THURSDAY, JUNE 13, 1878

ETHNOLOGY OF NORTH-WEST AMERICA

United States Geographical and Geological Survey of the Rocky Mountain Region; Tribes of the Extreme North-West. By W. H. Dall. *Tribes of Western Washington and North-Western Oregon.* By Geo. Gibbs. (Washington, 1877.)

WE have already had occasion to draw attention to the extremely good work which is being done by the United States Geographical and Geological Survey, as well as to the liberal construction put upon the duties attached to it. The volume now issued is another striking illustration of both facts, and makes us wish that other Governments would follow the example of that of America. For the first time we have full and accurate details regarding the Eskimaux and other tribes of what was once Russian America and of the adjoining territory. Not only has all the available literature on the subject been consulted, but the errors and deficiencies of former writers have been corrected and supplemented by personal and patient observation. A wholly new light has been cast on the ethnology of these remote regions, and both the ethnologist and the philologist will obtain fresh materials of the utmost value. The scanty and often inaccurate information we have hitherto possessed has now been replaced by the full and careful statements of scientifically trained observers.

Mr. J. W. Powell was the geologist in charge of the expedition, and it is the materials collected by him and his assistants that have been thrown into shape and edited in the present volume by Mr. W. H. Dall and the late Mr. George Gibbs. Mr. Dall's elaborate articles on the tribes of the extreme North-West acquire additional importance from the fact that they represent in large measure the fruits of his own researches. Since 1865 he has visited nearly the whole of the north-west coast, besides a good deal of the interior, and his statements have consequently all the advantage of being the results of personal knowledge. His first article describes the various tribes of Alaska and the adjacent territory, comprising the Innuit or Eskimaux, and their off-branch, the Aleuts, and the Indian tribes belonging to the Tinneh and T'linket groups. Mr. Dall seems to exclude the Chukchis from the Innuit family; to use his own words, they are "totally distinct in language and race from the nomadic 'reindeer-people' with whom they trade." Their trade-jargon, by the way, is a *lingua franca* composed of words or corruptions of words belonging to both. However, nothing is more remarkable than the differences in manners and condition between many of the tribes described by Mr. Dall, who must, nevertheless, be of the same origin, and this fact shows how rapidly and widely savage tribes will come to differ from one another, even when living in close proximity. Mr. Dall's second article is a very interesting one on his exploration of the numerous kitchen-middens of the Aleutian Islands. Usually the middens consist of three layers, the lowermost being composed of echinus and similar shells, the second of fishbones, and the third of mammalian and other remains, the ruins of villages of a more recent period often crowning the whole deposit. The lowermost layer must go back to a remote date, and as Mr. Dall points out, would have required an immense number of years to form. The savages to whom it bears witness, must have been very low in the scale of humanity. They have left no traces of fire, weapons, or implements; indeed, had they possessed any, they would hardly have been content to subsist on sea-eggs. It is only towards the top of the layer that net-sinkers of a very rude pattern have been met with; but these may have worked their way through from the layer above, though the possibility does not seem to have suggested itself to Mr. Dall. With the fish-bone layer stone tools come into use; as Mr. Dall observes, "fish, when raw, is a substance which cannot be conveniently dismembered by teeth and nails." But it is not till we come to the mammalian epoch that the weapons show a decided improvement in form with attempts at ornamentation, though from the first the types are remarkably like those still used by the Eskimaux. Lamps, also, first came into use during this period, and no doubt the improvement in the tools was largely due to the lengthening of the working day by the introduction of artificial light.

Mr. Dall's third article is on the Origin of the Innuit. He differs from Mr. C. R. Markham in thinking that the Innuit emigration goes back to a vast antiquity, and agrees with Dr. Rink in holding that the Innuit have not come from northern Asia, but been pushed northward from the interior of America itself. Like the walrus they can be shown to have once ranged as far south as New Jersey. He admits, however, that green patches similar to those that mark the Aleutian kitchen-middens, have been observed by whalers on the shores of Wrangell Land, and he is certainly wrong in stating that "Linguistically, no ultimate distinction can be drawn between the American Innuit and the American Indian." It is true that both groups of languages are polysynthetic, not agglutinative, as Mr. Dall affirms, but it is doubtful whether all the Indian languages even can be referred to a single source, and certainly the Indian and the Eskimaux cannot be. Nor, again, does Mr. Dall seem to be right in suggesting that the Arctic Highlanders, who have no means of navigation, represent the original condition of the Innuit tribes generally; they must rather be regarded as an instance of degradation and relapse. But he does good service in pointing out the untenability of the theory which would bring the first inhabitants of America from Asia, by way of the Aleutian Islands. Apart from the fact that Behring found no traces of inhabitants on the islands named after him, and that the echinus layer in the Aleutian kitchen middens pre-supposes a population without means for crossing the sea; "we find that a gap of 138 statute miles separates the Commander's Islands from Kamschatka, and another of 253 miles exist between the former and Attu. Here is one of the deepest gulfs known in any ocean, over which rolls a rough, foggy, and tempestuous sea." Three appendices are attached to Mr. Dall's part of the work: one on the natives of Alaska, another on the terms of relationship used by the Innuit, while the third gives comparative vocabularies of the tribes of the extreme North-West. The first appendix contains the outlines of two grammars, one belonging to the Sitka dialect of the T'linket Indians and the other to the Innuit Aleuts of Unalashka, both by

M. Furuhelm. The second will prove of considerable importance for Eskimaux philology. The most noticeable fact connected with Sitka grammar is that "there are only two cases, nominative and instrumental," and that the instrumental case of the pronouns is employed with active verbs, which means that no true verb exists in the language.

The second half of the volume is occupied by an exhaustive account of the tribes of Western Washington and North-Western Oregon, by Mr. George Gibbs. While the ethnology of these tribes has been treated minutely, their dialects have received the attention to be expected from so able a philologist, and lengthy tables of comparative vocabularies are followed by a complete Niskwalli-English and English-Niskwalli dictionary. Mr. Gibbs begins by saying that "in the western district of Washington Territory—that is to say, between the Cascade Mountains and the Pacific—there is found, compared with the extent of country occupied, an extraordinary diversity in the aboriginal tongues. Mr. Hale, the ethnologist, who accompanied Capt. Wilkes's expedition, recognised among them eight languages belonging to five distinct families, and to these are now to be added six other languages which escaped his observation. In addition there are several but partially intelligible, even to those speaking the same general language." It is the old story; the lower we descend the larger becomes the number of dialects and independent tongues which it is the part of civilisation to destroy and unify. The further back we trace the stream of human speech the greater is its diversity, the more manifold its forms.

Among the ethnological facts brought to light by Mr. Gibbs, may be mentioned the universal flattening of the skull, the use of the haikwa shell as a medium of exchange, and of armour composed of elk-skins or of thin pieces of hard wood. Scalping is unknown, as are also totemism and the division of the tribe into clans, while, on the other hand, "slavery is thoroughly interwoven with the social polity of the Indians of the coast." Earthworks are found in various parts of the district, though they never present the figures of animals, and the existing Indians have no traditions of their origin. But there are clear evidences that the present population of the country is a mixed one, and was probably preceded by a more civilised race. Thus the Makah differ from the Indians of the Sound "in features and habits as much as language." In fact, the Indians of North America differ among themselves, both physiologically and linguistically, no less than the natives of Europe, and to lump them together under a single name is as rude and unscientific a proceeding as that of the Greeks and Romans, with whom all other peoples were "barbarians." If the labours of Mr. Powell and his assistants do nothing more than impress this fact on the student of language and race, they will have effected a good and needful work.

A. H. SAYCE

CULLEY'S PRACTICAL TELEGRAPHY

A Handbook of Practical Telegraphy. By R. S. Culley. Seventh Edition. (Longmans, 1878.)

THIS well-known book has reached its seventh edition. It was first published in the year 1863, and 190 pages were sufficient to recount its practical instructions. Now 450 pages scarcely suffice to accomplish its purpose. The book reminds one of some old house that has been added to from time to time by different occupiers until it has lost all trace of plan or design. Valuable teachings of experience on one subject are found buried here and there in chapters devoted to other subjects. It is a pity that the author did not thoroughly revise and rewrite his book. It is more like some old housewife's recipe book, full of useful and valuable information, scattered indiscriminately about, than a methodical scientific manual of a grand practical art which has grown within the last few years with gigantic strides. It never pretended to be the result of scientific originality or profound research, but simply to be a practical book intended for practical men. Its great success is more a proof of its want than of its merit. Nevertheless it has merit, and that of no mean order.

Commencing with the sources of electricity and the laws of the current, of magnetism and electromagnetism, of induction and of atmospheric and cosmic electricity, it proceeds to describe the construction of a line of telegraph, both over-ground and under-ground. Modes of testing the various apparatus used, and the systems for signalling are fully described. Cable working and testing receive very exhaustive treatment. The automatic system of working—the child of Bain and the pupil of Wheatstone—receive full handling, and the recent developments of the duplex and quadruplex systems receive their fair share of description. The telephone is not neglected, but we must wait for an eighth edition for the later wonderful developments of Hughes and Edison.

In speaking of the history of the telegraphic system in this country in his meagre but pithy introduction, Mr. Culley says:—"No assistance whatever was granted by the Government, and it was only after several years of adversity that the undertaking became firmly established." Rather a strange remark from the pen of an officer of a company who owed its foundation to the support of the Government. The first contract of any magnitude ever made by the founders of the company was with the Government, who agreed to pay 1,500*l*. a year for twenty years, and 1,000*l*. a year for another twenty years, for telegraphic communication to Portsmouth; and it was this contract that enabled them to float their concern. However, it is an Englishman's happy privilege to abuse to his heart's content his own Government for what it does not do, and to ignore entirely what it does do, and we should be sorry to interfere with his prerogative in this respect; but it is curious to find a Government official making such a sweeping and erroneous statement as the above in a book accepted by his department as its text-book.

It is in the development of submarine telegraphy that England principally shines on the Continent and in America, and it is surprising to find our author omitting all mention of her great deeds in this field. English enterprise in this respect is most marked. English capital is invested in every sea, and English genius has surmounted every difficulty, whether natural, mechanical, or electrical. In 1876 the length of cable laid was 63,990 nautical miles, of which 59,547 were owned by private companies.

There is a great tendency to deny the existence of English inventive genius. The over-shadowing influence of the recent sensational inventions of the telephone and phonograph have led even practica men to believe that inventive power had crossed the Atlantic, but no one who reads Mr. Culley's book can fail to learn how much has been done in England. Though duplex working was revived by Hearns, and quadruplex made practical by Edison, neither was invented in America. On the other hand, Hughes's beautiful type-printer was born in America, but it was developed in Europe, and its birthplace knows it not. Thomson's syphon recorder, Varley's double-current translator and condenser working, Bain and Wheatstone's automatic systems, fast-speed translators, and all the valuable systems and apparatus in use for testing have sprung from here, and are well described in this work. The Post Office telegraph system, in its technical department, is a credit to this country and a pattern to the world, and it possesses on its staff some of the most practical electricians of the day. Messrs. Preece, Lumsden, Marson, Gavey, and Kempe are well known everywhere, and though their labours are not acknowledged by Mr. Culley, it is well known that they have contributed materially to establishing the telegraphic system of the Post Office. It is especially in developing the automatic system and in establishing fast-speed translators that the Post Office officials have been so successful. A relay station in Anglesey has increased the rate of working between London and Dublin from 70 to 120 words per minute. Translating relays working at the rate of 120 words per minute are quite new in telegraphy. Mr. Culley has given scant justice to Mr. John Fuller for his new form of bichromate battery, a battery that is coming into very extensive employment for all purposes. It is a zinc-carbon couple, the exciting fluid being Poggendorff's mixture. Its peculiarity consists in the shape of the zinc, which is permanently inserted in a bath of mercury. Its electromotive force is double that of a Daniell's cell, its constancy wonderful, its economy great, and its cleanliness and freedom from smell all that can be desired.

This work is deservedly popular, not from its literary merit, but from the position of the author and from the great mass of very valuable practical information it possesses.

OUR BOOK SHELF

Manual of the Vertebrates of the Northern United States, Including the District East of the Mississipi River and North of North Carolina and Tennessee, Exclusive of Marine Species. By Prof. D. S. Jordan, M.D. Second edition, Revised and Enlarged. (Chicago: McClurg, 1878.)

THE object of this volume is to give collectors and students a ready means of identifying the families, genera, and species of the vertebrate animals of North America. Following the usage of botanists, the author has adopted the system of artificial keys to the classes, orders, families, genera, and species, while use has been freely made of every available source of information. The account of the mammals has been chiefly compiled from Prof. Baird's work, and Dr. Coues has given great assistance in the part relating to the birds; while in this edition the account of the fishes has been entirely re-written in order to include the results of recent investigations in that department. The fact that a work of this nature should in two years' time call for a second edition, is, indeed, a proof of the interest taken in natural science by the American people. This edition seems to fairly represent the present state of knowledge.

