is unmistakably betrayed, especially in the high cheek-bones, presenting such a striking contrast to the regular European features of the Indonesians (see Figs. 19, 20, and 21). The portrait is from a photograph forwarded to France by MM. Montano and Rey, and originally published in *La Nature*, April 3, 1880.

But if we must speak with great hesitation and much reserve of a common Malay type, we can speak all the more confidently not only of a common Malay speech, but of a common "Malayo-Polynesian," and even of a common Indo-Pacific speech. Indeed the chief objection to the linguistic expression Malayo-Polynesian is that it is no longer sufficiently comprehensive. In the alternative Indo-Pacific, which, on the analogy of Indo-European, I have proposed as a substitute, the first component must be taken in two senses, so as to include both the Indian Ocean and a portion of Further India. When Fr. Müller wrote: "So much remains certain, and will never by the most brilliant and cogent reasonings be disproved: the Malayo-Polynesians are connected with no Asiatic people," he had in his mind not so much the "Malayo-Polynesian race" as the Malayo-Polynesian language. In this sense the statement was true enough according to his lights. In common with other eminent philologists he entirely overlooked Cambojan, or from insufficient data probably regarded it as a monosyllabic-toned language allied to the Indo-Chinese family. He consequently considered it as fundamentally distinct from the Malayo-Polynesian group, which is admittedly polysyllabic and untoned. But we have already seen in Section IV. that Cambojan or Khmêr is not a member of the Indo-Chinese family, and that it is polysyllabic and untoned, like all other known forms of speech. In the above-quoted paper "On the Indo-Chinese and Inter-Oceanic Races and Languages" (pp. 15-22) I further show that the true affinities of Khmêr are with the Malayo-Polynesian tongues, the whole forming a vast linguistic family stretching from Madagascar to Easter Island, west and east, from Hawaii to New Zealand, north and south, and with its basis still resting on the Indo-Chinese peninsula, where it originated, and whence it has been diffused throughout the Oceanic area with the migrations of the Mongolo-Caucasian races. Here it has long reigned supreme, continually encroaching upon and surrounding, as in so many detached enclaves, the diverse Negrito and Papûan tongues, but itself now threatened with extinction by the advancing Siamese and Annamese on the mainland, and by the still more aggressive English in Polynesia.

All the arguments establishing the intimate connection of the Cambojan and Malayan languages need not be repeated; but that based on the principle of modifying infixes has attracted so much attention, and is in itself so interesting, that the readers of NATURE will perhaps be glad to have it here resumed:—

"Common to the Khmêr and Malaysian tongues is one feature so peculiarly distinctive as of itself alone almost sufficient to establish their common origin. This is the use of identical infixes, which, though forming a marked characteristic of Khmêr, Malay, Javanese, Tagala, Malagasy, and other members of this group, has not yet been generally recognised. . . . The infixes in question are always the same, the liquids *m* and *n*, and even *mn*, with or without the connecting vowels *a*, *o* with *m; a*, *i* with *n*. Thus:—

IN KHMÊR: *m*, *am*, *om*, *mn*, *n*.

Slap, dead; samlap, to kill.
Sruöch, pointed; samruöch, to point.
Thleäk, to fall; tomleäk, to throw down.
Rolôm, to fall; romlom, to knock down.
Chereäp, to know; chumreäp, to show, teach, make known.
Kur, to draw; Komnur, a design.
Srek, to cry; samrek, a shout.
Chêk, to share; chamnek, a part or portion.
Sauk, to corrupt; samnauk, a bribe.
Pram, to publish; bamram, a notice.
Pang, to wish; bamnang, a wish.
Rep, to confiscate; rombep, seizure, thing seized.
Ar, to saw; Anar, a saw.

IN MALAGASY: *in*, *om*.

Hanina, food; homana, to eat.
Tady, twisted, a rope; tomady, strong.
Taratra, glaring; tomaratra, transparent.
Safotra, overflown; somafotra, brimful.
Sany, likeness; somany, like.
Safy, spying; somafy, sight of distant object.
Vidy and vinidy, bought.
Vaky and vinaky, broken.

IN MALAYSIAN: *um*, *âm*, *in*.

Javanese.

Rayah, to bereave; rinaya, to be bereft.
Hurub, flame; humurub, to flame.
Balinbin, a small fruit; binalinbin, a round gem.

Tagala.

Basa, to read; bumasa, to make use of reading.
Kapatir, brother; kinapatir, brotherly.
Tapay, to knead; tinapay, bread.
Guntin, shears; gumuntin, to cut with shears.

Malay.

Palu, to beat; pâmalu, a club.
Pukul, to strike; pâmukul, a hammer.
Sipit, to grasp; sinipit, an anchor.
Padam, to extinguish; pâmadam, an extinguisher.
Pilih, to choose; pâmilihan, choice" (pp. 20-1).

This characteristic, of which nothing but the faintest echoes occur in any other linguistic system, is obviously one that is incapable of being borrowed, as prefixes and suffixes may occasionally be borrowed. Hence it must be regarded as an organic principle developed in the primitive speech before its differentiation into the various Oceanic branches, whose common origin seems thus to be established beyond question. The theory of such a remarkable feature being evolved independently at several points in this linguistic area and in no other cannot be seriously entertained.

Here therefore we have one type of speech everywhere common to two racial types, and the question arises, how all the Malayan peoples have come to speak exclusively polysyllabic untoned tongues, while their nearest kindred, the Mongoloid peoples of Indo-China, still speak exclusively monosyllabic toned languages. To explain this phenomenon we must remember that, as already pointed out, the polysyllabic-speaking Caucasians preceded the monosyllabic-speaking Mongols both in Farther India and in the Archipelago. Hence when the Mongols quitted the mainland they found the islands occupied by the Caucasians, with whom they amalgamated, and whose speech they adopted. Similar instances, though perhaps not on such a large scale, have occurred often enough elsewhere, even in historic times. Thus the Mongolo-Tatar Aimaks and Hazaras of North Afghanistan all now speak

[1] Continued from p. 251.

Persian; the Ugro-Finnic Bulgarians have been Slavonised in speech since the tenth century; the Northmen of the Lower Seine valley entirely forgot their Norse tongue within two generations, and many of the early English settlers in Ireland rapidly became "Hiberniores ipsis Hibernicis," more Irish than the "Irishry" themselves. Special causes, arising from the utterly antagonistic nature of toned and untoned languages, must have accelerated the process of assimilation in Malaysia, where nevertheless its universality still remains a remarkable circumstance. For it is undoubtedly surprising that not a single Malay community should have succeeded in retaining its original monosyllabic speech, and still more surprising to find that every trace of monosyllabism had already disappeared, at least from Java, Madura, and Bali some two thousand years ago. The old Kawi language current in those islands and reduced to writing by the Buddhists at that remote period is as genuine a polysyllabic tongue as its modern representatives, Javanese, Sundanese, Madurese, and Balinese.

FIG. 22.—Malayan Type, Celebes. King of Gorontalo.

The eastern or Sawaiori branch differs greatly from the western or Malaysian, with which it has now really little in common beyond the fundamental elements. But these, after a separation of probably many thousand years, are still numerous enough to establish beyond all doubt their primeval unity. In this instance, however, as in so many others, community of speech in no way involves community of descent, for we have just seen that the language now spoken by the Malay races was in all probability imposed upon them by their Caucasian predecessors in the Archipelago. On the other hand there is no reason to suppose that the Eastern Polynesians ever spoke any other than their present language, its resemblance to the Malay being due not to their relationship with the Malay people, but with the Indonesian Caucasians, from whom the Malays borrowed their speech.

FIG. 23.—Malayan Type, Sumatra. Chief of Sendegeassi, Nias Island.

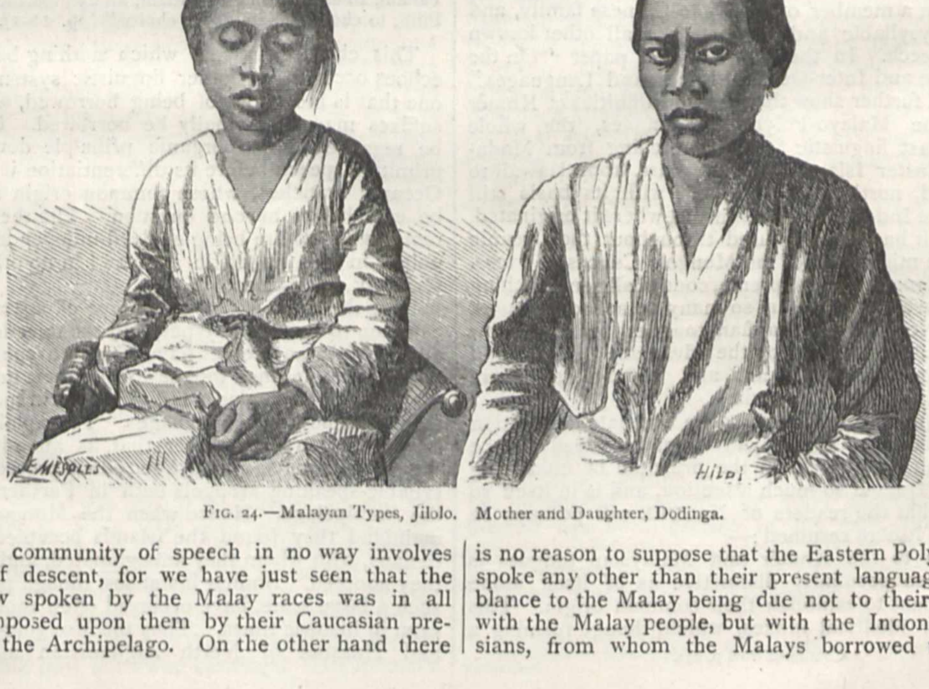


FIG. 24.—Malayan Types, Jilolo. Mother and Daughter, Dodinga.

Like the other members of the family Sawaiori is agglutinating, but it occupies a very primitive or undeveloped position in that order of speech. Thus it betrays very slight traces of the infix principle, but it possesses as a prefix the same particle *ma*, which in Cambojan and its Malaysian congeners appears as an infix. In Samoan, for instance, *fai* = to do, but *mafai* = to be able; *sasa'a* = to spill, *masa'a* = spilt; *liligi* = to pour out, *maligi* = to be poured out; *fasi* = to split, *mafasi* = to be split off; *fati* = to break, *mafati* = to be easily broken; *fola* = to spread out, *mafola* = to be spread out; *gaegae* = to shake, *māgaegae* = to be loose; *goto* = to sink, *magoto* = to be sunk or waterlogged, and so on, generally in an intransitive or passive sense.

But the chief peculiarity of the Sawaiori tongues is their extremely simple phonetic system, comprising no more than fifteen letters (five vowels and ten consonants), with no closed syllables or combinations of two or more consonants without an intervening vowel. Hence the strange forms assumed by English and other European words in the mouths of the natives. When he visited Tahiti in 1769 to observe the transit of Venus, Cook tells us that "after great pains they found it utterly impossible to teach the Indians to pronounce their names. . . . They called Capt. Cook, Toote; Mr. Hicks, Hete; Molineux they renounced in absolute despair, and called the master Boba, from his Christian name Robert; Mr. Gore was Toarro; Dr. Solander, Torano; and Mr. Banks, Tapane; Mr. Green, Eteree; Mr. Parkinson Patini; Mr. Sporing, Polini; Petersgill, Peterodero; and in this manner they had now formed names for almost every man in the ship" (*First Voyage*).