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.*]

The Phonograph and Vowel Theories

SEVERAL letters have appeared in NATURE bearing on the subject of the phonograph, and referring to our first communications upon the subject. We are glad to see that our statement as to the reversibility of consonants (NATURE, vol. xvii. p. 423) is generally accepted. We feel that as yet the phonograph does not speak with sufficient clearness to determine how perfect this reversibility is, and that the effect of many minute parts of articulate utterance cannot be heard with any certainty. Mr. Ellis, in his first communication, ranked the phonograph somewhat too low, but we are more than satisfied with the acknowledgment in his second letter (vol. xviii. p. 38). Mr. A. M. Mayer and Prof. Sylvanus Thompson both speak of the marks on the tinfoil as differing according to the distance of the mouth from the diaphragm. We do not observe any effect of this kind and see no theoretical reason for any alteration in the relative phases of the simple tones with a change of distance from the mouth. Mr. Mayer seems here to have fallen into an error. We find ample confirmation of Helmholtz's statement that the phase relation between two constituents is not appreciated by the ear. Each person usually, but not invariably, adheres to the same phase relation on one pitch, but different people pronouncing the same vowel with approximately the same constituents, combine these differently, which, as Mr. Mayer says, would make reading the marks on the tinfoil a very difficult matter.

With reference to the letter by Mr. C. R. Cross which appears in NATURE, vol. xviii. p. 93, we adhere with much confidence to the opinion that the five vowels, *a e i o u* (Italian), pronounced in succession, are by contrast at least thoroughly distinguishable when the instrument is run at various speeds, such as to reproduce the sounds at all the pitches within the compass of the average human voice. That no marked change is produced in the relative values of the vowels is confirmed by the fact that neither in public nor private exhibitions do the hearers of sentences alternately run slow and fast suggest that the vowels have changed with a change of speed. This alone would be a sufficient proof that *oh* does not change into *ee*, as we understand Mr. Cross to say, and there is no ground, according to Helmholtz's theory, for expecting that it would. To us the relative sounds of the vowels at various speeds seem at least as perfect as those obtained from Willis's well-known experiment, where a succession of vowels is suggested by contrast when the length of a resonating tube is altered.

We do not, however, think that our instrument speaks with sufficient distinctness to warrant our expressing an opinion as to the constancy of quality of any single vowel when the instrument is run at various speeds.

Some *oh*s remain apparently very constant, and at times we thought that other *oh*s became brighter or more like "awe."

Sometimes we thought *awe* became very like "ah." We should be glad to learn the impressions of any of your readers as to this point.

We venture, however, to remind any one trying the experiment that a low note followed by a high one suggests a change from *u* (Italian) to *i*. Thus if we whistle a low note and then the octave to it or a note near this, the ear is easily persuaded that the whistle resembles *u i*, but if now, beginning again on the note we just thought was *i*, we go up another octave, the new sequence again suggests *u i*, although the very note which was last taken to represent *i* now stands for *u*. If, therefore, we wish to judge what a sound really is we should not trust much to contrast, especially when a change of pitch is involved in the comparison.

We have now obtained and analysed a very large number of vowel curves, especially for the sounds *o* and *u*, and with your permission will send a selection of these for publication after the results of our investigation have been communicated to the Royal Society here. These curves show what the voice effects when singing at different pitches a vowel which remains of constant quality according to the appreciation of the speaker. The analysis of the curves gives the partial tones of which the vowel sounds are composed, and it becomes a matter of considerable interest to see how far these results confirm or contradict existing theories.

We therefore propose to give a short sketch of these theories, hoping that if in error, we may be at once corrected.

Prof. Willis showed (Cambridge *Phil. Soc. Trans.*, vol. iii.) that, by varying the length of a tube attached to a free reed, he was able to produce the sensation of a change of vowel sound. This sensation is not very definite, especially for the vowels *i* and *e*; but, when the length of the tube is changed rapidly, the ear accepts the suggestion of a change from *u* to *o*, *a*, *e*, and *i*. Prof. Willis concluded that the vowel quality was given in each case by the coexistence of the note proper to the tube with that of the reed, whether the former was or was not harmonic to the latter. One must bear in mind that Willis wrote before it was recognised that all musical sounds are compounded of harmonic partial tones, and also before the function of a resonator was understood. This we may call the absolute single-tone theory. Wheatstone pointed out that the tube used by Willis acted simply as a resonator.

F. C. Donders (*Donders' Archiv*, vol. i.) observed that when the mouth was formed to speak a given vowel, the cavity had a certain definite pitch of resonance, or maximum resonance, which he determined by observing the pitch of the whispered vowel. Donders and Helmholtz agree in considering that this characteristic pitch is nearly constant in man, woman, and child, for a given vowel. Donders also observed that the vowels were, in certain cases, accompanied by a "geruisch" or "whish."

Helmholtz attacked the subject in a different way. By means of resonators he applied a qualitative analysis to the sounds which came out of the mouth cavity when a vowel was spoken, and pointed out that a vowel-sound at a particular pitch was characterised, not by a single tone, but by many tones. In an early paper, translated in the *Phil. Mag.* for 1860, he describes not only the analysis by resonators, but the synthesis by means of tuning-forks, which is now a familiar experiment. In this paper he appears inclined to believe that it is the relation between the constituent tones which determines the vowel quality; that, for instance, any pair of simple tones one octave apart will, if properly proportioned, always make an *o*. This theory made considerable way; it is taught with small qualification as to absolute pitch in Tyndall's lectures on sound, and elsewhere; it may be called the relative-pitch theory.

Helmholtz himself does not seem ever to have formulated it, for although the paper referred to distinctly suggests it, he guards himself by saying that the relations observed can only be considered as proved for the particular forks used, and, in fact, his experiments were only made at two parts of the scale.

In the "Tonempfindungen" the relative-pitch theory is entirely abandoned, but it is not a little difficult to ascertain what Prof. Helmholtz's latest theory is. This difficulty is indeed admitted by his translator, Mr. A. J. Ellis.

By Herr von Quanten, whose papers were published in *Poggendorff's Annalen* for 1875, Prof. Helmholtz was understood to mean that for each vowel one, and in some cases two, tones of definite absolute pitch must be strongly present, these tones being those which Prof. Helmholtz calls the characteristic tones of the vowel. This would imply either that each vowel could only be sung on a very few notes, or that the characteristic tones were present as inharmonic partials. Neither of these conclusions being in accordance with fact, von Quanten concluded that Helmholtz was wrong; but Mr. Ellis, with justice, as we think, points out that the true conclusion ought to have been that Helmholtz could not possibly have meant to broach an absurd theory.

We confess that we were ourselves led to believe at first that Helmholtz taught that each vowel contained strongly either its characteristic tone or some of the higher partials of that tone or tones very near these, and that this was what gave it its distinctive character. This was the theory which our first experiments seemed definitely to contradict. We now believe, however, that this is not the doctrine taught by Helmholtz.

Indeed we fail to find in the "Tonempfindungen" any very complete vowel theory, but we think that the following passage, taken from Donders' pamphlet "De Physiologie der Spraakklanken, 1870," expresses very clearly a doctrine which is very generally looked upon as that of Helmholtz.

Donders says (if our translation from the Dutch be correct):—

"Vowels spoken loud are sounds of a determinate timbre maintained unaltered, depending on the form of the mouth-cavity and of the mouth-aperture, and, even without the accompanying 'whish,' characterised by strong comparatively low upper tones not occurring in a definite order relatively to the prime tone, but for each vowel of an approximately constant pitch."

We understand Donders to believe that on whatever part of the scale a vowel be spoken the pitch or pitches of maximum resonance of the cavity are constant for a given vowel, and that indeed the form itself is constant. This may be called the *constant cavity theory*, and is taught by Mr. Ellis as the doctrine of Helmholtz.

We fail to find that Helmholtz himself has stated this doctrine definitely in all its rigidity, although he accepts the results of Donders' experiments, and has himself confirmed and amplified them. Almost every statement made by him concerning vowels is limited to those which he could produce by forks forming an harmonic series with B♭ for the prime. Any experiment described by Helmholtz is of course to be relied on, and so far as we have yet traversed the ground we find that the phonograph gives results in accordance with his experiments as to these constituents, but when we examine the one or two more general statements made by Helmholtz we find room for doubt, both as to his meaning and as to the truth or completeness of the conclusion.

Thus at the end of Chapter V. Helmholtz says:—"Vowel qualities of tone consequently are essentially distinguished from the tones of most other musical instruments by the fact that the loudness of their partial tones does not depend *only* on the numerical order but *chiefly* upon the absolute pitch of those partials; thus when I sing the vowel A to the note E♭ the reinforced tone *b''*♭ is the twelfth partial tone of the compound; and when I sing the same vowel A to the note *b'*♭ the reinforced tone is still *b''*♭, but is now the second partial." The two words marked by us in italics have been introduced for the first time in the fourth edition.

This passage might very well be understood to mean that a certain tone of perfectly or at least very approximately definite absolute pitch must necessarily be present in a given vowel. Further examination has, however, convinced us that Prof. Helmholtz does not require the presence of any characteristic tone or of any one of a group of characteristic tones in a vowel. This is made obvious by Chapter VI. In this chapter, which treats of artificial vowels, we find that in order to make an *e* by tuning-forks Prof. Helmholtz employed *b*♭ and *b'*♭ as "being adjacent to the deeper characteristic tone *f'*," which in fact lies midway between them; in the same way he employs *f'''*, *a'''*♭, and *b'''*♭ for the same vowel, treating all these as adjacent to the higher characteristic tone *b'''*♭. Thus the theory of Prof. Helmholtz is satisfied if tones lying anywhere within a whole octave be present, provided the characteristic tone lie somewhere near the middle of that octave. This is consistent with Donders' statement of the theory, provided "approximately constant pitch" be allowed to signify anything within six semitones.

We consider the following abstract as representing the doctrine taught in the "Tonempfindungen":—

1. For a given vowel there is a certain form of mouth cavity which has a pitch (sometimes two pitches) of strongest resonance —as *b'*♭ for *o*.

2. If this vowel be spoken or sung on any subtone of this pitch, the overtone corresponding to that pitch will be strongly present.

3. If the same vowel be pronounced at some other pitch then these harmonic partials will be reinforced which lie within, say, six semitones of the characteristic pitch.

No opinion seems to be expressed on the following two points:—

1. Whether the mouth cavity for a given vowel remains constant when the pitch of the vowel is altered. Mr. Ellis understands Helmholtz to affirm this, which is apparently Donders' view, but we have failed to perceive any passage in which this is definitely asserted. Helmholtz says the cavity for a given vowel has a pitch of strongest resonance, but this is not

quite the same statement as saying that when that vowel is spoken at all pitches the same cavity is employed.

2. Whether the mouth-cavities for given vowels are supposed to differ phonetically *only* in respect of pitch of maximum resonance. Helmholtz states clearly that in respect of their pitch of maximum resonance they are different, but he does not clearly say whether or no any other differences are essential. There are passages which seem to show that he considers that any resonator of the required pitch (whether in the least like the mouth in shape or material) would answer as well, or nearly as well, as the special mouth-cavity for the production of a given vowel. On the other hand it is at least conceivable that the cavity for, say, *o* may be very different from that for *a* in other respects than simply in the pitch of maximum resonance. As to this we find no statement in the "Tonempfindungen."

In fine we do not see that Prof. Helmholtz, although he has largely added to our knowledge concerning vowels, has laid down any law by which, given the pitch at which any one vowel is to be spoken, the reinforcement of its constituent tones could be even roughly predicted. This prediction could, however, be roughly made upon the constant-cavity theory, and has been made by Mr. Ellis in his valuable additions to the translation of Helmholtz's work. Prof. Helmholtz seems to do little more than tell us the constituents of a series of vowels sung or said on two notes of one scale, coupled with one peculiarity and in some cases two peculiarities of the resonance cavity. He has avoided all general conclusions except that quoted above, which states that the vowel peculiarity depends chiefly on the absolute, and not on the relative pitch of the partials.

In our next communication we hope to be able to state how far the information we have derived by means of the phonograph contradicts, supports, or supplements the above theories.

Edinburgh, May 29 FLEEMING JENKIN
J. A. EWING

Extinct and Recent Irish Mammals

I BEG to thank Prof. Leith Adams for his criticism, in NATURE, vol. xviii., p. 141, of my "Preliminary Treatise on the Relation of the Pleistocene Animals to those now living in Europe" (*Palæon. Soc.*, 1878), in which, from the nature of the work, it is impossible that mistakes should not be. I cannot, however, plead guilty to some of the mistakes which are placed to my credit:—1. That "the Irish elk is placed among the pre-historic mammals in consequence of its presence in the peat-bogs of England, Scotland, and Ireland." What I wrote (p. 6) was that the presence of the extinct Irish elk in the peat-bogs, which are of well-ascertained pre-historic age, renders it impossible to accept Sir Charles Lyell's definition of the term recent, in which no extinct species are stated to occur.

Of course the Irish elk, as Prof. Leith Adams remarks, has long been known to be met with, almost universally, in the lacustrine marls underlying the peat, and it is thus described in p. 27 of Mr. Sanford's and my own Introduction (*Palæon. Soc.*, 1866). I do not know of its occurrence anywhere *in peat*, but at the bottom of peat-bogs, to which the bones of animals suffocated in the peat in all probability gravitate. It seems to me very unlikely that all the remains at the bottom of peat-bogs belong to a period before the peat was accumulated.