To resume: in the Indo-Chinese and Oceanic regions we have altogether five distinct types—three dark (Negrito, Papûan, and Austral, with the doubtful Tasmanian), one yellow (Mongolian), and one brown (Caucasian). These, with their various ramifications and interminglings, give the seven main divisions of our scheme, which may now be expanded and complemented as under. Here, for reasons fully specified, the familiar term "Malayo-Polynesian" disappears, and Malay itself sinks to the position of a variety of the Mongolian type. Although grouped with the Oceanic branch of this division, it should be noted that the Malays also occupy most of the peninsula of Malacca. But they seem to be intruders in this region, the true aborigines of which are the Negrito Samangs, and in any case their real home in historic times is the Eastern Archipelago.

A.—DARK TYPES

I. NEGRITO.—Aetas of the Philippines; Andamanese Islanders; Samangs of Malacca; Kalangs of Java: Karons of New Guinea.

II. PAPÛAN.—1. *Central Branch:* Papûans proper of New Guinea and adjacent islands, Mafors, Arfaks, Koiari, Koitapu, Waigiu, Aru, Salwatty, Mysol, Gebi, &c. 2. *Eastern Branch:* Sub-Papûans East (Melanesians), Admiralty, Louisiade, New Britain, New Ireland, Solomon Islands, New Hebrides, Loyalty, New Caledonia, Fiji. 3. *Western Branch:* Sub-Papûan, West ("Alfuros"): Floris, Ceram, Buru, Timor, Parts of Gilolo, Banda, Kissa, Savu, &c.

III. AUSTRAL.—Australians, Tasmanians (?).

B.—CAUCASIAN TYPES (Fair and Brown)

IV. CONTINENTAL BRANCH.—Khmêr or Cambojan Group: Khmers proper, Khmêrdom, Charay, Stîeng, Cham, Banhar, Xong, Khang, &c.

V. OCEANIC BRANCH.—Indonesian Group: Battas of Sumatra, Dyaks of Borneo and Celebes, some "Alfuros" of Ceram and Gilolo, Mentáwey Islanders. Sawaiori or Eastern Polynesian Group: Samoa, Tonga, Tahiti, Marquesas, Tuamotu, Maori, Hawaii, Tokelau, Ellice.

FIG. 25.—Malayan Type, Sulu Islands. The present Sultan of Sulu.

C.—MONGOLIAN TYPES (Yellow and Olive Brown)

VI. CONTINENTAL BRANCH.—Indo-Chinese Group: Chinese, Annamese, Tibeto-Burmese, Thai (Siamese, Laos, Shan, Khamti), Khasia, Khyen, Karen, Kuki, Naga, Ahom, Mishmi, Bhod.

VII. OCEANIC BRANCH.—Malayan Groups: Malays Proper, Javanese, Sundanese, Madurese, Balinese, Macassar, Bugi; Malagasy of Madagascar; Tagalo-Bisayans of Philippines; Formosan Islanders; Mikronesians (Pelew, Carolines, Ladrones, Marshall, Gilbert Islands).

It thus appears that the three great divisions of mankind (A, B and C) are in possession of an ethnical region which some anthropologists have regarded as the cradle of the human race. Observing that the anthropoid apes of equatorial Africa—gorilla and chimpanzee—are dolichocephalous, while those of Malaysia—orang-utan and gibbon—are brachycephalous, certain polygenists have suggested that the former may be the progenitors of the dolichocephalous Negroes, the latter of the brachycephalous Negritos. But we have seen that the Papûans of the extreme east (New Hebrides, Fiji, &c.) are also dolichocephalous, and even of a more pronounced type than the natives of Sudan. On the other hand, the Obongos, Akkas, and other pigmy tribes of Central Africa appear to be brachycephalous,[1] so that the theory fails at both extremes, Fiji and the Gaboon. Assuming however that mankind may have been evolved in the Eastern Archipelago or in some now submerged adjacent lands, and bearing in mind the relative value attached to the idea of race, as implied in our definition of species, the present conditions might still admit of explanation. In the Andamanese Islanders, whom Prof. Flower justly regards as of an "infantile type," and in the Javanese Kalong, whose features von Rosenberg describes as the most decidedly ape-like he had ever seen, we would have still *in situ* the earliest extant representatives of primeval man. Migrating westwards across a now lost "Lemuria," this primitive Negrito race may have reached equatorial Africa, where it is still represented by Du Chaillu's Obongo, Lenz's Abongo or Akoa, Schweinfurth's Akka, and where it may under more favourable conditions have become differentiated into the Negro of Sudan. Migrating eastwards across a continent of which the South Sea Islands are a remnant, the same Negritos may have similarly become slowly differentiated into the present Papûan or Melanesian peoples of those islands. Migrating northwards, before the severance of the Archipelago from the mainland, they reached Malacca and the Deccan, where they may still be represented by the Maravans and other low castes of that region. Moving thence over the Asiatic continent, they became under more temperate climes differentiated, first probably into the yellow Mongol, and then through it into the fair Caucasian type. But however this be, the subsequent migrations of the Mongols and Caucasians to the Archipelago, as above set forth, was probably, after all, but a return under new forms to their old homes. Here their mutual interminglings have again evolved fresh types and sub-types, producing a chaos of races whose true affinities I have endeavoured in these papers to elucidate, while fully sensible that in all such inquiries the last word still must be, *felix qui potuit rerum cognoscere causas.*

A. H. KEANE

[1] The Akkas certainly; but Lenz seems to think that the Abongos are dolichocephalous, so that this point remains still to be settled. Dr. Barnard Davis however in his *Thesaurus Craniorum* recognises brachycephaly in equatorial Africa, four out of eighteen skulls in his collection from this region being distinctly brachycephalous.

THE PHOTOPHONE

THE following calculation, made with the view of examining whether the remarkable phenomena recently discovered by Prof. Bell could be explained on recognised principles may interest the readers of NATURE. I refer to the *un-electrical* sounds produced by the simple impact of intermittent radiation upon thin plates of various substances.

It has been thought by some that in order that a body exposed to variable radiation may experience a sensible fluctuation of temperature its rate of cooling must be rapid. This however is a mistake. The variable radiation may be divided into two parts—a constant part, and a periodic part—and each of these act independently. Under the influence of the constant part the temperature of the body will rise until the loss of heat by radiation and conduction balances the steady inflow; but this is not appreciable by the ear, and may for the present purpose be left out of account. The question is as to what is the effect of the periodic part of the whole radiation, that is, of a periodic communication and *abstraction* of heat which leaves the mean temperature unaltered. It is not difficult to see that if the radiating power of the body were sufficiently high, the resulting fluctuation of temperature would diminish to any extent, and that what is wanted in order to obtain a considerable fluctuation of temperature is a *slow* rate of cooling in consequence of radiation or convection.

If θ denote the temperature at time t, reckoned from the mean temperature as zero, q be the rate of cooling, $E \cos pt$ the measure of the heating effect of the incident radiation, the equation regulating the fluctuation of temperature is—

$$\frac{d\theta}{dt} + q\theta = E \cos pt.$$

Thus—

$$\theta = \frac{E \cos (pt + \epsilon)}{\sqrt{\{p^2 + q^2\}}},$$

showing that if p and E be given, θ varies most when $q = 0$.

Let us suppose now that intermittent sunlight falls upon a plate of solid matter. If the plate be transparent, or absorb only a small fraction of the radiation, little sonorous effect will be produced, not merely because the radiation transmitted is lost, but because the heating due to the remainder is nearly uniform throughout the substance. In order that the plate may bend, as great a difference of temperature as possible must be established between its sides, and for this purpose the radiation should be absorbed within a distance of the order of half the thickness of the plate. If the absorption be still more rapid, it would appear that the thickness of the plate may be diminished with advantage, unless heat conduction in the plate itself interferes. The numerical calculation relates to a plate of iron of thickness d. It is supposed that q is negligible in comparison with p, *i.e.* that no sensible gain or loss of heat occurs in the period of the intermittence, due to the fluctuations of temperature themselves.

If the posterior surface remains unextended the extension of the anterior surface corresponding to a curvature ρ^{-1} is $\frac{d}{\rho}$, and the average extension is $\frac{d}{2\rho}$. Let us inquire what degree of curvature will be produced by the absorption of sunlight during a time t, on the supposition that the absorption is distributed throughout the substance of the plate, so as to give the right proportional extension to every stratum.

If Ht denote the heat received in time t per unit area, c the specific heat of the material per unit volume, e the linear extension of the material per degree centigrade, then

$$\frac{1}{\rho} = \frac{2eHt}{c.d^2}.$$

In the case of sunshine, which is said to be capable of melting 100 feet of ice per annum, we have approximately in $C.G.S$ measure

$$Ht = \cdot 008\, t.$$

Thus
$$\frac{1}{\rho} = .016 \frac{et}{cd^2}.$$

For iron $e = \cdot 000012$, $c = \cdot 86$.

Thus if $t = {}_{5}{}^{1}$ (of a second), $d = \cdot 02$ cents.

$$\frac{1}{\rho} = 1 \cdot 12 \times 10^{-6}.$$

This estimate will apply roughly to a period of intermittence equal to $\frac{1}{250}$th of a second, *i.e.* to about the middle of the musical scale. If the plate be a disk of radius r, held at the circumference, the displacement at the centre will be $\frac{r^2}{2\rho}$, or $\cdot 56\, r^2 \times 10^{-6}$. In the case of a diameter of 6 centimetres this becomes $5\cdot 0 \times 10^{-6}$.

Five-millionths of a centimetre is certainly a small amplitude, but it is probable that the sound would be audible. In an experiment (made, it is true, at a higher pitch) I found sound audible whose amplitude was less than a ten-millionth of a centimetre.[1] We may conclude, I think, that there is at present no reason for discarding the obvious explanation that the sounds in question are due to the bending of the plates under unequal heating.

January 13 RAYLEIGH

[1] *Proc.* Roy. Soc. 1877.

NOTES

WE regret to learn of the death of the Rev. Humphrey Lloyd, D.D., Provost of Trinity College, Dublin, on the 17th inst., at the age of eighty-one years. Dr. Lloyd's contributions to scientific literature have been many and important, and to these and to his career generally we hope to refer at length in our next number.

PROF. HUXLEY has been appointed to the Inspectorship of Fisheries vacant by the death of Mr. Frank Buckland.

THE Queen has been pleased to confer a pension of 200*l.* upon Mr. Alfred Russel Wallace.

THE election of Dr. B. A. Gould of Cordoba in the place of the late Prof. C. A. F. Peters, director of the Observatory at Kiel, as Correspondent of the Academy of Sciences at Paris, completes the authorised number in the section of Astronomy.

YORK has already begun to make preparations for the 51st meeting of the British Association in that city on August 31 next. A meeting is to be held on the 26th inst. to appoint a reception committee and take other steps in connection with the approaching visit of the Association. The local secretaries are the Rev. Thomas Adams and Dr. Tempest Anderson.

THE well-known collection of fossils formed by the late Mr. E. Wood of Richmond, Yorkshire, has been purchased by Mr. William Reed, F.G.S., of York, and by him presented to the Museum of the Yorkshire Philosophical Society, York. The collection consists of about 10,000 specimens, and is specially rich in fossils from the Carboniferous rocks.

THE great *soirée* of the Paris Observatory will take place on February 5. One of the features of the display will be a series of vacuum tubes exhibiting the spectral peculiarities of the several gases inclosed.