2. I have never held, and still less to my knowledge printed, that "man and Irish elk, reindeer, mammoth, horse, and bear, were contemporaneous in Ireland." Evidence of palæolithic man, the contemporary of the mammoth in Ireland, is, so far as I know, altogether wanting. If Prof. Leith Adams will kindly write me a reference to any such statement of mine it shall be corrected at once.

My list of Irish animals, which merely purports to give the principal historic mammalia, does not profess to give all the mammalia, which will doubtless be fully treated in Prof. Leith Adams' promised work. W. BOYD DAWKINS

Owens College, Manchester, June 9

Alternate Vision

MR. GALTON'S remark (NATURE, vol. xviii. p. 98), that "sometimes the image seen by the left eye prevails over that seen by the right, and *vice versâ*," leads me to describe a curious defect in my own eyesight, which in a different way confirms what he says. While my right eye is fairly long-sighted, my left eye is very short-sighted. For instance, the focal distance of my right eye for your leader type is 18 inches, and for the left eye only 8¼ inches. For your letter type the focal distance for the one is 16 inches, and for the other 6½ inches. This is by the light of a Duplex lamp, and by focal distance, I mean the distance at which I can see distinctly. The result of this inequality in my two eyes is that the right—or long-sighted one—involuntarily closes when I read, and I am not aware of its being shut, except when some one who is a stranger to the peculiarity calls attention to it. During the day, however, in looking about both eyes are generally open, though when I look intently at a distant view, I find the short-sighted eye shuts occasionally. But in a general way both eyes are open, and I have two distinct images presented to my brain, one blurred and indistinct, even for faces a yard distant, and the other clearly defined, I believe, to the usual distances. How is it that my brain or mind rejects the blurred image and chooses the distinct one, so that I see everything perfectly clearly. If I get a piece of dust in the good eye, or close it, I immediately see the blurred image, and if this take place in the street, it causes a painful degree of confusion as to distances, &c., so that I am often brought to a standstill by such an occurrence. That both images really are presented to the brain I know. For instance, in travelling by train I frequently amuse myself by placing my eyes so that the short-sighted eye sees a portion of a scene through the window, without the good eye being able to see it. Then I see the blurred image only; but as the train moves the blurred is replaced by the bright one, as the good eye gets to work. The blurred image always appears at a higher level than the other, and it is the same when I shut my good eye for a moment and look at the fire with my bad one. On reopening the good one the blurred fire appears slightly above the bright one, and the latter almost instantly drives the indistinct image away—like a dissolving view. Things appear, as a rule, much flatter to me than to people who enjoy binocular vision. I know this because I have a pair of spectacles so arranged as to equalise my sights. When I put them on, objects like trees put on a delightful fulness and roundness to which I am usually quite a stranger, and the effect is most charming. I may add that two of my brothers have a similar defect of vision.

May 31 J. I. R.

The Eskimo at Paris

I HAVE read with great interest in vol. xviii. p. 16 of your renowned journal the article concerning the Eskimo, the exhibition of whom in Paris, &c., has recently made so great a sensation.

Unfortunately, it seems to me, the writer of the article, M. A. Bordier, has been incorrectly informed with regard to the introduction of these people. It is not to Mr. Geoffroy St. Hilaire, the director of the Paris Jardin d'Acclimatation, but to M. Charles Hagenbeck, the well-known and intelligent dealer in wild animals of our town, to whom science is indebted for the introduction both of the Eskimo, the Hamran and other types of the different tribes of Nubia, and the Laplanders.

I should be much obliged to you if you would kindly insert the above correction in an early number of your journal.

Hamburg, May 28 J. D. E. SCHMELTZ

The Telephone

HAVING seen a paragraph in NATURE communicated by Mr. Severn, of Newcastle, New South Wales, describing a method of using a telephone to enable deaf persons to hear, I have tried the experiment in the manner Mr. Severn describes—by fastening a string to the parchment diaphragm of a simple telephone made of wood, and carrying this string round the forehead of the deaf person, who clasps the string with both hands and presses them over his ears. The experiment in this way was partially successful; the sound of the voice was always heard, and some words were distinguished. Afterwards I fastened a single string to the telephone and got the deaf person to hold the string between his teeth. He then heard every word distinctly, even when spoken in a low tone of voice at the whole length of the room.

63, Strand, W.C. JOHN BROWNING

TILL now I have looked in vain for any account in NATURE of experiments with the telephone or phonoscope, inserted in the circuit of a selenium (galvanic) element (see NATURE, vol. xvii. p. 312).

One is inclined to think that by exposing the selenium to light, the intensity of which is subject to rapid changes, sound may be produced in the phonoscope. Probably by making use of selenium, instead of the tube-transmitter with charcoal, &c., of Prof. Hughes, and by exposing it to light as above, the same result may be obtained.

I should be glad to know whether experiments have been made in this direction; for if the above should prove true, there is no doubt that many applications would be the result.

Kew, June 3 J. F. W.

Meteor

HAVING just seen a magnificent meteor, I send you an account of it, as from its position it may have been seen at Gibraltar.

At 7.30 this evening a large meteor appeared as nearly as possible N.E. by E. of my position, at about 25 to 28° from the horizon, in a wide opening in the clouds, and proceeded with a moderately fast motion towards the north, slightly descending in a path slightly concave to the horizon. I did not see it disappear, as it went behind some bushes which hid the sky between N. by W. and N. by E.; if it disappeared due N. it would have been about 20° from the horizon as estimated by the altitude of the pole-star. The appearance was very remarkable, the head being of a brilliant green and the tail bright red. When I first saw it I took it for a first-class rocket passing at about 300 or 400 yards from me with a bright Bengal light of green colour at its head. The brightness was certainly from 10 to 15 times that of Venus at its brightest. It shone in the twilight more brilliantly than I ever saw Venus against a dark sky. The tail was not persistent as far as I could judge, against the light sky, and no report was heard, though I listened for several minutes. A bright star, which I believe was Vega, was just below it among the clouds, and afforded a fair standard of comparison; it was from thirty to forty times, at least, brighter than this star. W. A. SANFORD

Funchal, May 27

P.S.—I find that I have forgotten to mention that my position is about two miles south-west of the cathedral of Funchal.

Multiple Rainbow

ON Saturday evening I (and others) observed a rainbow which presented a very peculiar phenomenon. The primary bow, in the neighbourhood of its apex, was apparently composed of three distinct bows. Just below the violet of the principal bow the bright portion of a second bow was observed, and at about half the distance between the bright portions of these two bows was observed the bright portion of a third bow. The secondary bow looked much as usual, and the principal primary bow was very perfect, so far as I could see, on each side. The repetitions of the primary bow extended only through an angle of 35° or 40°, and did not apparently end at the same point.

Between the point of observation and the sun are some pieces of still water in Bushey Park. Overhead were some clouds upon which the sun was shining. I think the phenomenon was due to the reflection of the sun from the clouds. R. S.

Hampton Wick, June 1

Opening of Museums on Sundays

MANY of your readers will be glad to know that the very admirable and extensive museum at Maidstone was opened to the public on Sunday last, and will in future be open on Sunday afternoons from two to six o'clock.

The opening was a great success: the mayor and many of the influential inhabitants were present, and more than 1,000 people visited the museum on that afternoon, the average attendance on week-days being from 50 to 100. The most perfect order was preserved, and every part of the museum received its share of attention, even the library being more than full of readers.

I believe that this is the first and only scientific museum that has yet been opened on Sunday in the United Kingdom, the Art Gallery at Birmingham and Aston Hall being of a different character, and so I have thought it worth while to call your attention to it.

For the sake of those who have not yet visited Maidstone Museum I may say that it is one of the best local museums in the country, having remarkably fine palæontological, conchological, and other collections; that it will well repay a visit, or more than one; and that Mr. Bartlett, the courteous curator, is always ready to give visitors any assistance that he can. Maidstone itself, and the country round, are well worth visiting. I must not forget to mention the cemetery, which is one of the most beautiful in the country.

10, Bolton Row, Mayfair, W., June 10 W. H. CORFIELD, Chairman of the Committee of the Sunday Society

THE FISHERIES OF BRITISH NORTH AMERICA

I.

IT was provided by the Treaty of Washington, that, on payment by the United States of a compensatory sum (to be determined by a Commission) to the Dominion of Canada, the Fishing-grounds of British North America should be entirely thrown open to the fishermen of the Union; those of the United States coast, on the other hand, being opened to the fishermen of the Dominion only as far south as the 39th parallel of N. lat., which is almost exactly that of Washington. While the payment of the compensation since awarded by the Commission is being protested against by not a few influential politicians in the United States, the probable influence of the Fishery clauses on the future of the Dominion of Canada is being carefully considered in those parts of it which they especially affect; and we have before us a very able report on this subject by Mr. H. Y. Hind, M.A., a Member of the Legislature of Newfoundland, of which, as based on a careful scientific study of the physical and biological conditions involved in the questions at issue, we think that a summary will prove interesting to our readers.

It is somewhat startling to be told that "as a maritime power the Dominion of Canada stands *fifth* among the nations of the world." This expression, however, is obviously meant by Mr. Hind to refer, not to its *armed* but to its *commercial* marine, which is only surpassed by that of the Mother country, of the United States, of Norway, and of Italy. Its vessels number more than 7,000, and their registered tonnage amounts to above a million and a quarter tons, increasing at the rate of 60,000 tons per annum; its supply of trained seamen is drawn from a fishing population scattered over 3,000 miles of sea-board; and the annual value of their catch reaches at least 20 millions of dollars. The political importance of sea-fisheries as a nursery for seamen, irrespective of the pecuniary value of the catch, is admitted on all hands; and hence it is that a far-sighted policy looks to the value of the British American Coast fisheries as consisting not only in their present productiveness, but also in the security they afford for the maintenance and permanency of what has of late become one of the greatest industries of the Dominion—the work of ocean-carrying.

Now, while the length of the coast-line in British America not covered by previous treaty-arrangements, which is now opened to the United States fishermen, is about 3,700 miles, and the area of its coastal fishing grounds is about 11,900 miles, the length of the United States coast-line opened to British fishermen, is only 1,030 miles, and the area of its fishing-grounds about 3,500 miles. But the respective values of these grounds are not to be estimated by their relative extent alone; for while the United States fishing-grounds north of the 39th parallel were formerly extremely productive, they are now much less so, chiefly through the improvidence of their own people; the cod-fishery, in particular, having been ruined in a great measure beyond repair. On the other hand, the United States coastal waters south of the 39th parallel still maintain much of their original productiveness, supplying a very large quantity of fish to the markets of New York and the South. But to these prolific fishing-grounds access is forbidden to British-American fishermen, who are thus placed at a great disadvantage compared with those of the United States; the latter being able, when the approach of winter makes the fishing industry of the Dominion coasts hazardous or impracticable, to start at once for the southern grounds, where they can pursue their calling through the winter months. This is so great an advantage, that it frequently renders a northern summer fishery remunerative, which would not be so if the fishermen were dependent upon it alone.

The fish which frequent the United States coast-waters south of the 39th parallel are chiefly of the "anadromous" kind—that is, they live for most of the year in the sea, where they attain the greatest part of their growth, running up into fresh waters for the purpose of spawning. The chief among these are the shad, the alewife or fresh-water herring, the rock-fish, and the striped bass. On the other hand the "commercial" fishes—the cod, herring, haddock, hake, halibut, and mackerel—are found in greatest abundance where the temperature is kept down by the Arctic current, which at the same time furnishes their great store-house of food, and the temperature congenial to them. On the fishing banks of the open sea, the abundance of hake and cod depends essentially upon the resort of herrings; but it is by the "anadromous" fishes that the cod is attracted in-shore. And the destruction of the cod-fisheries which formerly existed on the New England coast is attributed by the United States Fisheries' Commission to the comparative annihilation of the "anadromous" species, through the obstruction and contamination of the river-waters by the various land-industries established along their banks. Below the 39th parallel, however, the "anadromous" fishes find an accessible winter's home in the warm water off the coast of the Southern States, and enter its rivers to spawn as early as February. The United States fishermen being privileged to follow them thither, are thus placed in a position of great advantage as compared with those of the Dominion; the enterprise of the former being stimulated, while that of the latter is cramped, by the Fishery-clauses of the Treaty of Washington, which, as Mr. Hind points out, "place an obstructive boundary on the operations of the British-American fishermen far more limited and confined than formerly existed under the Reciprocity Treaty, while in the same breath they remove every impediment to perfect freedom of action to the United States fishermen throughout an area of great productiveness and practically unlimited extent."