DR. FRITSCH, Professor of Zoology at the University of Prague, has sent us a specimen of a cast, taken by the galvano-plastic process, of a skeleton of one of the extraordinary Labyrinthodont reptiles, described by him in his work, "Fauna der Gaskohle der Permformation Böhmens." As the matrix in which these skeletons are found contains much pyrites, it soon crumbles away on exposure to the air. By this process of Dr. Fritsch's the specimens however may be examined, even when magnified twenty-fold, and all little minutiæ of the skeleton can be seen. Complete sets of these galvano-plastic casts, representing all the more important reptile remains found, can be had on application to Prof. Fritsch.

IN Siberia, a country so rich in gigantic fossils, the body of a colossal rhinoceros has been discovered in the Werchojanski district. It was found on the bank of a small tributary to the Jana River, and was laid bare by the action of the water. Similar to the mammoth washed ashore by the Lena River in 1799, it is remarkably well preserved, the skin being unbroken and covered with long hair. Unfortunately only the skull of this rare fossil has reached St. Petersburg, and a foot is said to be at Irkutsk, while the remainder was allowed to be washed away by the river soon after it had been discovered. The investigation of the skull gave the interesting result that this rhinoceros (*R. Merckii*) is a connecting form between the species now existing and the so-called *Rhinoceros tichorrhinus*, remains of which are not unfrequently found in the gravel strata of Eastern Prussia. It is supposed that *R. Merckii* is the now extinct inhabitant of the eastern part of Siberia.

HERR JULIUS GILLIS, a wealthy merchant of St. Petersburg, offers a prize of 1000 florins for a popular work on "Kant's Views on the Ideality of Time and Space." Herr Gillis will not only pay the cost of publishing of the work which obtains the prize, but will also let the author have the profits its sale may realise. Details regarding this matter can be obtained from Last's Literary Institute at Vienna.

MR. WARREN DE LA RUE will, on Friday next, the 21st inst., deliver his discourse at the Royal Institution on "The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells." Prof. Schäfer will give the first of a course of twelve lectures on the Blood, on Tuesday next (January 25); Mr. Francis Hueffer, the first of a course of four lectures on the Troubadours, on Thursday next (January 27); and Mr. Sidney Colvin the first of a course of four lectures on the Amazons, on Saturday next (January 29). The next Friday evening discourse will be given by Dr. Arthur Schuster, on the Teachings of Modern Spectroscopy, on January 28.

MR. E. T. SACHS sends us some interesting notes from Batavia:—"Within the past month I have been so lucky as to make what I hope is a very interesting if not remarkable discovery. On the Island of Biliton, 200 miles from here, I found a fresh-water fish which produces its young *living from its mouth.* I am quite prepared for the cry of incredulity that will be raised; but I conducted my observations with living fish and closed doors, and what I assert is undeniable: the eggs are hatched in the lower portion of the head of the fish, and are projected out at the mouth and from nowhere else. I have secured several specimens, which I shall send to Dr. Günther, who will of course at once set the matter at rest. I also got on Biliton a butterfly, which is either a new Thecla or else it is the male of the pretty *Myrina nivea* peculiar to the island. I fancy it must be the latter. I was only three weeks on the island on other business, and was never two miles from the shore, so I have reason to be satisfied with my trip. I mean to go again next May or thereabouts, and go into the interior, and also try to get some living fish to breed from in Batavia. . . . There is a Dr. Schluyter here who is working hard at invertebrates. He is just busy on the tri-pang family, and will no doubt produce a fine monograph. He gets some fine crustaceans from the Straits of Sunda. I have shown him my fish, and he knows nothing of it."

ON the subject of crickets Mr. Sachs writes:—"These are sold in the markets in Batavia, inclosed in small bamboos. There is not much superstition about it, as little ticklers (pieces of stick with a bunch of plants analogous to our broom tied on the end) are sold with it wherewith to stir up the unfortunate insect when it doesn't chirp. Only children buy them."

A SHARP shock of earthquake was felt at Peshawur at 4 a.m. on December 10. The atmosphere was clear at the time; small drafts and eddies of cold wind followed the shock. The previous evening there had been a few drops of rain, the first for three months. The temperature was rather warmer than it had been, owing to the sky being more overcast. A smart shock was felt at the Bridge of Allan, near Stirling, on the morning of the 12th, about seven o'clock. There was a severe shock at Thurgau on the night of the 13th, accompanied by underground noises.

THE difficulties of the old Paris Municipal Council with the gas company were not adjusted before its dissolution. We believe that the new Municipal Council is sure to accept all the proposals coming from any gas company which has proved practically by some previous experiments the value of their system, and are willing to accept a remuneration proportional to the quantity of light produced on a scale similar to the Lontin agreement, viz. 10 deniers for each 120 or 130 sperm candles.

THE French Government has appointed an engineer of the Ponts et Chausées, M. de Villier du Terroge, to report on the possibility of establishing in Paris underground railways. The difficulty is in the length of the tunnels to be excavated, which will be greater than on the Metropolitan Railway, and the necessity of procuring smoke-consuming engines.

ON the 7th inst. a silver tea and coffee service was presented by the Mayor of Liverpool, in the name of a large number of subscribers, to Mr. A. Norman Tate for his disinterested efforts to promote scientific education in that city.

A GENERAL Horticultural Exhibition will be held at Frankfort-on-Main from May 1 to October 1 this year. Particulars may be obtained by applying to "Die Gartenbau-Gesellschaft" at Frankfort-on-Main.

THE Electric Railway, constructed by Siemens and Halske, between the Anhalter Station, in Berlin, and the suburban village of Lichtenfeld, has been satisfactorily completed, and will be opened to public traffic on the 1st of next month.

A NEW electric lamp has been brought out in Paris; it is a combination of the Werdermann with a perforated carbon filled by an insulating medium. It is said to work well.

AT a meeting of the Council of the Epping Forest Naturalists' Field Club, held on Saturday evening, January 8, the following resolution was passed on the motion of Mr. Francis George Heath, seconded by Mr. N. F. Robarts, F.G.S.—"That the Council of this Society, on behalf of the large section of the population of London interested in the pursuit of Natural History, desires to record an emphatic protest against the proposal of the Great Eastern Railway Company to carry a line across Epping Forest, believing that it is wholly unnecessary for the Railway to take the route projected, and that it would not fail to prejudicially affect the advantages secured by the Epping Forest Act, which directs that the forest is to be preserved as far as possible in its natural aspect."

OUR ASTRONOMICAL COLUMN

JANSON'S STAR OF 1600.—The so called *Nova* of 1600, which is 34 Cygni of Flamsteed, and P Cygni of Schönfeld's catalogues of variable stars, was discovered by Wilhelm Janson, a pupil of Tycho Brahe's, and entered upon his globe in that year. It has been erroneously stated in some astronomical works (as in Cassini's "Elements d'Astronomie) that Kepler was a co-discoverer of this star, of which he himself informs us to the contrary in his treatise, "De stella tertii honoris in Cygno, quæ ad annum MDC fuit incognita necdum extinguatur, Narratio astronomica"; this is appended to his well-known work, "De stella nova in pede Serpentarii," published at Prague in 1606. At p. 154 we read, "Cum mense Majo anni 1602 primùm literis monerer de novo Cygni phænomeno," &c., while at p. 164 Kepler says distinctly that Janson was the discoverer, "Primus est Gulielmus Jansonius, qui hanc novam a se primùm anno 1600, conspectam profitetur inscriptum in globum cælestem anno 1600 editum factâ." Kepler gave the position of the star for the end of 1600 in R.A. 300° 46', Decl. + 36° 52'. He observed it during nineteen years, it became fainter in 1619, and disappeared in 1621, though Fortuni Liceti dates a reappearance in the same year. In 1655 Dominique Cassini observed it again; it increased during five years, until it attained the third magnitude, and afterwards diminished. On the testimony of Hevelius, it reappeared in November, 1665, it was again faint in the following year, but subsequently brightened without reaching the third magnitude, in 1677 and 1682, it was only of the sixth magnitude. Cassini says on June 24, 1715, a star of this magnitude was seen in the position of P (Bayer) equal to the three which are near that marked *b* in Cygnus by Bayer.

Edward Pigott was at some pains to elucidate the history of this star in a communication presented to the Royal Society in 1786 (*Philos. Trans.* vol. lxxvi. p. 189). He says he had minutely examined the observations made in the previous century with the following results as to the star's fluctuations:—

1. Continues at its full brightness for about five years.
2. Decreases rapidly during two years.
3. Invisible to the naked eye for four years.
4. Increases slowly during seven years.
5. All these changes, or its period, are completed in eighteen years.
6. It was at its *minimum* at the end of the year 1663.

It does not always increase to the same degree of brightness, being sometimes of the third, and at other times only of the sixth magnitude. He adds that he was entirely ignorant whether it were subject to the same changes since the beginning of the eighteenth century, as he had not met with any series of observations upon it.

It cannot be said that Pigott's conclusions (which Schönfeld appears to think are only indifferently supported by the observations upon which they are stated to be founded) have received any confirmation since his time. If in the absence of systematic series of observations we consult the catalogues of the present century, we have the following estimates of magnitude amongst others:—Piazzi, 5·6; Bessel, 6·7 (on September 14, 1825); Argelander's *Uranometria*, 5; and *Durchmusterung*, 5·3; Yarnall, 5·2; Radcliffe observations, 1870, 5·8. But in view of the undoubted variation in the brightness of this star in past times, more regular observation seems desirable. Has it ever been carefully examined under the spectroscope? Its light has a strong yellow cast. Mädler found no appreciable proper motion. The star occurs in the second Radcliffe catalogue, and in the Greenwich catalogue of 1864. The position carried back to Kepler's epoch from these authorities is in close accordance with that given in his treatise.

THE NEW CAPE CATALOGUE.—At the meeting of the Royal Astronomical Society on the 14th inst. the Radcliffe observer, Mr. E. J. Stone, laid upon the table the complete sheets of his great Catalogue of Southern Stars, observed during his superintendence of the Royal Observatory, Cape of Good Hope, which has been printed since his return to England. This very important work contains the places of between twelve and thirteen thousand stars, including, in addition to the stars observed by Lacaille, a considerable number of stars falling within similar limits of magnitude. "A stereographic projection, showing the distribution of the stars contained in the Cape Catalogue, 1880, between 110° and 180° N.P.D." has been lithographed by Mr. Stone. We believe a number of suspected cases of large proper motion amongst the southern stars disappear under the new determination of their positions at the Cape.

BIOLOGICAL NOTES

ARCHÆOPTERYX MACRURA.—A very able article on this strange-feathered animal by Prof. Carl Vogt was read before the Saint Gall Meeting of the Congress of Swiss Naturalists, and was published in the *Revue Scientifique* for September, 1879. This has been translated in the recently-published number of *Ibis*, with a photograph of Herr Häberlein's specimen. H. von Meyer, in 1861, described this species (under the specific name lithographica) from the impression of a "bird's" feather in the Solenhofen slate. Prof. Owen, on the discovery by Dr. Häberlein of a specimen (imperfect) described it "as he alone knows how to do." The head of this specimen was wanting. Dr. Häberlein's son, about 1875, succeeded in splitting a slab so skilfully as to have on one of its halves the whole animal, and on the other its impression. This specimen Herr Häberlein is anxious to dispose of, and it is the one described by Carl Vogt. The animal preserved in the slab is of the size of a ringdove. The remains described by Prof. Owen belong to the same species, but to an example greater by a fifth. It is entire; the head, neck, trunk, and hind-quarters are placed in profile, the head is bent backwards, so that its top nearly touches the back. The wings, united at the shoulder girdle, are spread as if for flight. The head is small, pyramidal, nearly flat. The orbit is large, with the nostril in front of it. By means of a lens two little conical and sharp teeth are perceived at the end, planted in the upper jaw. On the lower surface there is a forked bone to be seen, but Prof. Vogt dare not say whether this is the lower jaw or a tongue bone; the bones of the head show clearly that it is a true reptile's head. Its shoulder-girdle proves also to be that of a reptile. In fact the head, the neck, the thorax, with the ribs, the tail, the shoulder-girdle, and the whole fore-limb, are plainly constructed as in reptiles. The pelvis has probably more agreement with that of reptiles than with that of birds. The hind-foot is that of a bird, therefore reptilian affinities prevail in the skeleton over all others. The feathers are those of a bird. The remiges of the wings are fixed to the ulnar edge of the arm and to the hand; they are covered for nearly half their length with a fine filiform down; none of them project beyond the others. It is possible that at the base of the neck there was a ruff like that of the condor. The tibia was clothed with feathers for the whole of its length. Archæopteryx thus wore breeches, as do our falcons All the other parts of the body were evidently naked. It would thus seem to take its rank neither among birds nor reptiles. It forms an intermediate type of the most marked kind, and confirms in a brilliant way the views of Prof. Huxley, who has united birds and reptiles—to form of them under the name of Suuropsids, a single great section of Vertebrates.

EUROPEAN AND NORTH AMERICAN BIRDS.—The occurrence of North American birds in Europe has always been a subject of interest to ornithologists. In the April number (1880) of the *Proceedings* of the Royal Dublin Society there is a paper by Percy Evans Freke giving a comparative catalogue of the birds found in Europe and North America, in which the species of North American birds are arranged in columns side by side with the same species found at times in Europe. The geographical distribution of these species is also given, and the residents, which are probably breeders, are distinguished. This list seems worked out with a great deal of care. A paper on the same subject by Mr. J. J. Dalgleish appears also in the April number (1880) of the *Bulletin* of the Nuttall Ornithological Club, with a table giving a "List of Occurrences of North American Birds in Europe." Great care has evidently been taken in this memoir also to secure correctness. On comparison of the lists it would seem as if Evans had overlooked Gätke's paper on Heligoland Birds.

A GNAT WITH TWO KINDS OF WIVES.—Dr. Fritz Müller describes in a late number of *Kosmos* (October) a very remarkable two-winged insect which he calls *Paltostoma torrentium*, and which he found at Itajah. The larvæ were found by him under stones and rocks in the little streams with which this province abounds. These larvæ were carefully watched and reared, and the perfect insects on their appearance were found to be males and females, but the latter of two well-marked and very different types. In the male gnat the eyes occupy nearly the whole side of the head, and leave not even room for the three ocelli, which are thus forced to the top of a peculiar stalk-like body. In one of the two forms of the female the eyes occupy the whole length of the head, but leave between them a broad belt, which in the second form of female is not half so wide or long. In the large-eyed females the parts of the mouth are formed after the type of those to be met with in the blood-sucking females of the mosquito or horse-fly. But in the small-eyed females and in the males this formidable development of the parts of the mouth, which enables the large eyed females to feed on blood, is wanting, and the former are honey-suckers, obtaining this food from the nectaries of several flowers. Along with this remarkable difference in the parts of the mouth there is a notable difference in the foot-joints, the honey-sucking wives having slender feet, with smaller claws than their honey-sucking husbands; while the blood-sucking wives have the last foot-joint short and wide, furnished on its under surface with a thick pad, from which arise strong curved hairs; the claws are also much longer. Thus the small-eyed honey-loving form has the more simple structure of foot, whereas the blood-seeker has not only the more complicated form of foot, but great eager eyes looking about for what they can get to devour.

THE FUNCTION OF ASPARAGINE.—Boussingault's researches seemed to show that asparagine was a substance comparable to urea, the result, like it, of a transformation of albuminous matters, and that this substance made its appearance only in seeds during their germination; but from the discovery of this substance not only in bitter almonds when the embryo is not yet visible; in the same seeds when completely ripe; in the young seeds of the apricot, plum, and cherry, and even in the unopened inflorescences of the pear, M. L. Portes sees reason to doubt the propriety of ascribing to it this function. If, he says, Boussingault's experiments show the existence in leguminous plants of an asparagine concomitant with the act of germination—which might be called blastemic asparagine—there also exists in the almond tribe and pear-buds, another form apparently not having any physiological connection with the other, which may be referred to as ablastemic. In both cases the asparagine is a secondary product; its formation is in intimate connection with the production of new cells. Sweet and bitter almonds gathered in March in the middle of France were proved to contain neither sugar nor starch, but dextrine was present. Previous analysis allows one to affirm that neither sugar nor starch ever existed in them, nor as yet were they in the flowering stalk. May it not be admitted that the dextrine and glucose which speedily appear have at least in part an albuminoid origin? since the seed does not contain, nor will it for a long time contain, starch; since the young seed shows no sugar; and lastly, since there is a product of excretion representing the azote of the transformed protoplasmic matter. (*Revue Internationale des Sciences biologiques*, October 15.)

A CAUSE OF THE MOTION OF DIATOMS.—According to one view diatoms move by means of strong osmotic processes, which, being more intense in one direction, cause impulsion in the other. Some observations by Herr Mereschkowsky supporting the latter view are described by him in the *Botanische Zeitung* (1880, p. 529). He examined two species of Navicula and one of Stauridium in sea-water containing many very small micrococci, which, near the diatoms, vibrated greatly, but at a distance were quite still. It was first evident that the movements of the diatoms consisted of a straightforward motion, then a backward, with a pause between, or of a turning round the axis. Then it was noticed that so long as the diatom remained still, all the actively vibrating micrococci were uniformly distributed, whereas, when the diatom moved, the micrococci vibrated with excessive activity at the hinder end, as if a strong water current entered behind the alga. At the fore end there was only a very slight motion of micrococci. When the still state was reached the vibration became again equally distributed, and on commencement of the backward motion a reverse distribution of the vibration was observed. These phenomena (observed also in rotation of diatoms) can only be explained, the author considers, by the hypothesis above stated.

FUNGAL GROWTHS IN THE ANIMAL BODY.—By experiments on animals, Herr Grawitz (*Virchow's Archiv*, B. 81, p. 355), has recently proved the following:—1. The well-known mould-fungi *Eurotium* (*Aspergillus*) and *Penicillium* occur in two varieties, which are quite alike in form, but quite different physiologically; the one proving wholly indifferent in the blood-system of the higher animals, while the other has all the malignity of the worst pathogenic fungi known. 2. From any original form both varieties can be obtained by continued cultivation, and similarly from either of the two varieties the other may be got, in twelve to twenty generations, by systematic cultivation. 3. The principle of the cultivation is to habituate the fungi which live on solid, weakly acid, nutritive substances at a temperature of about 8° to 20° C., through a series of generations, to liquid alkaline albumen solutions, and a heat of 38° to 40° C. 4. The malignity of the pathogenic mould-fungi consists, in acute cases, in their spores, which on reaching the circulation of the higher mammals, there germinate, and passing into different parts of the body, multiply, and cause local neuroses, and death in about three days. In the subacute and chronic cases a reactive inflammation occurs in each of the numerous fungus-centres, which may cause the death of the hyphæ and lead to cure. 5. Most of the small mould-accumulations easily seen with the naked eye in the kidneys, liver, muscles, and retina, are microscopically distinguishable neither by size nor by histological characters from fungi of the same species, which have grown on their favourite substrata, except that they have only rudimentary fruit-stalks, and never attain to the separation of spores.

BRAIN-WEIGHT.—The weight of the human brain, according to a recently-published work by the eminent Munich anatomist Prof. Bischoff, is on an average 1362 grammes for man and 1219 gr. for woman. The difference between the average brain-weight of man and woman thus amounts to 143 gr., or 10·50 per cent.

The brain-weight of man exceeds that of all animals except the elephant (4500 gr.) and the larger Cetaceæ (2500 gr.). The brain-weight of the largest apes is hardly a third of man's. Prof. Bischoff has worked with a considerable amount of material; his data comprise the weights of brain of 559 men and 347 women.

PHYSICAL NOTES

EXPERIMENTS have been made by Herr Glan (*Wied. Ann.* No. 11) as to the action of gases and vapours on the optical properties of reflecting surfaces. No such influence (expressed in alteration of phases in reflection) is found to exist if the gases and vapours do not act chemically on the surfaces, or are not precipitated in visible quantity (as when the temperature is below the dew point).

DR. FUCHS describes a new interference photometer (*Wied. Ann.* No. 11) in which no polarisation of the rays at right angles to each other is required. It consists simply of two similar isosceles glass prisms joined by their basal surfaces, which enclose an air layer variable in thickness by pressure. A diaphragm reaches out in prolongation of the surface of junction. The observer looks obliquely towards this surface and sees one illuminated surface directly through the double prism, the other by reflection at the air layer. One light-source is fixed, and the other is displaced till the interference bands disappear.

THE polar differences in luminous phenomena of the discharge of electricity through gases were considered by Wiedemann and Rühlmann as possibly due, in part at least, to a gas layer (more or less condensed) on one electrode. Supposing that other kinds of envelopes with like action would essentially affect the phenomena, Herr Holtz has been able (*Wied. Ann.* No. 11), by covering one electrode, *e.g.* with silk, or placing a stretched silk disk before it, to verify this, and almost quite obliterate, in some cases, the polar differences.

IN a recent publication describing electrical researches, by Herr Goldstein, in Berlin, that author investigates the phenomena which occur when, in a space so far evacuated that the green phosphorescent light occurs with the discharge from the cathode, there are, not one, but several cathodes. He has met with a new form of electrical repulsion, not to be classified either with the mechanical repulsion in collision of ponderable masses, or with electrostatic or electrodynamic repulsion. (An abstract of the memoir appears in *Wiedemann's Beiblätter*, No. 11.)

APPLYING his theory of the potential energy of liquid surfaces to great cycle-operations in nature, M. van der Mensbrugghe (*Bulletin* of Belg. Acad., 9 and 10) has lately calculated that if evaporation subdivides the liquid of seas into spherules of *e.g.* 1-10,000th mm. diameter, each kilogramme of water presents a collection of spherules whose total potential energy is equivalent to 450 kilogrammetres, *i.e.* more than a million times that of a sphere of compact water also weighing 1 kilogramme. This shows what prodigious quantities of work-units are carried virtually into the atmosphere by water vapour, and there is to be added the potential energy acquired by this vapour in virtue of its weight. The author applies his theory to the effects of condensation, to glazed frost, to phenomena of rivers and waterfalls, &c. He anticipates important verifications of it from the examination of the Gulf Stream in the Gulf of Mexico projected by the United States, and recent soundings have tended to confirm it.

M. MONTIGNY (*Bull.* Belg. Acad. 9 and 10) has lately studied the effects of making bells vibrate with liquids in them (water, ether, alcohol, sulphide of carbon), or when wholly immersed in liquids. He found that (1) the sound produced was always more grave than the natural sound; (2) that the lowering of tone was more marked in both cases the more dense the liquid (thus it is less with ether than with sulphide of carbon); (3) that with all the liquids tried the alteration in sound of a given bell was much more marked when the bell was wholly immersed than when merely filled with the liquid; and (4) that in both cases the lowering of tone was more marked for grave than for acute notes. The general inference is that the rapidity of vibrations of a sounding body is considerably diminished by a liquid with which its walls are in contact, and that this diminution is more sensible when the contact is established on both sides of the vibrating body than when only on one side. The mode of action is related not only to the density, but to the compressibility of the liquid. The lowering of sound is more sensible with water than with alcohol and ether; the latter being less dense and more compressible liquids. The form of the bell and the nature of its substance (that is its special elasticity and its density) are shown also to affect considerably the pitch of the sound produced in contact with liquids. M. Montigny is investigating whether air is a medium of too little density and too great compressibility to modify sensibly the duration of vibrations of sonorous bodies.