The Physical conditions under which marine life exists on the coasts of British North America, differ in this important particular from those which prevail in the seas of Northern Europe—that while the great modifying influence of the latter is the warm N.E. flow, popularly known as the Gulf Stream, the former are chiefly dominated by the Arctic Current, which brings down glacial *surface*-water from the coasts of Greenland and Labrador. The existence of a low *bottom*-temperature, wherever the basin is deep enough to admit the Arctic under-flow, is common to both: but while, on the European side—to take as an example what I have called the "Lightning" channel that lies N.E. and S.W. between the Orkney and Shetland Islands and the Faroes—the glacial under-flow from the N.E. is overlaid by a comparatively warm upper-flow from the S.W., on the American side the glacial under-flow from the N.E. is overlaid by a cold upper-flow from the same quarter, urged southwards by the prevalence of northerly winds along the Greenland and Labrador coasts. And alike in the upper and in the under south-moving strata is there a *westerly* tendency (caused by the *deficiency* of easterly momentum which they bring from latitudes higher than 60° into lower parallels) which causes them both to "hug the shore" along the whole coast-line not only of British North America, but of the United States. The superficial Arctic wind-current cannot be distinctly traced further south than New York; but none the less is there a band of cold water intervening between the coast-line of the Southern States and the Gulf Stream; and the *Challenger* soundings have distinctly shown the continuity of this band with the deep Polar under-flow which underlies the Gulf Stream, and surges up on the western slope of the Atlantic basin.

The course not only of the superficial Arctic current, but probably also that of the deep under-flow, is greatly modified by local conditions; that of the former chiefly by the strong tides and local winds of the coast, especially in estuaries, straits, or inlets; and that of the latter by variations in depth—the effect of a shallowing bottom being to bring the cold under-flow nearer to the surface. And thus, as Mr. Hind observes, the extraordinary variations which present themselves on the Dominion Coasts are specially worthy of study in their relation to Fish-life. No such peculiarity is more remarkable, than that which seems almost constant in the Strait of Belle Isle, separating the north end of Newfoundland from Labrador; for here, in the latitude of London, the sea has a glacial temperature all the year round. Pack-ice remains in these Straits through the early summer, with a comparatively high air-temperature; and they are never clear of bergs. Sometimes the surface freezes over again at Midsummer after the breaking up of the winter ice. In 1873 the surface-temperature of the sea in these Straits on four consecutive days in the latter part of June was found to range from 36° to 28°; the air-temperature during the same time ranging between 43° and 68°. The extremely little influence which this comparatively high air-temperature had upon the temperature of the surface water, clearly shows that the latter must be constantly kept down by melting ice, and also by the surging-up of the deep glacial underflow. Numerous cases are cited by Mr. Hind of the influence of winds and tides in lowering the surface-temperature by mixing the deep cold stratum with the superficial; the general rule being that easterly sea-winds generally raise the temperature of the surface-water, while westerly winds cool it. That such changes (as from 52° to 38° in a single day) have no relation to the temperature of the winds themselves, is clearly shown by comparative observations of the sea- and air-thermometers; the moist easterly sea-winds being generally colder (at least during summer) than the dry winds crossing from the land; while the influence of a shoaling bottom, lying in the course of the deep glacial flow, is shown by a sudden descent of the surface-temperature to 33°. So, again, a mixing of the different strata produced by currents along the shoaling waters of the Labrador coast, particularly among the islands, rapidly reduces the temperature; so that, in a cold calm after a storm in December, all the conditions are present for that formation of "anchor-ice," of which Mr. Hind gave an account in a former communication. "The sea on the shoals is uniformly cooled; a clear sky and a north wind assist the radiation of heat; and ice-spicules form with great rapidity in the Labrador current, often increased in local intensity by tides." It has been lately stated, on the authority of Prof. Mohn, as a fact well known to the Norwegian fishermen, that the deep water is often so cold that it freezes if disturbed, although it continues liquid so long as it remains perfectly still; fishes passing into such a glacial stratum being frozen, and coming to the surface as lumps of ice.

Mr. Hind draws attention to a remarkable series of observations of temperature and specific gravity, taken by Dr. Kelly, of Quebec, during the Admiralty Survey of the Gulf of St. Lawrence in 1830-36; which show that a very curious temperature-stratification exists in that vast estuary, obviously produced by the mixing of the great body of fresh water brought down by the river St. Lawrence with the cold Labrador current. A zone of water of a certain degree of warmth is superimposed upon a zone sometimes of lower and sometimes of higher temperature; and these zones are cup- or saucer-shaped, having a general relation to the depth in different parts of the Gulf, and sometimes coming to the surface at variable distances from the coast. In every case, however, *the relative position of the zones is strictly accordant with their relative specific gravities;* the overlying of a warmer by a colder zone being due to the dilution of the latter by the admixture of fresh water, as appears from the following examples:—

	I.		II.		III.	
	Temp.	Sp. Gr.	Temp.	Sp. Gr.	Temp.	Sp. Gr.
Surface	54°	1·0225	43°	1·019	51°	1·0180
5 fathoms	—	—	—	—	42·5	—
10 ,,	46	—	37·5	1·023	38	—
20 ,,	—	—	39	1·0246	32·5	1·0261
30 ,,	34·5	—	—	—	33	1·0266
50 ,,	34	—	33	1·026	—	—
80 ,,	—	—	—	—	34	1·0266
100 ,,	37	1·0270	36	1·0275	35	1·0271
150 ,,	—	—	—	—	35	1·0278

A similar alternating temperature-stratification has been recently observed by the Norwegian Expedition in the seas between the coast of Norway and the Faroes; and I venture to predict that when the *temperatures* of the successive strata shall have been correlated with their respective *salinities* (which are modified by the admixture of fresh water discharged from the Norway fiords), the stratification will be found conformable to the same law of *the heaviest water lying deepest.*

There is one locality not far distant from our shores, in which similar influences have been found to produce equally decided, though less strongly-marked effects; I refer to the Baltic Straits, in which very careful observations of temperature and specific gravity have now been carried on for several years under the able direction of Dr. Meyer of Kiel, and his coadjutors. Here there is an admixture of waters from three different sources—the North Sea, the Baltic, and the underflow of glacial water which is brought as far south as the Skagerrack by a comparatively deep channel lying outside the Norway fiords. The North Sea brings water of ordinary salinity and of a temperature corresponding generally to that of the air: the Baltic outflow brings a variable quantity of water of low salinity: and the deep Norwegian channel brings water of very low temperature. In addition to these factors, there is the operation of winds and tides, which greatly modify the movements alike of the superficial and of the deeper strata. These influences are now so well understood, that, by a careful correlation of them, the temperature and salinity of the waters at the various observing-stations may be closely predicted; very small differences in specific gravity on the one hand, or small variations in level (and therefore in downward pressure) produced by winds and tides, being sufficient to determine movements in great masses of water, tending to the restoration of the disturbed equilibrium. In fact, as Dr. Meyer assured me during a recent visit to this country, "Your trough-experiment is being daily carried out on the great scale in the Baltic Straits, with the like results."

It is now well-established that the Temperature-stratification of the Sea has, as Mr. Hind says, *an all-important bearing* on the great fisheries:—"It determines the vertical positions in the sea, of the zones of minute and microscopic life which constitute the food of the higher forms, up to those of the fish which feed either directly or indirectly upon them." The cold of the Arctic seas is commonly supposed to be inimical to animal life; but hat the very contrary is the fact, is shown by the abundance of fish along those parts of the British North American coast, whose waters are most reduced in temperature by the Greenland and Labrador current, as compared with their paucity along the New England shores, which are less affected by that current. The most noteworthy case is that of the Strait of Belle Isle, in which, though almost every square mile has been annually fished for more than two centuries, continued productiveness is the rule through an average of years. And thus it becomes clear that the relative extent of the *cold-water areas* which feed (so to speak) the several fishing-grounds of the North American coast, must be a factor of the greatest importance in determining their respective values. Thus, while the water-area within the 100 fathoms' line along the coast of the United States north of Cape Hatteras does not exceed 45,000 miles, that of the British-American coasts within the same limit of depth exceeds 200,000 square miles. And while the former is bounded more or less closely by the heated water of the Gulf Stream, which invades it during the summer months by a swing towards the shore, the latter is only bordered by the Gulf Stream along its southern edge, and is continuous to the north and north-east with a limitless sea of cold water, which is the home of those minute forms of marine life that constitute—directly or indirectly—the source of our "commercial" fishes, the cod, herring, and mackerel.

Another advantage possessed by the fishing-grounds of British North America over those of the United States, is their immunity from the ravages of the *blue-fish*—a voracious wandering fish, whose home is in warm southern waters, its northward migration taking place only during summer, and never extending far beyond Cape Cod. Its destructive agency has had much to do with the diminished productiveness of the New England fisheries; and further south is specially exerted on the mackerel schools. According to the estimate of Prof. Baird, the United States Fishery Commissioner, the weight of fish consumed by the blue-fish of the United States coast during the season is about 300,000 *million* pounds. In its turn the blue-fish is largely consumed as an article of human food, being taken in great numbers along the coast of the Southern States; but it is not suited for salting, and is consequently of no value as an export fish. From the fishing-grounds in which the blue-fish is taken in immense quantities during the early winter months, for the supply of the northern markets, British American fishermen are excluded.

Of the influence which Temperature has now been ascertained to exert over the habits (especially the migrations) of these fishes, and consequently over the productiveness of the great "harvest of the sea" furnished by them, as to which a valuable mass of information has been brought together by Mr. Hind, I shall give some account in a future communication.

WILLIAM B. CARPENTER

THE MICROPHONE[1]

THE following experiments were suggested by the description, which appeared in a recent number of NATURE, of the microphone lately invented by Professor Hughes. Instead of the pointed piece of carbon supported between two pieces of the same material as used by him, it occurred to me that ordinary gas cinders would be likely to answer the purpose tolerably well. To test this, I included in the circuit of an ordinary Bell telephone, a single Leclanchè cell, and a small jelly can half filled with cinders broken into pretty coarse fragments. The connections were made by slipping down at opposite sides, between the cinders and the sides of the

1 Abstract of a paper read before the Royal Society of Edinburgh on June 3, 1878, by James Blyth, M.A., F.R.S.E.

jar, two strips of tin, to which the circuit wires were attached. When the simple instrument was used as a transmitter, articulate sounds were heard very loud and distinct in the distant telephone, though occasionally marred by what appeared to be the rattling of the cinders in the jar. With this transmitter sounds were also quite audible, even when the speaker stood several yards away from it.

I next took a shallow box, made of thin wood, about fifteen inches by nine inches, and filled it with cinders, taking care, in the first place, to nail to the inside of its ends two pieces of tin to which wires could be attached. Having nailed down the thin lid of the box, and included it in the circuit of the telephone, along with one Leclanchè cell, I found that it made both a very sensitive microphone, as well as an excellent transmitter for the ordinary telephone. With three of these boxes hung up like pictures on the walls of a room, and connected in circuit, almost any kind of noise made in any part of the room was revealed in the telephone. Speaking was heard distinctly, and a part-song by two voices in the middle of the floor was rendered with surprising clearness and accuracy.

In my next experiment, still using the same cell in the circuit of the telephone, I tried as transmitter a single elongated cinder with the wires wound tightly round each end. Sounds uttered close to this cinder were quite audible, but I failed to hear them when I substituted for the cinder the carbon of a Bunsen cell with brass clamps firmly attached to each end, into which the circuit wires were screwed. Possibly either the more porous and friable nature of the cinder or the comparative looseness of the wire attachments, may have had something to do with this difference of effect.

I next removed the Leclanchè cell from the circuit and used as transmitter the jelly can containing dry cinders. I sometimes fancied that I heard sounds even with the cinders dry, but they became faintly, though distinctly, audible when the cinders became slightly moistened by the breath of the speaker. However, on pouring water into the jar, so as almost to cover the cinders, the sound was heard on the telephone almost as well as when the Leclanchè cell was in circuit. I did not, however, hear any sound with the cinders removed and water only in the jar, not even when the conducting power of the water was increased by being slightly acidulated.

In my next experiment I tried if the jar with the cinders would act as a receiver as well as transmitter, and was not a little surprised to find that it did so. For this purpose I used similar jelly cans, containing cinders both for transmitter and receiver, and included a battery of two Grove's cells in the circuit. Articulate sounds uttered in the one cinder jar were distinctly heard in the other, and even voices could be distinguished. However, the results were not so good as I have no doubt they will yet be, when better forms both of transmitter and receiver are adopted. Here we have the beginning of a kind of telephone worked entirely by the electric current without the aid of magnetism. I also tried successfully an ordinary telephone as transmitter and a cinder jar as receiver, but in this case, the sounds were somewhat fainter and not so easily distinguished. I remarked, also, that when an intermittent current was sent through the cinder jar, a very distinct rattling noise issued from it.

In order to find out if the cinders in the receiving jar were at all jostled about when sounds were being transmitted to it from a similar jar, the following experiment was tried. A strong battery was included in the circuit, and a clean glass jar containing cinders taken as receiving instrument. When this was taken into a dark room small flashes of electric light were observed here and there amongst the cinders while sounds were being sent.

JAMES BLYTH

RESTING SPORES

A VERY interesting memoir by Dr. Wittrock, the well-known Swedish botanist, was communicated to the Swedish Academy of Sciences in December last "On the Spore-Formation of the Mesocarpeæ and especially of the New Genus Gonatonema." The chief interest of this memoir seems to us to lie in its somewhat novel interpretation of some pretty well-known physiological facts, which we shall as briefly as possible proceed to enumerate.