AT a recent meeting of the Franklin Institute (*Journal* for December), Mr. Griscom described his new electric motor, which, weighing about 2½ pounds, compares favourably with those of the old forms of fifteen times its weight. Its most essential advantage is in the field magnets; the shape of which is such that all the magnetic lines of force, including those nearest the neutral line, are brought into the best possible position for effecting the revolution of the armature. If a bar of soft iron is pivoted at one end to move in a horizontal plane, and a semicircular magnet is placed concentrically with the circle the bar can describe, then a given force is exerted on the bar at a much greater distance from the poles when the latter is within the semicircle than when it is without. Herein (it is stated) is the secret of the power of Mr. Griscom's motor. The battery is inclosed in a strong waterproof box, gives no odour, and very little trouble in renewing. It is calculated that it will suffice for the sewing of a small family for one year; a professional seamstress would exhaust it more rapidly, but always in proportion to the exact amount of work done.

A NEW microphone, made by M. Boudet in Paris (*La Nature*, No. 394), has the general shape of a telephone on a support. It comprises a mouthpiece, in which is an ebonite plate 1 mm. thick, with a short bar of copper penetrating from its middle a short way into a glass tube in which are six little balls of retort carbon in a row; a second mass of copper following the last, and resting on a small spiral spring in a case. The pressure can be varied by means of a screw. The instrument is worked with six Gaiffe elements (peroxide of manganese and chloride of zinc) mounted in tension, and a Bell telephone. It is said to transmit the voice very distinctly without altering its timbre and without disturbing sounds being produced.

IN a note to the Vienna Academy (*Anz.* December 16) Prof. Stefan describes experiments on the influence of terrestrial induction in development of an electric current, and the excitement of the telephone by currents from a rotating coil. The coil used was 56 mm. in external diameter, and 11 mm. in width. The earth's influence is best shown by so connecting the apparatus with a galvanometer that the circuit is closed during one half of the coil's rotation, and broken during the other half; if the completion of the circuit correspond to the positive maximum of the electromotive force of the earth's magnetism, and the interruption to the negative, the galvanometer is positively deflected. The deflection may be reduced to zero by displacing the contact, and from the displacement and the number of rotations the potential may be inferred in absolute measure. Next the telephone was so connected with the coil that the full alternately opposite currents went uninterruptedly through the circuit. This gave a simple tone. With 100 rotations per second the horizontal component of the earth's magnetism did not suffice to excite an ordinary telephone, but it excited one having a horse-shoe magnet. (When the intensity of the field was doubled the ordinary telephone was also excited.) The tone corresponds to the number of rotations. When the coil was rotated 220 times in a second the ordinary telephone sounded. The telephone was shown to be less sensitive to currents whose intensity periodically changes than to interrupted currents (an ordinary telephone sounded with 100 rotations or fewer, when the circuit was closed only during a short time of each rotation).

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday evening a paper was read on the discoveries made by Mr. Leigh Smith last year on the coast of Franz Josef Land, including also a general sketch of the rest of his voyage in the *Eira*. Mr. Smith appears to have reached the southern shores of Franz Josef Land with comparative ease about the middle of August, and to have examined it and several islands along a coast-line of over 100 miles of previously unexplored ground. The new continent, as some would fain believe it to be, does not present an attractive appearance, for the coast-line is described as consisting of glaciers with dark frowning and flat-topped cliffs, here and there reaching to a height of 1200 feet. It was after passing Barents' Hook that new ground was actually broken, and the exploration was continued westwards until Mr. Smith succeeded in rounding the western headland. The farthest point actually reached by the *Eira* was in N. lat. 82° 20', E. long. 45°, and thence the land could be seen trending away to the north-west. During the voyage a meteorological record was kept, photographs taken, and various collections made, chiefly of botanical and geological specimens.

THE January number of *Petermann's Mittheilungen* contains an account of a journey from Dufilé to Lur, on the west shore of Lake Mwutan-Nzige, by Dr. Emin Bey, in the last months of 1879. Herr Clemens Denhardt brings together much valuable information on the East African region between Mombasa and the Victoria Nyanza, with special reference to the trade-routes, accompanied by an excellent map. An article of special scientific interest is contributed by Dr. H. Hoffmann on the Comparative Phænology of Central Europe. In a series of tables and in a map the average time of bloom is shown for a very large number of places, with reference to Giessen as a standard. There is a very interesting account by Baron Nordenskjöld of his visit to Behring Island, followed by some critical remarks on the vegetative region of the Serra da Estrella, by Dr. O. Drude.

Bulletin, No. 5, 1879, of the American Geographical Society contains a paper by General R. E. Colston on "Life in the Egyptian Deserts," and an amusing lecture by Lord Dunraven on "Moose and Cariboo Hunting."

THE French station of the African Association has been established by M. Savorgnan de Brazza at Nghimi, on the route from Machogo to Levumba, in the region of the sources of the Ogové, in 1° 30' S., and about 11° E. from Paris.

THE publication in which the results of the determination of the South American longitudes by electricity have been tabulated by American observers has just arrived in Paris. All the positions determined by M. Mouchez on the Brazilian coast have proved correct within a difference of 1½ second of time. These determinations were taken by Admiral Mouchez when a subordinate officer in the French service twenty years ago, by lunar distances, occultations, and eclipses.

THE author of the summary of Geographical Discovery in *Whitaker's Almanac* writes to us in reference to the notice on p. 232, that it is not stated that Mr. Leigh Smith's voyage is "the most remarkable geographical event of the year," to the depreciation of Mr. Thomson's African journey; "but that, in spite of the success of the latter, Mr. Smith's voyage would probably be considered by many as the most remarkable geographical event of 1880." We doubt if "many" would hold such an opinion, merely for the reason assigned in the *Almanac*. "May I be allowed to point out," he adds, "that the word 'research' means careful search or investigation? and that mere searching for the North Pole is not the sole object of Arctic voyages?" We are glad the writer is of this opinion, though we doubt if Mr. Leigh Smith's voyage has much bearing on Polar "research."

CHESAPEAKE ZOOLOGICAL LABORATORY

A REPORT of the third year's work at the Chesapeake Zoological Laboratory of the Johns Hopkins University has been addressed to the President of the University by Mr. W. K. Brooks, Director of the Laboratory. An advance copy of this has been sent us, from which we make some valuable extracts.

The laboratory was opened at Beaufort, North Carolina, on April 23, 1880, and closed on September 30, after a session of twenty-three weeks. It was supplied with working accommodations for six investigators, and the facilities which it afforded were used by the following six persons:—W. K. Brooks, Ph.D., Director; K. Mitsukuri, Ph.B., Fellow in Biology; E. B. Wilson, Ph.B., Fellow in Biology; F. W. King, A.M., Professor of Natural Science, Wisconsin State Normal School; H. C. Evarts, M.D., Academy of Natural Sciences, Philadelphia; H. F. Osborne, Ph.D., Fellow of the College of New Jersey.

Beaufort was selected for the third season's work because it is the nearest accessible town south of Baltimore which is favourably situated for zoological study. The scientific advantages of Beaufort are very great; the most important is the great difference between its fauna and that of the northern Atlantic coast.

"The configuration of our coastline," the Report goes on, "is such that Cape Hatteras, the most projecting point south of New York, deflects the warm water of the Gulf Stream away from the coast, and thus forms an abrupt barrier between a cold northern coast and a warm southern one. The fauna north of this barrier passes gradually into that of southern New England, while the fauna south of the barrier passes without any abrupt change into that of Florida, but the northern fauna is sharply separated by Cape Hatteras from the southern. As the laboratory of the U.S. Fish Commission and Mr. Agassiz's laboratory at Newport afford opportunities for work upon the northern fauna, it seemed best for us to select a point south of Cape Hatteras in order to study the southern fauna with the same advantages, and as Beaufort is the only town near the Cape which can be reached without difficulty, it was chosen as the best place for the laboratory. The situation of this town is exceptionally favourable for zoological work, for the surrounding waters present such a diversity of conditions that the fauna is unusually rich and varied."

After describing in detail the special characteristics of the locality Mr. Brooks goes on to say:

"The zoological resources of Beaufort have not escaped the attention of American naturalists, and there are few places upon our coast, outside of New England, where more zoological work has been done. In 1860 Drs. Stimpson and Gill spent a season in dredging and collecting in the vicinity of Beaufort, Cape Lookout, and Cape Hatteras, and an account of their work was published in the *American Journal of Science*. Dr. Coues, who was stationed at Fort Macon during the war, occupied himself for two years in collecting the animals which are found here, and he published a series of papers on the 'Natural History of Fort Macon and Vicinity' in the *Proceedings* of the Academy of Natural Sciences of Philadelphia. These papers, which were continued by Dr. Yarrow, contain copious and valuable notes on the habits and distribution of the animals which were observed, and we found them a great help to us. These two naturalists found 480 species of animals in the vicinity of Beaufort. Of these 480, 298 are vertebrates, and 182 are invertebrates. Of the vertebrates 24 are mammals, 133 are birds, 27 are reptiles, 6 batrachians, 97 fishes, and 11 selachians. Of the invertebrates 147 are mollusks, 21 are crustaceans. The list of vertebrates is very nearly exhaustive, and we made no additions to it; but the list of invertebrates is obviously very imperfect, and although we made no attempt to tabulate the species which we observed, there would be no difficulty in enlarging the list twenty or thirty fold.

"Among other naturalists who have spent more or less time at Beaufort I may mention Prof. L. Agassiz, Prof. E. S. Morse, Dr. A. S. Packard, Prof. Webster, and Prof. D. S. Jordan. Prof. Morse procured most of the material for his well-known paper on the Systematic Position of the Brachiopoda on the Sand-bars in Beaufort Inlet.

"I will now attempt to give a very short statement of some of the leading points in our own summer's work. Much of our time was spent in studying the development of the Crustacea, since this is one of the most important fields for original work upon our southern coast. The supply of material is almost inexhaustible, and would employ a number of students for many years. The life-history of the Crustacea is of great interest in itself, and the recent species are so numerous and diversified that there is no group of animals better adapted for studying the general laws of embryonic development in their relation to the evolution of the group. These considerations have led us to devote especial attention to this group during this and the preceding seasons. One of the published results of the first season's work was an illustrated account of the metamorphosis of Squilla, a representative of a somewhat aberrant group of Crustacea. During the second season a member of our party, Prof. Birge, made a very thorough study of the development of Panopæus, one of our crabs, and the account of his observations, with drawings, was ready for publication several months ago. At Beaufort we spent most of our time upon this subject, and figured more than 800 points in the development of various Crustacea.

"Among these I wish to call especial attention to our observations upon the development of the Sergestidæ; the least specialised of the stalk-eyed Crustacea. This very peculiar group was not known to occur upon our coast until we found a few specimens of one genus at Fort Wool, and the same genus—Lucifer—in great abundance at Beaufort, associated with another genus which is also new to North America. As nothing whatever was known of the development of Lucifer, we made every effort to obtain the eggs and young, and after four months of almost fruitless labour we finally succeeded in finding all the stages of the metamorphosis, and figured them in a complete series of ninety-nine drawings. We also obtained a somewhat less complete series of figures of stages in the life history of the second Sergestid. Our only motive in this work was the desire to fill a gap in our knowledge of crustacean development by supplying the life-history of a very interesting group of animals, but the result was found to have a very unexpected value, since it contributes to the discussion of a number of problems in general embryology and morphology, and is the most significant crustacean life history which has ever been studied.

"The following are some of the more important points:—The egg undergoes total regular segmentation. There is no food-yolk, and cleavage goes quite through the egg. There is a true segmentation cavity. Segmentation is rhythmical. There is an invaginate gastrula. The larva leaves the egg as a Nauplius, and passes through a protozoea stage and a schizopod stage. The fifth thoracic segments and appendages are entirely wanting at all stages of development.

"Another interesting group which was studied is the Porcellanidæ; the least specialised of the true crabs. The adults of our American species are almost restricted to our southern waters, although the swimming larvæ are carried north by the Gulf Stream. Within the last two years two northern naturalists have studied these floating embryos upon the south coast of New England, but as they were working upon stragglers so far from home, their accounts are incomplete and somewhat contradictory. Our advantages at Beaufort enabled us to contribute towards the solution of this confused subject by raising one species of Porcellana from the egg. We also raised six other species of crabs from the egg, and made drawings of the more important stages of development. One of the species which was thus studied is the edible crab. Its metamorphosis has never been figured, and although it presents no unusual features, its economic importance gives value to exact knowledge of its life history. Mr. Wilson also studied the development of one s ecies of Pycnogonida, a group of very peculiar Arthropods distantly related to the spiders. As he has paid especial attention to the systematic study of this group, and is now engaged in describing the Pycnogonids collected in the Gulf Stream by Mr. Agassiz, the opportunity to study them alive in the laboratory has been a great advantage to him.

"Another important investigation is the study by Mr. Wilson of the embryology of the marine Annelids. Although the representatives of this large group are abundant and widely distributed, little was known of the early stages of their development until he procured the eggs of several species and studied them at Beaufort. This investigation has shown, among other things, that the accepted division of Annelids into two great groups, the Oligochæta and Polychæta, is not a natural method of classification. The work upon the development of marine Annelids was supplementary to an investigation which Mr. Wilson carried on last spring at Baltimore, and which he will continue this winter, upon the development of land- and fresh-water Annelids.

"As much time as possible was given this season to the study of the hydroids and jelly-fish of Beaufort. The life history of several of them were investigated, a thorough anatomical study of some of the most important forms was carried on, and nearly two hundred drawings was made. It is almost impossible to complete a study of this kind in a single season, but if one or two more summers can be given to the work, we have every reason to hope for valuable results, for although the North Carolina coast is the home of many species which are only found as stragglers upon our northern coast, and of other species which are not known to occur anywhere else, and of some genera and families which are new to the North American coast, this field has suffered almost total neglect.

"Nearly three months of the time of two members of our party, Mitsukuri and Wilson, were given to the study of the habits, anatomy, and development of Renilla, a compound Polyp very much like that which forms the precious coral, but soft and without a stony skeleton. The animals which form the community are so intimately bound together that the community as a whole has a well-marked individuality distinct from that of the separate animals which compose it. The compound individuality of Renilla is quite rudimentary as compared with that of a Siphonophore, and as there is no trace of it in the closely allied Gorgonias, it furnishes an excellent field for studying the incipient stages in the formation of a compound organism by the union and specialisation of a community of independent simple organisms. With this end in view the anatomy of the fully-developed community was carefully studied, and the formation of a community was traced by rearing a simple solitary embryo in an aquarium until a perfect community had been developed from it by budding. During the process of development the law of growth by which the characteristics of the compound organism are brought about was very clearly exhibited, and it is fully illustrated by nearly one hundred drawings.

"One of the most interesting results of our work is the explanation by Mr. Wilson of the origin of the metamorphosis of the larva of Phoronis, a small Gephyrean worm which lives in a tube. Several of the most noted embryologists of Europe have studied the development of Phoronis, and our knowledge of its life history is due to their combined labours. Last summer Mr. Wilson reviewed the subject, and added some important points, and during the present season he has shown by the comparison of a great number of allied forms that the very peculiar metamorphosis admits of an extremely simple explanation. The adult is sedentary and confined to its sand tube, while the larva is a swimming animal totally different in structure. The change from the larva to the adult is very rapid and violent. It occupies only a few minutes, and during the change the larva becomes turned wrong side out, so that what was internal is external. Mr. Wilson's comparison shows that Phoronis was originally a free animal, and that the structural peculiarities which fit the adult for sedentary life in a tube are of recent acquisition. The larva has however retained its ancestral adaptation to a swimming life in order to provide for the distribution of the species. There must have been a time, in the evolution of the species, when the adult was imperfectly adapted to a sedentary life, and also imperfectly adapted to a swimming life; and if the development of the individual were a perfect recapitulation of all the stages in the evolution of the species, we should have, between the swimming larva and the sedentary adult, a stage of development during which the adaptation is not quite perfect for either mode of life. It is clearly an advantage for the animal to pass through this stage as quickly as possible, or to escape it altogether. The peculiar metamorphosis enables the larva to remain perfectly adapted to a locomotor life until the occurrence of the sudden change which fits it for life in a tube; and Mr. Wilson has pointed out the manner in which the metamorphosis has been acquired in order to bridge over the period of imperfect specialisation. This explanation is somewhat similar to that which Lubbock has given of the origin of the metamorphosis of insects, and we may hope that the same method of investigation will throw light upon the significance of other remarkable instances of metamorphosis in the invertebrates.

"During the summer the following abstracts of some of the more important points in our work have been published in scientific journals:—

The Development of the Cephalopoda and the Homology of the Cephalopod Foot. By W. K. Brocks. *Amer. Journal of Science.*

The Development of Annelids. By E. B. Wilson. *Amer. Journal of Science.*

The Rhythmical Nature of Segmentation. By W. K. Brooks. *Amer. Journal of Science.*

The Origin of the Metamorphosis of Actinotrocha. By E. B. Wilson. *Amer. Assoc., Boston Meeting.*

Notes on the Medusæ of Beaufort. By W. K. Brooks. *Amer. Assoc., Boston Meeting.*

Budding in Free Medusæ. By W. K. Brooks. *Amer. Nat.*

Development of Marine Polychætous Annelids. By E. B. Wilson. *Zoölogischer Anzeiger.*

Embryology and Metamorphosis of Lucifer. By W. K. Brooks. *Zoölogischer Anzeiger.*

The Early Stages of Renilla. By E. B. Wilson. *Amer. Journal of Science.*

"Other abstracts are now in the press, and others are ready for publication.

"A paper, with four plates, on the 'Early Stages of the Squid,' is also in the press, and will soon be issued in the Memorial Volume of Memoirs of the Boston Society of Natural History."

ELASTICITY OF WIRES[1]

THE experiments described in this paper form a continuation of experiments undertaken in connection with the work of the Committee of the British Association for commencing secular experiments on the elasticity of wires.

Long-continued application of stretching force increases to a very great extent the tensile strength of soft iron wire. Thus in experiments described to the British Association in 1879 (see Report of the Committee just referred to), a particular very soft iron wire was shown to have a breaking weight 10 p.c. higher if the weight necessary to break it is applied half a pound at a time per day, than it has if the breaking weight is applied half a pound at a time at intervals of say two minutes. It was found also that this wire, quickly broken, extends before breaking by as much as 25 p.c. of its original length; whereas if the application of the stress is very slow, the extension is not more than 5 or 6, or perhaps 8 p.c. Further experiments have been undertaken on this subject, and are still in progress.

Using a continuous arrangement for applying the stretching weight and employing some very soft iron wire which had been specially prepared, and which was used in former experiments, the greatest weight which could be rapidly put on the wire without breaking it was determined. It was found that with a weight of 41 lbs. gradually applied in 6¼ minutes the wire stretched by 24·4 p.c. of its original length, and broke 18 minutes after the weight was put on. With the same weight, 41 lbs., applied in 6¾ minutes, the wire stretched 22·1 p.c. and broke in 24 minutes. With 41 lbs., however, applied in 7⅛ minutes, the wire stretched 18 p.c., and did not break. This weight, therefore, appeared to be just as much as the wire would bear with this method of applying the weight. Accordingly it was applied to a great number of wires for different lengths of time for the purpose of hardening them, and arrangements have been made for keeping a number of wires for very long times with this stretching force applied to them. The amount of extension produced by the application of the hardening stress was observed in each case.

After the hardening stress had been applied for a certain time the additional weight necessary to break the wire was determined, and also the additional elongation before breaking, which was in all cases almost insensible. The wires seemed permanently set in about forty minutes from the time when the hardening stress was applied. They did not alter in length till just before they broke, when they generally stretched 1 or 2 millimetres on a length of about 1,800 mm. The following table shows some of the results out of a great many that have already been obtained.

Length of wire used.	Hardening stress applied in pounds.	Time taken by continuous machine in applying the hardening stress in minutes.	Extension produced by application of hardening stress in p.c. of original length.	Duration of hardening stress in hours.	Total breaking weight after hardening.
150 cm.	41	6¼	24·4	Broke with 41 lbs.	
,,	,,	6¾	22·1		
,,	,,	9½	18·7	24	47·44
,,	,,	7	17·2	27	47·5
,,	,,	8	17·3	117	48·13
,,	,,	7⅛	18·1	790	52·31

Curves have also been obtained and were exhibited to the Section showing the extension with gradually applied weights both of a number of wires and of the different parts of the same wire; also curves showing the extension at different intervals of time from the beginning of an experiment in which the wire is running down under a weight sufficient to break it finally.

The author acknowledged the great assistance that he had received from Mr. A. C. Crawford and other students the in Physical Laboratory of the University of Glasgow.

Similar experiments are in progress on wires of copper and tin, and it is intended to test gold wire very soon, as it will probably give interesting results, and results very different from those given by soft iron wires.

[1] Strength and Elasticity of Soft Iron Wires. Abstract of a Paper read at the British Association, by J. T. Bottomley, M.A., F.R.S.E.

SPECTROSCOPIC NOTES, 1879-80.

DOUBLE Reversal of Lines in Chromosphere Spectrum.—The magnesium lines of the *b* group, and the two D-lines of sodium have been seen several times (first on June 5, 1880) *doubly-reversed* in the spectrum at the base of a prominence.

A bright line first appears in the centre of the widened dark lines; then this bright line grows wider and hazy at the edge, and a thin dark line appears in its centre, as shown in the figure. The phenomenon lasts usually from ten minutes to an hour. It is evidently the exact correlative of the double reversal of the bright sodium lines, observable in the flame of a Bunsen burner or alcohol lamp under certain circumstances when the quantity and temperature of the sodium vapour in the flame are greatly increased.

The H-lines in the Chromosphere and Sun-spot Spectra.—In 1872 I found the H- and K-lines to be reversed in the spectra of prominences and sun-spots, as observed at Sherman, 8000 feet above the sea. Until recently I have not been able to verify the observation, except for a moment during the eclipse of 1878. During the past summer, however, I have succeeded in seeing them again, and with suitable precautions as to shade-glass, adjustment of slit to true focal plane for these special rays, and exclusion of extraneous light, I have no further difficulty with the observation. The spectroscope employed has collimator and view-telescope each of 1¼ inches aperture, and about 13 inches focal length, and a speculum-metal Rutherfurd grating with 17,300 lines to the inch. A shade of cobalt-blue glass greatly aids the observation. The solar image is 1¼ inches in diameter.

In the spectrum of the chromosphere, H and K are both *always* reversed. I have never failed to see them both when circumstances were such that *h*, the nearest of the hydrogen lines, could be seen.

Furthermore, H, in the chromosphere spectrum, is *always double:* that is, a fine bright line always accompanies the principal line, about one division of Ångström's scale below. The principal line seems to be exactly central in the wide dark shade, the other is well within the nebulosity. K on the other hand shows no signs of duplicity.