In one lovely group of green-coloured algæ we find a number of very pretty species, many of which consist of one-celled forms, and others of which, obeying a law of cell growth, not only produce new cells but also cause these to adhere to one another and so, as this growth goes on, give a chain-like or filamentous appearance to the mass. These filamentous green freshwater algæ are very common. Dillwyn, in the beginning of this century, knew and described many of them, and he also seems to have well known that the contents of some of their cells formed oval bodies called resting spores. The merit of having worked out the history of these spores belongs to Prof. A. de Bary, from whose researches it was first made clear that in some of these forms (Zygnema) one of the chains of cells will come to lie alongside of another chain, and then the cell-wall of two opposite cells will grow outwards until they meet. On meeting the tips of these outgrowths will be absorbed, and the two cells will thus communicate by means of this newly-formed canal, whereupon it will follow that the contents of both cells will each go half way to meet the other, and their conjoining will take place in the newly-formed canal, or sometimes in one of the cells; or that the whole of the contents of one of the cells will pass over and combine themselves with the contents of the other. In either case the result will be the formation of a new body—well known as the zygospore, but also known under many other denominations. But, again, in other forms (Mesocarpus), while the initial process will be the same so far as the formation of the cross channel goes, the further steps differ much, it being only the green-coloured portions of the protoplasm of both cells that move over into the canal, whereupon the central portion of this green mass, composed of about equal parts of the contents of the two cells becomes developed into a zygospore, leaving the rest of the cell-contents to fade away. The physiological import of these two quite different phenomena was therefore this: in Zygnema and its allies the total contents of two of the cells were required to form a zygospore—whereas in Mesocarpus this was formed out of only portions of the cell-contents. There is thus no strict analogy between these two forms of zygospores, and they probably should not both receive the same name. De Bary perceiving this, referred to the one as resting-spores formed by the partition of the zygospore [the parts destitute of green contents having been partitioned off], strangely applying this term to that stage when the two cells had combined to form one, and to the other as resting-spores without partition. De Bary's attempt at being logical has apparently been overlooked by many writers on this subject, notably by such eminent investigators as Max Cornu and Sachs, who still apply the term zygospore to both forms, but Pringsheim has grappled with the difficulty in his most thoughtful paper "On the Alternation of Generation in Thallophytes," and suggests that the first stage in the reproductive process in Mesocarpus is the "conjugation"-stage—here the cells join and become, so far as their cell-walls are concerned, united into one. The next stage is the more important one, in which the cell-contents commingle, and the result is the production of the central cell—a carpospore—and of two or four cells which surround it, and form the equivalent of a fruit-like body, or sporocarp, and of course it would make no matter whether this sporocarp were formed in the connecting canal as in Mesocarpus, or whether it fills this and extends over into both the cells as in Staurospermum, or as in Plagiospermum is altogether formed in one of the cells; the essential feature being the differentiation into the carpospore and its investing covering the sporocarp.

Now Dr. Wittrock has made the rather startling observation that in one and the same species (*Mougeotia calcarea*, Clev.), the formation of the spores may take place equally in the manner of the three above-mentioned genera; also that occasionally even the spores may be formed without any conjugation, and further that in a plant found growing last October in an aquatic stone house in the Upsala Botanical Gardens, and which is described as *Gonatonema ventricosum*, the spores are formed in a neutral way through the agency of cells never intended for and incapable of conjugation. Such spores the author calls agamospores, and he finds a second species of this new genus in Hassall's anomalous *Mesocarpus notabilis*. This memoir of Wittrock's will be found in the *Bihang till k. Svenska Vet. Akad. Handlingar*, Band 5, No. 5, 1878. It is written in English, and illustrated with a plate. Upon it the following observations may not seem altogether out of place.

If the interpretation placed on the phenomena to be witnessed in the Mesocarpeæ by Prof. Pringsheim be accepted, then this family can scarcely be left among the Conjugatæ, and this would hold true also of Wittrock's new genus, as indeed is so stated by himself. But may not the phenomena be interpreted in yet one other way? First, as to the agamospores in Gonatonema. Is it beyond the bounds of possibility that, despite their external likeness to zygospores, these are simply vegetative spores, to be compared to one of the so-called tetraspores in Florideæ? They surely cannot be compared to any form of organism itself the product of the commingling of the contents of two different cells! Another suggestion, to account for this agamospore, has been made to me by my friend William Archer. It is that there may have been a separation between the upper and lower portions of the protoplasmic contents of the same cell, and that these, without waiting for the formality of forming separate cells, may have then and there conjugated. This is certainly a most ingenious suggestion, and is strengthened by the well-known fact that, in some Desmids, after the single-celled frond has divided into two halves, and before the newer portions grow into anything like the similitude of the older portions, the two halves, which were only just parted, will conjugate and form an ordinary zygospore. De Bary gives some pretty figures of this strange phenomenon, which, according to Mr. Archer, might be carried one step further, and there be no parting at all. In favour of my own idea I can only add that the first origin of what, in some of the Florideæ, will form the tetraspores, and the origin of these agamospores, appear to me to be the same. Next as to the sporocarps in Mesocarpus. The differentiation into sexual entities of the protoplasmic contents of cells is confessedly, at first, scarcely perceptible. It would be impossible, in many cases, to say with any confidence, this one is the germ cell, and that one is the sperm cell. But gradually a differentiation appears in that the contents of the former exhibit themselves as passive, and of the latter as active; the contents of the one remain quiescent, those of the other pass over to conjugate with the former, but all through the contents that commingle are almost in every case alike in quantity. Carry the differentiation a step further on, and we find that the contents that commingle may be at first somewhat, and then be strikingly unlike in quantity. The passive contents will be divided into a comparatively small number of portions (in Fucus eight), but these each can be fertilised by the very smallest portion of the active contents. Now may not the Mesocarpeæ be a link between these groups? The contents of each of the two cells divides into certain portions. The fertilising power of the active contents is not sufficient for the passive contents, and hence but one portion—that the most specialised—is fertilised; this forms the zygospore; the other portions remain sterile. Then this spore would differ from the zygospore of Zygnema just in the same proportion as it would differ from the oospore of Fucus, but the fructification would not at all be a representative carpospore, and the at first sight very anomalous case of *M. calcarea* may be explained by supposing that the number of partitions is a matter of but secondary importance, unless the fertilising power of the active contents were to increase. This field of research is an important one, and much as we are indebted for information on these points to the labours of the Swedish botanists, we must still continue to look for fresh facts and new explanations.

E. PERCEVAL WRIGHT

PROF. C. F. HARTT[1]

CHARLES FREDERIC HARTT, whose death by yellow fever occurred at Rio de Janeiro on the 18th of last March, was born at Fredericton, New Brunswick, August 23, 1840. For three years and a half before his decease he had successfully withstood the fatigues of exploration and the labours of organising and carrying on the geological commission of Brazil, an undertaking beset with many trying difficulties.

Prof. Hartt's connection with natural history dates from boyhood. Encouraged by Prof. Cheesman, he made rapid progress in his favourite studies, without, however, neglecting the other branches of learning. But his particular bent always lay toward natural history, language, music, and art.

While a student at Acadia College, he undertook, under the direction of Dr. Dawson, extensive researches into the geology of Nova Scotia, which province he explored on foot from one end to the other. In 1860 he accompanied his father to St. John, there to establish a college high-school. This change of location brought him into another field for exploration, that of the geology of New Brunswick, and he commenced his new labours at once. The Devonian shales at the locality called Fern Ledges, in the vicinity of St. John, were the principal objects of his research. After a long siege of hard work he was amply repaid by discovering an abundance of land plants and insects, of which the latter still remain the oldest known to science. Prof. Agassiz was attracted by this last discovery of the young Canadian naturalist, and invited him to enter his museum at Cambridge as a student. This he did in 1861. Each vacation he returned, either to New Brunswick or Nova Scotia, to continue his explorations. In 1864 Mr. Hartt was employed, with Profs. Bailey and Matthews, on the geological survey of New Brunswick, and, while engaged in this work, obtained the first full proof of the existence of primordial strata in that province. Many of his discoveries in Nova Scotia and New Brunswick were published in the Provincial Government reports, and also in Dr. Dawson's "Acadian Geology."

Upon the organisation of the Thayer Expedition to Brazil, by Prof. Agassiz in 1865, he was appointed one of its geologists, and henceforth to the time of his death he was ever a most devoted investigator of South American natural history. Aided by New York friends he returned to Brazil alone in 1867, this time examining with the greatest care the reefs of the Abrolhos Islands, and those of the coast, as well as the geology of a part of Bahia and Sergipe. The results of his work thus far were pub-

[1] From an article by Mr. R. Rathbun in the *Popular Science Monthly* for June.

lished in 1870 as the "Geology and Physical Geography of Brazil." In addition to the account of Hartt's researches, it included the best results of all who had ever published on the geology of the country.

Early in 1868 he was elected Professor of Natural History in Vassar College, and shortly after of Geology in Cornell University. In 1870, with Prof. Prentice and eleven students of Cornell University, he again went to Brazil. He entered the Amazonian Valley, hoping there to discover, at the falls of the different tributaries of the Amazonas, other fossiliferous formations than the cretaceous, which latter alone he had found along the coast. He was well rewarded, and returned to the United States with large collections of fossils of the palæozoic age, and sufficient other evidence to allow of his giving us a very accurate though general idea of the formation of the Amazonian Valley. His results were strongly opposed to the theory of Prof. Agassiz, of its glacial origin. He returned again to the Amazonas in 1871 with Mr. O. A. Derby. Together they carefully re-explored the same regions gone over before, adding much to the stores already brought to the United States, and also examining the ancient Indian mounds and shell-heaps of numerous localities.

Returning from Brazil once more he remained at Cornell University about three years, quietly working up the results of his later trips, and publishing his reports upon them. In August of 1874, by request of the Brazilian Minister of Agriculture, he went to Rio de Janeiro to submit his plans for the organisation of a Geological Commission of Brazil. He entered on his work in May, 1875, with five or six assistants.

On the reorganisation of the National Museum at Rio, in 1876, Hartt became Director of its Department of Geology, but on account of his many other duties he was soon obliged to resign that position. The results of his researches may be briefly summed up as follows:—Before he went to Brazil on his second trip, in 1867, scarcely anything was known of fossiliferous deposits there, and thus no material existed toward the study of the systematic geology of the country. A few cretaceous fossils had been recorded from Bahia; the Danish naturalist Lund had very fully described the bone-caverns of Lagoa Santa in Minas Geräes, and we knew of coal-plants from Rio Grande do Sul, but beyond this the palæontology of Brazil was a perfect blank. Hartt's greatest achievement in Brazil was probably his solution of the structure of the Amazonian Valley. It was founded on the best of palæontological evidence which proves the existence of an immense palæozoic basin lying between the metamorphic plateau of Guiana on the north, and that of Central Brazil on the south, and through which flows the river Amazonas. Silurian, Devonian, and carboniferous rocks, make up the series in regular succession, and in many localities are highly fossiliferous. He has explained the character of the isolated cretaceous deposits, mostly discovered by himself, existing along the coast from Pará to Bahia, and of the carboniferous and other regions south of Rio. He has shown us the manner in which the rocky structure of Brazil was built up, and has done much toward solving the relations of the crystalline rocks which compose by far the larger portion of its surface. He has explored the shell-heaps, burial-mounds, and other relic-localities of the prehistoric tribes from far up the Amazonas to the southernmost coast province. We owe to him also the first real satisfactory explanation of the reefs of Brazil, which he distinctly shows to be of two kinds—sandstone and coral. He spent much time in studying the customs and languages of the modern Indian tribes of the Amazonas and Bahia, and collected very much material toward a grammar and dictionary of the Tupé Indian language in several of its dialects. But to attempt a complete account of Prof. Hartt's Brazilian explorations and discoveries would require a longer article than we can give here. In connection with the Geological Commission of Brazil he founded a large museum in Rio de Janeiro, which will always bear testimony to his great final undertaking. It forms the most complete repository of South American geology in the world.

A start had just been made toward publishing the reports of the commission when the death of Prof. Hartt deprived it of its main support. But though this will occasion some delay in the publication, it is to be hoped that we shall soon have before us the entire results of this most important of explorations.

Prof. Hartt's published works are not very voluminous. He was so confident of a longer life that he delayed too long, but still he was a constant contributor to American scientific periodicals.

THE DARK CONTINENT[1]

In our article last week on "Old Maps of Africa" we said that even if it were the case that the great lakes and rivers of Central Africa were known to early Portuguese missionaries and traders, it would not in the least detract from the glory of modern African explorers. Even if the work of those early travellers had not been clean forgotten, it was done so imperfectly that in any case it would have had to be done over again; their work bears about the same relation to that of modern explorers that the observations of an ancient Chaldean shepherd watching with powerless eyes the march of the stars, while he tended his flock on the hill-side, do to those of a modern astronomer armed with all the instruments of an observatory. It scarcely needs a perusal of these two volumes to convince us that it would be simply absurd to attempt to deprive Mr. Stanley of the glory of being the first white man whose keel has cleaved the broad bosom of the Upper Congo. He has done *his* work in such a way that there is no chance of it being ever forgotten.