In the spectrum of a sun-spot H and K are also, both of them, generally, though not always, reversed; and the reversal is not confined to the spot, but covers often an area many times larger in its neighbourhood.

In the spot spectrum, however, H has never yet been seen double. The companion line of H is therefore probably due to some other substance than that which produces H and K; a substance prominent in the chromosphere, but not specially so in the neighbourhood of spots. In view of the recent observations of Vogel, Draper, and Huggins, it is natural to think that hydrogen is probably the element concerned. If so, it may be expected that H will be found doubled in the spectrum of a spot which reverses the hydrogen line *h*. I have not yet been able to test it in this way, as *h* is rarely seen reversed, though C and F occur pretty frequently.

[*Note.*—An observation made since my paper was written leads me to modify this opinion, that the companion of H is due to hydrogen, and satisfies me that in all probability both H and K must themselves be hydrogen-lines. At 11 A. M. on October 7, a bright horn appeared on the S.E. limb of the sun. When first seen it was about 3′ or 4′ in elevation, but it rapidly stretched up, and before noon reached a measured altitude of over 13′ (350,000 miles +) above the sun's limb. It faded away and disappeared about 12.30. It was brightest about 11.30 with an altitude of about 8′ and at this time both H and K were distinctly, and for them, brilliantly reversed in it clear to the summit. H was not double in it to any notable elevation, though the companion of H was visible at the base of the prominence. The H- and K-lines also showed evidence of violent cyclonic action, just as C did. *h* was only faintly visible in the prominence; F and the line near G were of course strong. But no other lines, either of sodium, magnesium, or anything else, could be traced more than a very few seconds of arc above the sun's limb. I am not able to say how long the H-lines continued visible, or to what elevation they extended afterwards, as I returned to the C-line to watch the termination of the eruption. If I remember rightly, this eruption reached a higher elevation than any before observed. There was (and is to-day) nothing on the sun's limb visible with the telescope which would account for it.—Princeton, October 8.]

Examination of Lines in the Solar Spectrum which are given in the Maps as common to Two or more Substances.—For this purpose a spectroscope of high dispersion has been constructed by combining the grating mentioned above, which has about 4 square inches of ruled surface, with a collimator and observing telescope each of 3 inches aperture and about 42 inches focal length, using magnifying powers ranging from 50 to 200. The apparatus is arranged upon a wooden frame-work, and when in use is strapped to the tube of the 12-feet equatorial of our observatory, so that it is kept by the driving-clock directed to the sun. An image of the sun is formed on the slit by an achromatic object-glass of 3 inches aperture, in order to increase the light and to avoid the widening of the lines due to the sun's rotation. A large prism of about 20° angle was sometimes placed in front of this object-glass (between it and the sun) to separate the colours before reaching the slit; and in examining the darker portions of the spectrum a concave cylindrical lens was sometimes used next the eye, like a shade glass, to reduce the apparent width of the spectrum and thus increase its brightness.

The grating is an admirable one, on the whole the best I have ever seen. But I have been greatly surprised at its excessive sensitiveness to distortion by pressure or inequalities of temperature. Although the plate is fully ⅜ of an inch thick, and only 3½ inches square, an abnormal pressure of less than a single ounce at one corner will materially modify its behaviour, and a quarter of a pound destroys the definition entirely. In fact the plate is not naturally exactly flat, and to get its best performance it is necessary to crowd a little wedge gently under one corner. When it is in good humour and condition, however, the performance is admirable; one could wish for nothing better, unless for a little more light in the violet portions of the spectrum.

With this instrument I have examined the 70 lines given on Ångström's map as common to two or more substances. Of the 70 lines, 56 are distinctly double or triple; 7 appear to be single; and as to the remaining 7, I am uncertain; in most cases, because I was unable to identify the lines satisfactorily on account of their falling upon spaces thickly covered with groups of fine lines, none of which are specially prominent.

As a general rule the double lines are pretty close, the distance being less than that of the components of the 1474 line. Generally also the components are unequal in width or darkness, or both, though in perhaps a quarter of the cases they are alike in appearance. The doubtful lines are the following, designated by their wave length on Ångström's map: 5489·2, 5425·0, 5396·1, 5265·8, 4271·5, 4253·9 and 4226·8. I strongly suspect 5396·1 and 5265·8 (which present no difficulty in identification) of being double, but could never fairly split either of them, and therefore leave them among the doubtfuls.

Those which show no signs of doubling, so far as could be seen, were: 6121·2, 6064·5, 5019·4, 4585·3, 4578·3, 4249·8, and 4237·5.

In respect to the lines 5019·4, 4585·3 and 4237·5 it is quite possible there may be some mistake as to the coincidence, since in his *tables* Thalén gives neither of them as due to iron. An accidental strengthening of the dotted line, which, on the map, leads up from the symbol of the element concerned, through the iron spectrum, would account for the matter, by making the line appear on the map as belonging to iron also.

As the facts stand, therefore, it is obvious that arguments which have been based upon the coincidence of lines in the spectra of different elements lose much of their force; it appears likely that the coincidences are in all cases only near approximations. At the same time this is certainly not yet demonstrated. The complete investigation of the matter requires that the bright line spectra of the metals in question should be confronted with each other and with the solar spectrum under enormous dispersive power, in order that we may be able to determine which of the components of each double line belongs to one, and which to the other element. If in this research it should be found that *both* of the components of a double line were represented in the spectra of two different metals, and the suspicion of impurity were excluded, we should then indeed have a most powerful argument in favour of some identity of material or architecture in the molecules of the two substances involved.

Distortion of Solar Prominences by a Diffraction Spectroscope.—Generally, in such an instrument, the forms seen through the opened slit are either disproportionately extended, or compressed along the line of dispersion. The reason is this: if the slit be illuminated by monochromatic light, the image of the slit, formed on each side of the simple reflected image in the focus of the view-telescope (which is supposed to have the same focal length as the collimator), will have the same width as the slit itself only in one special case, not usually realised with a reflecting grating.

If the angle, between the normal to the grating and the view-telescope, is *less* than that between the normal and the collimator, the slit-image will be *narrower* than the slit, and a prominence seen through it will be *compressed* in the plane of dispersion. If the relation of the angles be reversed, then of course the distortion will also be reversed, and we shall have extension instead of compression.

The mathematical theory is very simple. Suppose the collimator and telescope to be fixed at a constant angle, as in the now usual arrangement.

Let angle between telescope and collimator = α.

Angle between telescope and normal to grating = τ.

Then angle between collimator and normal = $\kappa = \alpha - \tau$.

Also, let space between adjacent lines of grating = s.

And the order of spectrum observed = n.

Then, by principles of spectrum formation, we have

$$\lambda = \frac{s}{n}\left\{ \sin \tau - \sin \kappa \right\},$$

λ being the wave-length of the ray which is in the centre of the field of view:

whence $$\sin \tau = \frac{n\lambda}{s} + \sin \kappa.$$

Differentiating, we have at once

$$d\tau = \frac{\cos \kappa}{\cos \tau} d\kappa, \text{ or } \frac{\cos (\alpha - \tau)}{\cos \tau} d\kappa;$$

which reduces to, $d\tau = (\cos \alpha + \sin \alpha \tan \tau)\, d\kappa$. Distortion can only disappear in cases when this coefficient of $d\kappa$ reduces to unity. Special cases—

1. If $\tau = \kappa$ there is no distortion—but also no dispersion: it is the case of simple reflection.

2. If $\kappa = 0$, the grating being kept normal to the collimator, then $d\tau = \sec \alpha\, d\kappa$.

3. If $\tau = 0$, the grating being kept normal to the telescope (which in this case must be movable), then $d\tau = \cos \alpha\, d\kappa$.

4. If $\alpha = 90°$, $d\tau = \tan \tau\, d\kappa$.

5. If $\alpha = 0$, $d\tau = d\kappa$, and there is no distortion.

This is possible only by using the same tube and object-glass both for collimator and view-telescope, the grating being slightly inclined at right angles to the plane of dispersion. The principal difficulty in this form of instrument lies in the diffuse light reflected by the surfaces of the object-glass. It is hoped that this may be nearly obviated by a special construction of the lens which will throw the reflected light outside of the eyepiece. An instrument on this plan is being made for Prof. Brackett by the Clarks, for use in the physical laboratory at Princeton, and is now nearly completed.

Princeton, September 27, 1880 C. A. YOUNG

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

DR. J. E. HARRIS (D.Sc. Lond.) has been appointed to the vacant Professorship of Natural Philosophy at Trinity College, London.

FROM the new Calendar of the University College of Wales we learn that the present number of students is fifty-seven. We see there are classes for most of the branches of science, only unfortunately they are all taught by one professor, which, to say the least, must be rather hard on him. We hope the college will soon be able to have separate teachers, at any rate for the physical and biological sciences.

THE new University Library at Halle has just been opened. It is built entirely on the French system, and special precautions have been taken with regard to fire. It now numbers some 200,000 volumes, but there is room for half a million. The cost of the building amounts to 400,000 marks (20,000*l.*).

SCIENTIFIC SERIALS

THE *American Naturalist* for December, 1880, contains:—D. Cope, on the extinct cats of America.—F. V. Hayden, Twin lakes and Teocalli Mountain, Central Colorado, with remarks on the glacial phenomena of that region.—C. E. Bessey, sketch of the progress of botany in the United States in the year 1879.—C. S. Minot, sketch of comparative embryology, No. 5; on the general principle of development.—The Editor's Table.—Permanent exhibition of Philadelphia.—Recent literature.—A new edition of Packard's "Zoology" is announced.—General Notes. Scientific news. Proceedings of scientific societies.

Revue des Sciences Naturelles, December, 1880, contains: Herborisations of Strobelberger about Montpellier in 1620, translated, with notes, by M. Kieffer (a complete *exposé* of the extraordinary plagiarism of Strobelberger, who copied his work on the plants of Montpellier almost *verbatim* from the work of Lobel).—M. Doumet-Adanson, on an immense Calamary taken near Cette, January, 1880 (*Ommastrephes sagittata*). This specimen was nearly six feet in length, from the end of the body to the tops of the arms.—M. S. Jourdain, on the late development of scales in the eels.—E. Dubrueil, catalogue of testaceous mollusca collected from the French shores of the Mediterranean.—M. Reitsch, an analysis of Falkenberg's researches on the fecondation and alternation of generation in Cutleria.—F. Fontannes, on the stratigraphical position of the Pliocene group of Saint Aries, in the Western Bas-Dauphiné, and particularly in the environs of Hauterives (Drôme).—Scientific Reports and Bulletin.

Gegenbaur's morphologisches Jahrbuch, Band 6, Heft 4.—Dr. M. v. Davidoff, contribution to the comparative anatomy of the posterior limb masses in fishes, 2nd part (Plates 21, 23); Dr. W. Pfitzner, on the epidermis in the amphibia (Plates 24, 25); J. E. V. Boas, on the conus arteriosus in *Butirinus albula* and in other Teleostei (Plate 26); Dr. H. Rabl-Rückhard, on the mutual relations between the chorda, hypophysis and the middle ridge of the skull in the embryos of the sharks', &c., brains (with Plates 27, 28); Carl Rabl, on the "pedicle of invagination," &c., in Planorbis (Plate 29); Prof. R. Wiedersheim, on the duplication of the os centrale in the carpus and tarsus of Axolotl (Plate 30); Prof. C. Gegenbaur, critical remarks on polydactylism as atavism; short notices; W. Leche, on the morpology of the pelvic region in the Insectivora.