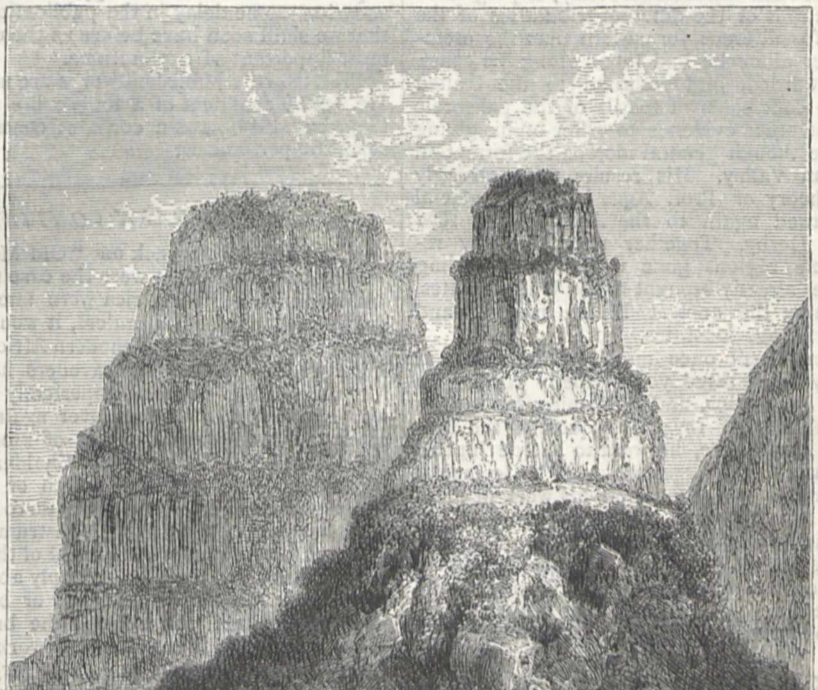
Let us at once assure those of our readers who may cherish the idea that, after having read Mr. Stanley's letters in the *Telegraph*, they need not trouble themselves with his book, that they labour under a delusion; compared with the book, the letters are a mere prospectus, and therefore we cannot hope within the limits of an article to give any adequate idea of its contents. From a merely literary stand-point, Mr. Stanley's work deserves to take a high rank. We know no other narrative of travel with which it can be compared; it reads more like a prose epic than a story of stern facts, and the reader who remembers his classics will be over and over again reminded of the story of the wanderings of Ulysses as chanted by Homer. No such revelation of African life and African character and African scenery has ever been made, scarcely, we think, even in the half-fictitious pages of Winwood Reade. The trustworthiness of Mr. Stanley's narrative cannot for a moment be doubted; his art has been evidently used simply to enable us to realise with perfect clearness the scenes and events through which he and his followers passed.

From the numerous notices we have published, our readers must be familiar with the great outlines of Mr. Stanley's discoveries. The two volumes before us are concerned mainly with the incidents of the wanderings of himself and followers from Bagamoyo to the mouth of the Congo; another volume, which is promised for autumn, will contain chapters on the hydrography, ethnology, and natural history of Central Africa, with "considerations" on the lakes, lands, and peoples of the equatorial regions; as well as chapters on the hydrography and physical geography of the western half of

[1] "Through the Dark Continent, or the Sources of the Nile, around the Great Lakes of Equatorial Africa, and down the Livingstone River to the Atlantic Ocean." By Henry M. Stanley. Two vols. Maps and Illustrations. (London: Sampson Low and Co., 1878.)

Africa, with special reference to the Livingstone Basin and River, and the volcanic formation of the defile through which the Livingstone falls into the Atlantic. Until the publication of this third volume it would be premature to discuss in detail the scientific results of the expedition, and we shall therefore at present content ourselves with briefly resuming the general results of Mr. Stanley's work.

Mr. Stanley left Bagamoyo on November 17, 1874, with a force of porters, soldiers, and boatmen of about 350. The expedition was thoroughly equipped for its work, and it is evident that the best possible use was made by Mr. Stanley of all his advantages. The objects of the expedition were not rigidly defined, and generally they may be said to have been to clear up the many unsolved problems relating to the sources of the Nile, the great

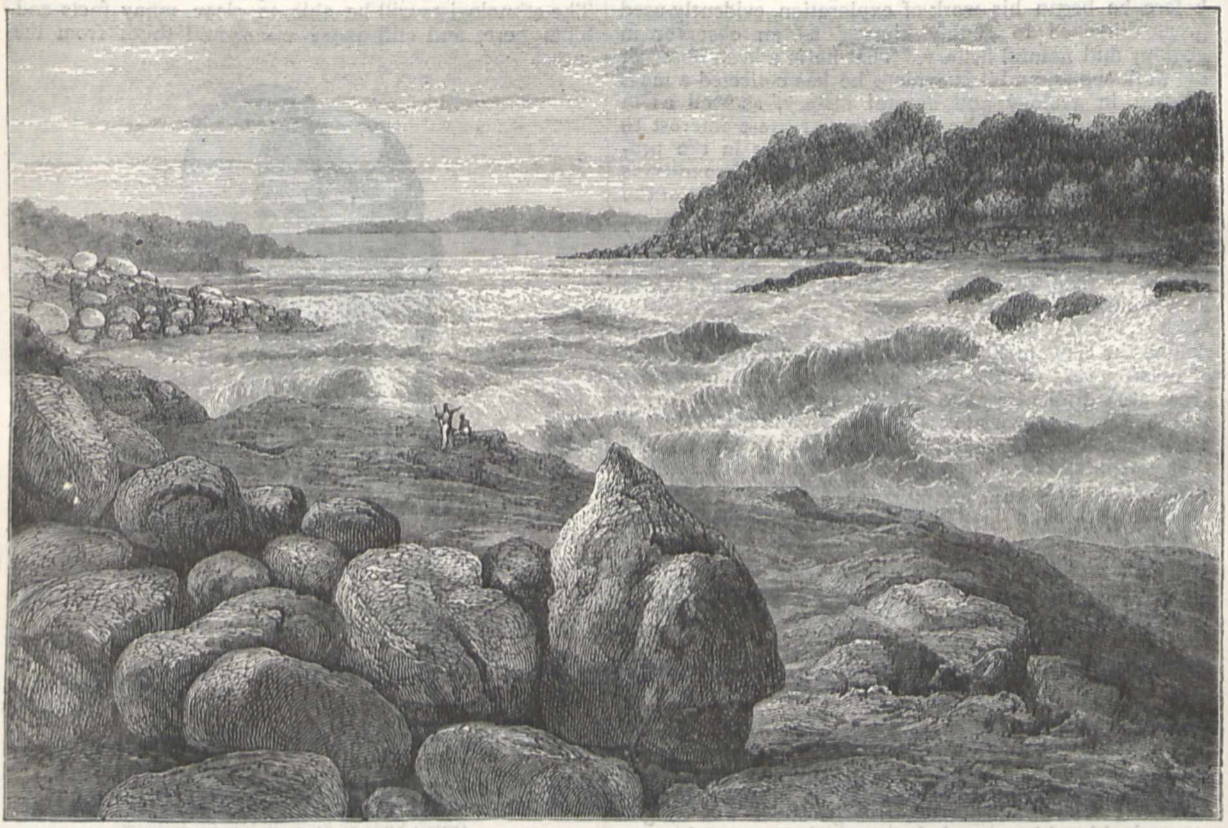


Scene on Lake Tanganika.

lakes of Central Africa, and the course of the great river, which, coming from the far south, passed Nyangwé, and flowed then no man knew whither. The ultimate source of the Nile was unknown; the configuration of the Victoria Nyanza was so uncertain, and so many objections had been raised to Speke's work there, that, as Mr. Stanley says, there was some danger of its being swept off the map entirely; so defective was our knowledge of the lake, that some geographers, including the sagacious Livingstone, maintained that it was not one lake but many; there was much to clear up in the region between Victoria and Albert Nyanza, and our knowledge of the latter was of the scantiest. The great western affluent of Lake Victoria, the Kitangulé, had to be traced, and our knowledge of Lakes Windermere and Akanyaru extended, as well as of the stretch between the latter and Tanganika.

On the last-named lake, notwithstanding the labours of Burton and Speke, Livingstone, and Stanley himself, and even of Cameron, there was not a little to do to complete our knowledge. Then there was much room for additional work in the interesting country lying between Tanganika and the Lualaba at Nyangwé, where Livingstone has left an everlasting memory as "the good old white man." Last of all there was the mile-wide Lualaba itself sweeping past Nyangwé, "north, north, north," into the great unknown, perhaps to the Nile, perhaps to some great lake, perhaps bending west to the Atlantic; though there could be little reasonable doubt that if a boat could run the gauntlet of the natives, it would find itself ultimately on the estuary of the Congo. These were the geographical problems to be solved, and Mr. Stanley solved them, and he only took two years and a half to do it.

Until he reached Ugogo, nearly half way between Bagamoyo and Lake Tanganika, Mr. Stanley kept not far from the caravan route westwards, well known to all readers of recent African travel. Turning suddenly northwards, he made straight for the Victoria Nyanza, over a rugged table-land, interspersed with plains, and with at least one wide desert, and many villages. In about $5\frac{1}{2}°$ S. lat. he came upon some tiny streams which he ultimately found to be the head waters of a river of something like 300 miles long, that runs into Lake Victoria as the Shimeeyu, and which is undoubtedly the furthest south source of the Nile. Camping at Kagehyi, on Speke Gulf, Mr. Stanley in his trim boat,



Cataract on Lower Livingstone.

the *Lady Alice*, circumnavigated the Victoria Nyanza, defining every creek and gulf, and proving it to be one great lake with an area of 21,500 square miles, an altitude of 4,168 feet, and with border-soundings of from 330 to 580 feet. The lake is bordered with islands all the way round, is much indented with creeks and bays, receives numerous tributaries from all sides, and its shores and many of its islands are thickly inhabited.

Mr. Stanley next set himself to the task of doing for the Albert what he had done for the Victoria Nyanza, but in this he was baulked by the timidity of the escort furnished him by his warm friend Mtesa, King of Uganda, on the north of the latter lake. He was only able to stand on the precipitous shore of what he named Beatrice Gulf. From what he then saw, combined with the information gleaned at the court of King Rumanika, he has plotted on the map accompanying his work the vague outlines of a new lake, to which he attaches the name of Muta Nzigé, somewhat to the south of the Albert Nyanza. The latter he locates in accordance with the recent circumnavigation of Col. Mason, with the proviso that after all there may be a connection between the two. If Mr. Stanley has not yet solved this problem, he has at least opened up a very interesting one, which possibly the Egyptian pioneers may unravel. Coming south to the coast of Ruminika, King of Karagwé, the gentle friend of Speke and Grant, and now of Stanley, he was able still further to add to our knowledge of a region teeming with interest, and again to open up problems which successive explorers must solve. We have now some idea of the great affluent of the Victoria Nyanza, which, issuing from Lake Akanparu, flows north through a long series of swampy lakes before it turns east to feed the great reservoir of the Nile. About Lake Akanyaru itself we know but little. Mr. Stanley, in the maps which accompany his work, no longer makes a long river flow from the west to feed it, though a considerable stream comes south from the Ufumbiro Mountains.

Still, however, he gives it a connection with little Lake Rivu, the supposed source of the Rusizi, the northern affluent of Lake Tanganika. Here is another curious riddle awaiting solution.

Coming to the Tanganika itself, we may say that Mr. Stanley has virtually completed our knowledge of its configuration, having for the first time defined the outline of its southern shore and proved that the Lukuga has not yet become an effluent, but promises ere many years to carry the waters of the lake to swell the volume of the Lualaba. Mr. Stanley adduces the strongest proofs that the Tanganika is rising with comparative rapidity, and it is possible that further research may show that the earliest Portuguese explorers, if ever they reached it, found two lakes on its site, divided by a ridge nearly half-way between its north and south points. Mr. Stanley, before he began his work of exploration, evidently used great diligence to qualify himself as an observer in geology and natural history. That he is a keen observer his work shows, and it is evident he has collected a mass of data in geology and natural history, as well as in ethnology, which will prove of the greatest interest to men of science, and which we may look for in the promised third volume. Evidently the geological conditions of the bed and shores of the Tanganika, as well as of the whole basin of the Livingstone, are unusually interesting and have occupied much of the explorer's attention. Until we have the whole of the data it would be premature to theorise. The lake Mr. Stanley makes out to be 329 miles long, with an area of 9,240 square miles. With 1,280 feet of cord he could find no bottom. Yet though the Tanganika is rising, Mr. Stanley seems to be of opinion that at one period nearly the whole of the great area drained by the Livingstone was under water, and that the numerous lakes to the west and south-west of Tanganika, with the river itself, are all that now remain of the great inland sea, if inland it was. On the banks of the Tanganika itself, high above the lake-level, he found rocks bearing distinct evidence of having been worn and rounded by water. Here is a splendid field for the enterprising geologist.

Of the great river itself, what more can we say but that, in the face of the most stupendous difficulties, he traced its course from Nyangwe to the sea? It is a splendid epic, this narrative of the expedition down this great river, whose banks are lined with the villages of hostile and cannibalistic natives, who literally hunted the little band for hundreds of miles. We doubt much if another man could be found who could have carried such an enterprise through with success. Anyone but Stanley would either have turned or been eaten ere the first cataracts were reached. One village street was fringed on each side with rows of skulls, which he was told were those of the soko—probably a species of chimpanzee. One of these, brought home by Mr. Stanley, was submitted to Prof. Huxley, who has diagnosed it as that of a human being. Of the dimensions of this river we have already spoken, and of its basin, of nearly a million square miles. Its discovery was worth all the sacrifices that were made; and, unless we are to count the pursuit of knowledge as an object of no worth, it must be admitted that Mr. Stanley has here done a thing that entitles him to rank in the first order of the pioneers of science. Apart from its high value as an addition to geographical knowledge, its importance as a highway to new fields of commercial enterprise cannot be overrated. North and south of it yet there are great white spaces to be filled up, but with such a magnificent base-line that should not be difficult to do.

Such is a brief outline of the principal geographical discoveries made by Mr. Stanley; but it gives the very faintest idea of what the reader will find in his book. Africa and African, to those who study these volumes, will be no longer mere names: the genius of Mr. Stanley has infused into them the breath of life. Mr. Stanley's strong human sympathy, aided by his knowledge of the Kiswaheli, has enabled him to bring before us the natives of Central Africa with a dramatic vividness never before attained. Henceforth it will be inexcusable to lump together the Waswaheli, the Wagoro, the Waganda, the Wanyamwesi, the Wajiji, the people of Manyema, and the many other tribes that people this much-watered land, as mere uniformly characterless "niggers." In Mr. Stanley's pages we see these various states and many individuals, each with their distinctive characteristics. The *physique* of the various peoples, their manners, their houses, utensils, and weapons, their dress, their modes of life, and even their modes of thinking and speaking, their legends, are pictured for us by pen and camera and pencil in a manner that must impress the laziest reader. The ethnologists will be able to glean many facts and hints here, and still more we should think from the

Kiteté, Chief of Mpungu, near the Lualaba.

volume that is to follow. Mr. Stanley presents us with a remarkable legend from Uganda, the Kingdom of Mtesa, concerning a blameless priest named Kintu and his descendants, which is well worth the study of the comparative mythologist. We have another strange legend as to the origin of the Tanganika, and we should think that in his wanderings much material of a similar kind must have been collected by Mr. Stanley: if so he would do science a service by publishing it. The chapters devoted to Mtesa and his kingdom are of special interest, and the explorer's friendship with this remarkable potentate promises to be fruitful of results. Further interesting details are given as of the mysterious white people of Mt. Gambaragara on the east shore of Muta Nzigé, which must rouse the curiosity of ethnologists. We learn a good deal also about the wandering Watuta, the terror of Central Africa, and of King Mirambo, a sort of African Napoleon, whom, however, Mr. Stanley speaks of in high terms as superior both in character and intellect to the general run of African "kings." Much new information also have we on the inhabitants of the Tanganika shores and the artistic people of Manyema, with their elaborately coiffeured heads. To speak of these people, and even many of the tribes on the banks of the Livingstone, as savages is a misuse of language. People who can build houses and organize villages and towns such as they do, who can work their native iron, ivory, wood, and bone, into all sorts of artistic and useful shapes, and who can reason and speak as Mr. Stanley shows us they do, have raised themselves to a level considerably higher than the savage. West of Tanganika, especially, the tribes seem very much mixed up, and there are many evidences that the Livingstone with the neighbouring region is a sort of borderland where several races meet, and where a constant struggle is going on. What can be made of these Africans under competent direction, Mr. Stanley himself has shown us in the case of his own people.

Of the various products, mineral, vegetable, and animal, of the country through which Mr. Stanley passed we have many glimpses. The natural wealth of the country is extravagant, and the botanist especially will find much that will interest him, especially as Mr. Stanley has been at the trouble of frequently giving the scientific names of the plants which he mentions.

There is ample furniture of maps in the work, all of them well-executed, though in Mr. Waller's two large maps there are occasional signs of carelessness in the spelling of names, and, very strangely, the memorable Vacovia of Sir Samuel Baker is omitted from the names on the east shore of Albert Nyanza. Beside the two large maps of East and West Equatorial Africa, by Mr. Waller, there are also an interesting series of five maps by the same hand, showing the progress of discovery in Equatorial Africa. There is, first, a portion of Dapper's map of 1676, very similar to that of 1701, which we gave last week, showing two great central lakes, from the most westerly of which, Zaire lacus, issue both the Nile and Congo. The next one shows our knowledge between 1849-56, with all the features of Dapper's maps swept away, and the first rude indication of Tanganika given. Then, between 1856-63, we have the work of Livingstone, Burton, Speke, Grant, enabling us to more correctly define Tanganika, locate Victoria Nyanza, and shadow out Albert Nyanza. The next stage, 1866-75, shows a great advance. By the labours of Schweinfurth, Baker, Livingstone, Stanley (first journey), and Cameron, the main features, from 10° N. to 15° S., east of 25° E. long. —rivers, lakes, and mountains—are filled in more or less accurately. Last of all come the results of the journey described in these two volumes, and which we have endeavoured to summarise in this notice. There is also a chart of the Lukuga creek, and two beautiful large-scale charts, by Stanford, of the Livingstone or lower falls (thirty-two in number), and of the upper or Stanley falls. Mr. Cooper has, as usual, done his part well in reproducing the numerous and varied illustrations; and altogether the get-up is thoroughly creditable to the publisher.

In conclusion, let us repeat that Mr. Stanley has done a great work, and told us all about it in a great book.

OUR ASTRONOMICAL COLUMN

THE TRANSIT OF MERCURY, 1868, NOVEMBER 4.—The second internal contact at this transit was well observed in many European observatories, though at others the bad definition and tremulousness of the sun's limb vitiated the results. If we calculate strictly from Leverrier's tables of sun and planet, with Prof. Newcomb's value of the mean solar parallax, 8″·848, we shall have the following formula for reduction of the observed Greenwich mean time at any place to the centre of the earth:—

$$t = 20h.\ 59m.\ 51{\cdot}9s. + [1{\cdot}4056]\, r \sin l - [1{\cdot}7832]\, r \cos l, \cos(L + 55^\circ\ 51'{\cdot}5),$$

where l is the geocentric latitude, r the radius of earth at the place, and L the east longitude from Greenwich.

A comparison with observations shows differences as below:—

Place of Observation.	Observed G.M.T. reduced to earth's centre. h. m. s.	Error of the Calculation. s.	
Bonn	21 0 3·4	− 11·5	Three observers: extremes differ, 13·5s.
Christiania	— 6·3	− 14·4	Four observers
Durham	— 12·2	− 20·3	
Greenwich	— 6·9	− 15·0	Six observers.
Leyton	— 12·6	− 20·7	
Lund	— 14·4	− 22·5	
Madrid	— 13·8	− 21·9	Merino. Rupture of ring.
Marseilles	20 59 57·6	− 5·7	Leverrier.
,,	21 0 12·6	− 20·7	Stephan.
Paris	— 7·6	− 15·7	Mean of André, Villarceau, and Wolff.
,,	20 59 57·0	− 5·1	Rayet.
Rome	21 0 10·4	− 18·5	Secchi and Mancini.
Vienna	20 59 55·5	− 3·6	Oppolzer.

At the Royal Observatory, Cape of Good Hope, where the transit was very completely observed, the sun's limb is stated to have been tremulous at the second internal contact, which probably accounts for the larger difference, −32·2s., between calculation and observation.

BRORSEN'S COMET OF SHORT PERIOD.—When the elements of this comet, at its first appearance in 1846, had been satisfactorily determined, it was pointed out by Mr. Hind, in a communication to the Royal Astronomical Society, that the comet must have made a very close approach to the planet Jupiter about May 20, 1842, and that probably to this near approximation the form of the orbit in 1846 might be attributed. The late Prof. D'Arrest examined this question more closely in the year 1857, and by the formulæ of the *Mécanique Céleste*, which had been already applied in the case of Lexell's comet of 1770, he ascertained that a great change of elements was then caused by the action of Jupiter, assuming the mean motion given by the observations of 1846 to be affected with no material error, as we now know to have been the case. He found that the greatest proximity occurred May 20·69, Berlin time, when the distance of the comet from Jupiter was only 0·0511 of the earth's mean distance from the sun, and that previous to April 19, 1842, the elements of the comet's orbit were as follows. The elements of 1846 are added for comparison:—

	Elements before the great perturbation.	Elements in 1846.
	° ′	° ′
Mean longitude, 1842, April 19·5 ...	237 16	—
Longitude of perihelion	133 27	116 28
,, ascending node ...	107 44	102 40
Inclination to ecliptic	40 51	30 57
Eccentricity	0·59275	0·79386
Semi-axis major	3·68645	3·15352

These figures prior to 1842 are necessarily only a first approximation to the orbit then described, but they sufficiently explain the circumstance of the comet not having been observed before that year, since the perihelion distance was then greater than 1·5, and as Prof. D'Arrest remarked, under this condition Brorsen's comet would hardly be observable.

According to Dr. Schulz's elements for 1873, when the comet was last visible, the nearest approach of its orbit to that of Jupiter now takes place in 283° 30′, when the distance is 0·124, and thirteen revolutions of the comet are almost exactly equal to six revolutions of Jupiter. D'Arrest, from a rough calculation, considered that the orbit might again undergo great or complete change from the action of this planet in the year 1937. The only other planet which the comet can approach with its actual elements is Venus, which, near the ascending node, may be within 0·11.

MIRA CETI.—According to Schönfeld's calculation the next *minimum* of this variable will occur on June 23. and the next *maximum* on October 11. There are comparatively few observations of the former phase and more attention to it is desirable. At present it is assumed that the perturbations of the maximum deduced from Argelander's formula, apply also to the nearest minimum. In this case the sum of the perturbations is +29·9 days.

GEOGRAPHICAL NOTES

WE last week referred to the important work done by Sir Andrew Scott Waugh in connection with the Great Trigonometrical Survey of India, and from the recently issued Report of Colonel Walker, the present Superintendent of the Survey, it will be seen that the work is being carried on with unabated energy. The Report refers to 1876-77, and tells us that during that year an area of 5,019 square miles was covered by principal triangulation; under secondary triangulation 5,400 square miles have been covered with points for the topographical survey, 3,100 miles have been operated in *pari passu* with the principal triangulation, and in an area of 23,600 square miles, lying mostly in portions of the Himalayas which are inaccessible to Europeans, a number of points have been fixed which will be valuable for geographical rectifications. The topography of upwards of 5,000 square miles has been completed in scales varying from half an inch to two inches, while several important geodetic operations were accomplished. In these Reports there is generally some important geographical work to record, accomplished by one of the native officials of the Survey. During the year 1876, the Mullah, one of the Survey explorers, made a survey up the course of the Indus from the point where it enters the plains above Attok, to the point where it is joined by the river of Gilghit. This is the only portion of the Indus which had remained unexplored. Here the river traverses a distance of some 220 miles, descending from a height of about 5,000 feet to that of 1,200 feet above sea-level. Its way winds tortuously through great mountain ranges, whose peaks are rarely less than 15,000 feet in height, and culminate in the Nanga Parbat, the well-known mountain, whose height, 26,620 feet, is only exceeded by a very few of the great peaks of the Himalayas. The river in many places is hemmed in so closely by these great ranges that its valley is but a deep-cut, narrow gorge, and, as a rule, there is more of open space and culturable land in the lateral valleys, nestling between the spurs of the surrounding ranges, than in the principal valley itself. No European has ever penetrated this region, and the Mullah only managed it by travelling as a privileged trader. Very difficult of access from all quarters, it is inhabited by a number of hill tribes, independent and suspicious of each other, and protected from each other by natural barriers and fastnesses. Each community elects its own rulers, and has little intercourse with its neighbours, and with the outer world only by means of privileged traders.

THE captain of a German steamer, just arrived at Hongkong, reports a singular condition of things in the island of New Britain, in the South Seas. He found the whole of the north-east coast enveloped in dense smoke, and he experienced great difficulty in proceeding up the channel between it and New Ireland, as fields of pumice-stone, several feet in thickness, covered the surface of the water. On February 9 he reached Makada, Duke of York group, and found that three craters had broken out in the New Britain peninsula, at the foot of the so-called Mother and Daughters Mountains, from which dense masses of pumice-stone were continually being thrown up. The passage between Duke of York Island and Blanche Bay had been completely closed by a compact field of pumice-stone, about five feet in thickness, according to the statement of the captain to a Hongkong paper. A tidal wave swept over Blanche Bay on February 10, and soon afterwards a new island appeared, about three-quarters of a mile in diameter. This island is situated to the south of Natopi, or Henderson Island, and where it now is no bottom was previously obtained at seventeen fathoms. It is probable that other alterations have taken place which could not be observed at the time, owing to the masses of floating pumice-stone. The captain of the vessel mentioned further states that the water in Blanche Bay was scalding hot for two days, and that immense quantities of boiled fish and turtle were thrown on shore, and eagerly devoured by the natives, who were starving in consequence of the unusual dryness of the season.