Archives des Sciences Physiques et Naturelles, December 15, 1880.—Tertiary man in Portugal, by M. Choffat,—Monograph of the ancient glaciers and the erratic formation of the middle part of the Rhone valley, by MM. Falsan and Chantre.—Organic dust of the atmosphere, by Dr. Yung.—On the question of lowering of the high waters of the Lake of Constance, by M. Achard.

SOCIETIES AND ACADEMIES

London

Royal Society, January 6.—Observations on the Structure of the Immature Ovarian Ovum in the Bird and Rabbit, and on the Mode of Formation of the Discus Proligerus in the Rabbit and of the "Egg-Tubes" in the Dog. By E. A. Schäfer, F.R.S.

The first part of the paper is devoted to a minute description of the young ovarian ova of the bird as seen in sections of the ovary of a laying hen. The germinal spot is described as composed of two distinct substances, namely, a homogeneous matrix staining but slightly with logwood and a number of coarse granules imbedded in it, which become darkly stained. The germinal spot may often be seen to be connected with the wall of the germinal vesicle by a network of fine filaments (intranuclear network). Appearances are also described which indicate that two germinal vesicles may be originally present in one ovum (? formed by the fusion of two primitive ova), and that one of the two may afterwards disappear.

A network of filaments is also described as existing in the yolk, which in some ova shows peculiar condensations of vitelline substance, which simulate nuclei; but the origin and meaning of these are left in doubt. Other appearances, as of systems of striæ, are also mentioned as occurring in larger ovarian ova. With regard to the membranes of the ovum the author differs from Waldeyer and agrees with Balfour in regarding the *zona radiata* as a product of the protoplasm of the ovum, and not as derived from the cells of the follicular epithelium.

The ovarian ovum of the rabbit is next described, and is found to agree in most essential particulars with that of the bird. The *zona pellucida* is porous, and allows granules of food-material to pass from the epithelium cells of the Graafian follicle directly into the vitellus. But it is chiefly in this epithelium that the interest centres, for the inner layer of cells of the follicular epithelium appears to be formed in the peripheral layer of the vitellus of the ovum itself, making their appearance first of all as mere nuclei (derived in all probability from the nucleus of the ovum), around which part of the protoplasm or vitellus of the ovum becomes segmented off. This description is compared with that which Kuppfer gives of the formation of an inner layer of follicular epithelium from nuclei which make their appearance in the periphery of the vitellus of the ovum of *Ascidia canina*, and with the observations of Kleinenberg upon the formation of a layer of cells from the periphery of the ovum of *Hydra*.

Finally the gland-like nature of the ovarian tubes in the bitch's ovary is insisted upon in agreement with Pflüger and Waldeyer, and in opposition to the view taken by Foulis.

January 13.—"On the Forty-eight Co-ordinates of a Cubic Curve in Space," by William Spottiswoode, President R.S.

In a note published in the *Report* of the British Association for 1878 (Dublin), and in a fuller paper in the *Transactions* of the London Mathematical Society, 1879 (vol. x. No. 152), I have given the forms of the eighteen, or the twenty-one (as there explained), co-ordinates of a conic in space, corresponding, so far as correspondence subsists, with the six co-ordinates of a straight line in space. And in the same papers I have established the identical relations between these co-ordinates, whereby the number of independent quantities is reduced to eight, as it should be. In both cases, viz., the straight line and the cubic, the co-ordinates are to be obtained by eliminating the variables in turn from the two equations representing the line or the conic, and are, in fact, the coefficients of the equations resulting from the eliminations.

In the present paper I have followed the same procedure for the case of a cubic curve in space. Such a curve may, as is well known, be regarded as the intersection of two quadric surfaces having a generating line in common; and the result of the elimination of any one of the variables from two quadric equations satisfying this condition is of the third degree. The number of coefficients so arising is $4 \times 10 = 40$; but I have found that these forty quantities may very conveniently be replaced by forty-eight others, which are henceforward considered as the co-ordinates of the cubic curve in space.

The number of identical relations established in the present paper is thirty-four. But it will be observed that the equations are lineo-linear in each of two groups, say the U-co-ordinates and the U′-co-ordinates; and as we are concerned with the ratios only of the coefficients, and not with their absolute values, we are, in fact, concerned only with the ratios of the U-co-ordinates *inter se*, and the U′-co-ordinates *inter se*, and not with their absolute values. Hence the number of independent co-ordinates will be reduced to $48 - 34 - 2 = 12$, as it should be.

Mathematical Society, January 13.—S. Roberts, F.R.S., president, in the chair.—Miss C. A. Scott and Messrs. J. Parker Smith, O. H. Mitchell, Fellow of Johns Hopkins University, and T. Craig, U.S. Coast Survey Office, Washington, were elected members. Dr. Hirst, in drawing attention to the loss the Society had sustained by the death of M. Chasles, gave a rapid sketch of that distinguished geometer's career and work; in lightly touching upon his private life he mentioned how gratified M. Chasles had been by the fact that he was not only the first Foreign Member of the Society, but for a long time the only one. The following communications were made:—On an apparently paradoxical relation of the circle, parabola, and hyperbola, by A. J. Ellis, F.R.S.—A proof of the differential equation which is satisfied by the hypergeometric series, by the Rev. T. R. Terry.—On the periodicity of hyperelliptic integrals of the first class, by W. R. W. Roberts.—On the tangents drawn from a point to a nodal cubic, by R. A. Roberts.—Sur une propriété du paramètre de la transformée canonique des formes cubiques ternaires, by Signor Brioschi (Milan).—Note on a kinematical theorem connected with the rectilinear courses of two vessels sailing uniformly, by C. W. Merrifield, F.R.S.—A partition-problem connecting the angles of a triangle with the angles of the successive pedal triangles, by J. W. L. Glaisher, F.R.S.

Paris

Academy of Sciences, January 10.—M. Wurtz in the chair.—The following papers were read:—On the conditions relative to the theoretic expression of the velocity of light, by M. Cornu.—Crystalline substances produced from old medals immersed in the thermal waters of Baracci, commune of Olmeto (Corsica), by M. Daubrée. Some of these bronze medals had merely a dark patina resulting from superficial sulphuration. A few others had a thick crystalline crust, the substance being apparently a double sulphide of copper and tin (of which the nearest natural analogue would be stannine). The water, containing only 0·3 gr. of mineral matters per litre, has chloride of sodium, sulphate of soda, and silica in predominance.—On the star-fishes dredged in the deep regions of the Gulf of Mexico and the Carribean Sea by the American ship the *Blake*, by M. Perrier. The new collections raise the number of species from twenty-seven to seventy. A pretty large number are new generic types.—On a class of linear differential equations, the coefficients of which are algebraic functions of the independent variable, by M. Appell.—On the circulatory apparatus of isopod crustaceans, by M. Delage.—Phylloxera in California, by M. de Lavignon. The old vine-growers say they have always known it, and they do not regard it as introduced with plants from Bordelais. Its effects are the same in kind as in France, but its progress is very slow by reason of absence (apparently) of the winged insect, quality of the soil (rich and deep), and the existence of an acarian parasite (*Tyroglyphus longior*).—The Inspector-General of Navigation reported on the variations of the Seine at Paris in 1880. The highest water was on January 4, the lowest on February 3 and 4.—On a process of astronomical observation for use of voyagers, &c. (continued), by M. Rouget.—On the transformation of reciprocal directions, by M. Laguerre.—On the size and variations of Purkinje's images, by M. Crouillebois. It is proved that the mechanism of the adaptation consists in a simultaneous modification of the curvature of the two faces of the crystalline lens.—Thermo-regulator for high temperatures, by M. D'Arsonval. This is applicable up to 1200° at least. A regulator like that before described has its space under the membrane connected by means of a capillary tube with a short hollow stem which can be opened or closed with a screw and is connected by two tubes with a mercury manometer, and an air-reservoir (of glass or porcelain) to be put in the medium that is to be kept constant. For temperatures over 300° he opens the stem when 1 atm. has been reached, and so lets the manometer come back to zero before closing again. A new method of reading must then, of course, be adopted.—Investigation of gaseous compounds and study of some of their properties with the spectroscope, by MM. Hautefeuille and Chappuis. With the spectroscope one can follow the isomeric change of ozone into oxygen, and prove that its destruction does not give hyponitric acid. Electrification of a dry mixture of nitrogen and oxygen, containing at least one-seventh of the former, gives a substance not before observed, and having a remarkable absorption-spectrum. It is thought to be *pernitric acid*, analogous to M. Berthelot's *persulphuric acid*.—On bromides and iodides of phosphorus, by M. Ogier.—Rapid stoppage of the rhythmic contractions of the cardiac ventricles through occlusion of the coronary arteries, by MM. Sée, Bochefontaine, and Roussy.—On the application of anatomical examination of the blood to diagnosis of disease, by M. Hayem. He gives two methods: examination of pure blood, in a thin layer, of constant thickness; and examination of blood diluted with a special reagent. The phenomena in certain diseases are described.—On the quantity of light necessary to perceive the colour of objects of different surfaces, by M. Charpentier. For retinal surfaces $\frac{88}{1000}$ to $\frac{440}{1000}$ mm. square the illumination necessary to make or perceive colour (once the luminous sensibility is obtained) was the same for each colour tried. It may, then, be said that for red, yellow, green, and blue the chromatic sensibility is independent of the retinal surface excited. Influence exerted by environment on the form, structure, and mode of reproduction of *Isoetes lacustris*, by M. Mer.—On the conservation of grain in closed reservoirs, by M. Muntz. With renewal of air he found about ten times more CO_2 produced than in a closed vessel. The volume of CO_2 found in contact with air is always less than that of O absorbed. The O is chiefly fixed by fatty matters. Too dry grain, not giving much of an asphyxiating atmosphere, is liable to the ravages of insects. The proportion of CO_2 increases rapidly with the degree of moisture. As the temperature is raised there is physiological combustion up to a point (about 50°), thereafter chemical. Anæsthetics, like sulphide of carbon, diminish, without stopping, the formation of CO_2.—On a simple means of bringing to life new-born infants in a state of apparent death, by M. Gozard. He describes a successful application of M. Le Bon's suggestion for young asphyxiated animals, immersing in a water-bath heated 45° to 50°.—M. Boutigny invited attention to the fact that boiling water projected on an incandescent surface instantly falls in temperature to 97°. He attributes this cooling to work done in production of the spheroidal state.

BERLIN

Geographical Society, January 8.—Dr. Nachtigal, president.—The President gave a sketch of the work of the Society's explorers for the past year. It was hoped that Dr. Lenz would have been present at the meeting, but he had been unable to leave St. Louis in Senegal, as yellow fever prevailed there. After a long interval letters had been received from Dr. Buchner, dated February, May, and July last. He had been for six months in Mussumba in Muatà Janvo's kingdom, carrying on topographical, photographic, and natural history work. After sending most of his papers and collections to Angola he proceeded northwards, writing on July 1 from Muene Chikambo. Dr. Nachtigal then referred to the East African Expedition, which, along with Capt. Ramaeckers, has arrived at Tabora, and Dr. Rohlfs' party, who on December 12 were at Massowah.—Herr Buchter exhibited a large number of photographs and drawings from the Upper Nile.

VIENNA

Imperial Academy of Sciences, January 7.—On the quantitative relations of electric expansion in glass and caoutchouc, by G. Korteweg and V. A. Julius.—Preliminary note on decomposition of water, by C. Baudet.—Researches on fats, by D. G. Goldschmiedt and M. v. Schmidt.—On an uncrystallisable acid obtained from albumen by oxidation with permanganate of potash, by E. v. Bruecke.

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