THE party which left England last month for Egypt on their way to reinforce the Church Missionary Society's expedition to the Victoria Nyanza, will proceed by steamer to Suakim, the port of Southern Egypt, accompanied probably by a dragoman engaged by the British Consulate at Cairo. At Suakim it is proposed that they shall engage camels to transport them across the desert to Berber, on the Nile, whence they will travel by steamer to Khartum. From that point they will journey under Col. Gordon's protection, and will, doubtless, have no difficulty in reaching Gondokoro. Thence it is arranged that they shall proceed by the Egyptian military outposts to the frontiers of Uganda, in which country Col. Gordon now has an agent, whose presence will no doubt insure safety to Europeans.

A LETTER from the French Ogowé Expedition was read at the last meeting of the Geographical Society of Paris. It is quite a year since it was written, and some apprehensions have been entertained as to the safety of the explorers. M. de Brazza states that the Ogowé is reduced to small proportions and flows from the south, so that it gives the impression of being really an arm detached from the Congo. The expedition was to travel northwards in order to examine the sources of a powerful affluent. Illness was prevailing amongst the small party, and the hostility of the native tribes was growing stronger.

THE forthcoming congress of the Geographical Society of Paris will not be international, but national, although it will be open to foreigners. The principal aim of the congress will be to organise a federation, between the Paris Society and similar institutions which its influence has started in large provincial cities during the past five years—viz., Lyons, Bordeaux, Marseilles, and Montpelier, where a society for the whole of Languedoc was recently established.

A REUTER'S telegram states that the schooner *Eothen* will probably sail from New York on Monday next for the Arctic regions to search for relics of the Franklin expedition. No doubt the purpose of this expedition is to obtain the relics reported to be in the possession of some of the mainland Eskimo.

A MEETING of the subscribers to the African Exploration Fund of the Royal Geographical Society will be held in the theatre of London University at 3 P.M. on Friday, June 14. Sir Rutherford Alcock, K.C.B., Chairman of the Committee, will preside.

ON A NEW METHOD FOR DISCOVERING AND MEASURING ÆOLOTROPY OF ELECTRIC RESISTANCE PRODUCED BY ÆOLOTROPIC STRESS IN A SOLID[1]

TORSION of a metal tube within its limits of elasticity produces æolotropic stress, of which the mutually perpendicular lines of maximum extension and maximum

[1] Abstract of a Paper read by Sir W. Thomson at the Physical Society, May 25.

contraction are spirals, each very nearly at 45° to the length of the tube.

From the author's early experiments (described in his paper on Electrodynamic Qualities of Metals, published in the Transactions of the Royal Society for 1856), showing a diminution of electric conductivity by pulling force in metallic wires, and Mr. Tomlinson's recent confirmations and extensions of those results, it is to be expected that the conductivity of the substance will be less in the direction of extension and greater in the direction of contraction in the stressed substance than the conductivity (equal in all directions) of the substance when free from stress. Hence, if an electric current be maintained along a tube, torsion would cause it to flow in spiral stream-lines, with spirality of opposite name to that of the twist. The whole flow may be resolved into two components: one right along the tube, the other round it. The latter would (like the current through a galvanometer-coil) deflect a needle hung in the interior of the tube with its axis perpendicular to the tube when undisturbed. Or it would magnetise a bar or wire of soft iron placed within the tube. The current itself would (except near the end of the tube) produce no external effect directly; but either of those appliances may be used to give an external indication.

Since the last meeting of the Physical Society, when the author raised this question of the spiral electric stream lines in a twisted tube, experiments have been made for him by Mr. Macfarlane in the physical laboratory of the University of Glasgow, on the last-mentioned plan; and on the former plan by Mr. J. T. Bottomley in the physical laboratory of King's College, London, by kind permission of Prof. Adams, and with the valuable assistance of his staff. Mr. Macfarlane, using a small mirror magnetometer suspended externally in the neighbourhood of one end of an iron wire placed within a brass tube, found that when the twist of the substance was right-handed the end of the wire next that end of the tube by which the current enters becomes a true north pole. Mr. Bottomley, with the cell and suspended mirror and needle of an ordinary dead-beat mirror galvanometer supported by an independent support within a brass tube along which a current is maintained, found that the true north pole of the needle is moved towards the end of the tube by which the current enters. Thus both Mr. Macfarlane's and Mr. Bottomley's observations confirm the anticipation that the electric conductivity is least in the direction of greatest extension, and greatest in the direction of greatest contraction of the metal. The apparatus by which Mr. Bottomley had made his experiment was exhibited to the meeting. It included a mode of balancing the effect on the internal needle by placing a circular portion of the main circuit at a proper distance from it, the centre and plane of the circle being in and perpendicular to the axis of the tube. From a measurement of the distance from the centre of the circle to the needle, when the balance is obtained, the ratio of the maximum to the minimum conductivity can be calculated.

NOTES

We publish a remarkable paper this week, by Mr. J. Blyth, on a new form of the microphone, which needs neither battery nor telephone. The curious importance of Mr. Blyth's invention need not be insisted on. By backing-up the pictures in a drawing-room it might, as has been suggested by a learned professor, be converted into an Ear of Donysius, and Horace's words, "suppositos cineri doloso," would come to have an awful meaning.

At the Royal Society on Thursday last, all those proposed as new Fellows, and whose names we have already published, were unanimously elected.

Prof. Simon Newcomb has published as a Supplement to the "American Ephemeris and Nautical Almanac," a few instructions for the observation of the total eclipse of the sun on July 29. The instructions refer to the limits of path of the shadow, instruments, arrangements for observation, the actual observation, search for intra-mercurial planets, drawings of the corona, &c. Prof. Newcomb's paper is accompanied by a series of photolithographic maps of the part of the United States concerned. They include a region extended about 150 miles on each side of the limits of totality. These maps contain certain special features which will render them very useful to observers. For example, on the right-hand side of the track is found, at convenient intervals, the Washington mean time at which the centre of the total phase reaches the several points, where the times are marked. From each of these points a dotted line extends across the path of totality; this line is the projection of a diameter of the shadow at the time indicated, so that the middle of the total phase occurs at this time all along the dotted line. These, and other features, render these maps of special utility.

A letter has been received in London by Dr. George Bennett, of Sydney, from Signor L. M. D'Albertis, the New Guinea traveller, dated from Sydney, New South Wales, April 14, 1878, in which he says, "I have taken my passage in the *Garonne*, which leaves direct for London on the 1st of May next, and expect to arrive in London about June 15, when I hope to see you. It is my intention to bring all my ethnological and other collections of natural history with me."

A laboratory for the study of marine zoology, in connection with the biological department of the Johns Hopkins University, will be organised this summer at Fort Wool, about a mile from Old Point Comfort, Va. The fort contains commodious buildings for laboratories and dormitories. The necessary apparatus for collecting and studying marine animals, nets, dredges, microscopes, reagents, aquaria, tables, &c., as well as a small scientific library, will be provided by the University. Through the kindness of the Maryland Commissioner of Fish and Fisheries, the boats used by the Commission will be at the service of the laboratory. The laboratory is organised mainly with a view to the wants of advanced scientific investigators, and there will be no formal courses of lectures. There will, however, be accommodation for a few less advanced students, and suitable instruction will be furnished to meet their individual needs.

Botanists will be gratified to learn that the publication by Prof. Asa Gray of his great work upon the "Flora of North America" has been commenced, and will be continued as rapidly as practicable. Many years ago a work with the same title was started by Drs. Torrey and Gray and carried through the Compositæ, where it stopped. The vast extension of the field of American botany, consequent upon the discoveries in California, Oregon, and other regions west of the Mississippi, has made the want of a manual extremely imperative, and this will be furnished by the work referred to. For the purpose of better satisfying the wants of students the work begins with the Gamopetalæ immediately following the Compositæ, and the ground covered by the original "Flora" will be taken up after the other orders are completed. The entire work will consist of two volumes of about 1,200 pages each, the first part, now issued, embracing about 400 pages. The book is to be had from the curator of the Harvard Herbarium at Cambridge.

The Japanese Government, which is making such rapid strides towards modern civilisation, has just awakened to the necessity of preserving its forests, and stringent regulations have been passed, which shall not only hinder the too rapid destruction of the forests, but increase the area covered by woodlands.

A VERY interesting paper was recently read before the Asiatic Society of Japan, by a native of that empire, in which the records of the earthquakes in that insular region for the past fifteen centuries were carefully compiled and classified. It appears that since the year 406 A.D. the authorities of Yeddo and other large cities have preserved, almost without interruption to the present time, descriptions of all earthquakes occurring, with their accompanying phenomena. As a rule it has been observed that the great shocks were preceded by a rise of temperature and violent atmospheric perturbations. The general average of great earthquakes has been ten in the century. The average of the present century is, however, double that number, and in the ninth century there were no less than twenty-eight destructive earthquakes. The list referred to describes a total of 150 great earthquakes during the past fifteen centuries, and a host of minor shocks. It is certainly one of the most novel and valuable contributions to this department of meteorology, and it is to be hoped that it will appear in a form and language available for European *savants*.

THE Japanese Government are evidently also losing no time in extending their system of telegraphic communication, for we learn from a Japan contemporary that there are now 125 telegraph stations in the country, and it is estimated that there are 5,000 miles of wire in operation; 1,000 miles more are in course of construction, and still further extensions are contemplated. Considering that the first telegraph line for practical purposes was not erected in Japan before the end of 1869, the result achieved is by no means unsatisfactory.

WE have before us three small publications, which indicate the activity of scientific research, especially botanical, in the United States. 1. *The Botanical Directory of America for* 1878 shows an array of names which would compare favourably with the number that could be included in such a list in the old country. Even those who are aware how much good work has been done by American women in several branches of science would hardly be prepared to find so large a proportion of ladies as are to be seen in the present list. 2. *Jahresbericht des naturhistorischen Vereins von Wisconsin für das Jahr* 1877-78, is a record of the year's work of the Natural History Society for the remote State of Wisconsin, so largely settled by Germans. Though some of the papers are in English—including an interesting one by Dr. E. N. Bartlett on *Aspergillus*, detected by him as a parasite in the ear, causing partial deafness—the official language of the Society appears to be German. 3. "A Catalogue of the Flowering Plants and Higher Cryptogams growing within thirty miles of Yale College," published by the Berzelius Society, appears to be carefully executed. The total number of indigenous species is—1,037 flowering plants, 52 vascular cryptogams, and 221 Muscniæ, besides 196 introduced flowering plants. It is accompanied by a map.

"VIS MEDICATRIX NATURÆ." In the light of this venerable saw we do not think it inappropriate in these pages to support an appeal which Dr. Dawson W. Turner asks us to make on behalf of the thousands of patients in the hospitals in and around London. The true healing art is based on rigid scientific research, and one of the most effectual methods of assisting the physician's efforts is to keep the patient in a cheerful mood and divest his thoughts from himself and his afflictions. A potent means to this end is cheerful reading, and we are sure that in this direction many of our readers will be able to assist Dr. Turner in his beneficent mission. Mr. Turner finds that of this class of books none are so acceptable to the sick and suffering, who *can* read, as the cheap one-volume editions of the best of our standard novelists—Scott, Dickens, and Marryat, especially, and then Trollope, Miss Sewell, Mrs. Gatty, and a host of others. Dr. Turner rightly makes a point of excluding everything that is the least "sensational." The lighter sort of serials are also acceptable, such as *Good Words*, *Aunt Judy's Magazine*, *Leisure Hour*, and so forth, as well as picture- and scrap-books, especially if the leaves are pasted on linen. We would add that we are sure many of the patients would welcome some of our more popularly written illustrated scientific works, which tell of greater wonders than ever novelist imagined, and the reading of which, besides amusing the patients, would leave a solid residue of knowledge behind. Dr. Turner's address is 13, Salisbury Street, Strand, W.C.

IN the forthcoming *fête* to be given by the City of Paris, no less than 200 electric candles will be kept burning during the whole of the night in several parts of the city, besides the regular display, which has been increased since our last note.

SOME of our readers may remember that Leverrier proposed to the French government to extend weather-warnings not only to agriculturists but also to the men who risk their lives in collieries. The mournful accident which has occurred near Wigan recently adds force to Leverrier's proposal, and surely, on the chance of its preventing such accidents, the plan might be tried.

IN Lisbon and its vicinity there was a violent shock of earthquake, accompanied by a storm of wind, at eleven o'clock on Saturday night, the duration about six seconds, and the direction east to west. Much alarm was caused.

THE Société Française d'Hygiène Publique, has appointed a Commission for utilising the Giffard Captive Balloon in the study of questions connected with hygiene, such as the influence of rapid decrease of pressure on vital functions, the causes of vertigo, &c. A preliminary programme has been published already.

THE Congress of Hygiene appointed by the French Ministry for the occasion of the Exhibition, will take place at the Trocadero Palace in the month of August. A number of excursions of special interest will be organised on the occasion. The initiative committee meets every week on Wednesday at the Pavillon de Flore (Palais des Tuileries), in the room where the late Congress of Geography was recently held.

PROF. PELIGOT of Paris discusses, in a recent number of the *Ann. de Ch. et Phy.*, the composition of ancient glass, combining his own analysis with a careful study of all passages on the subject in ancient authors. The specimens which he examined all contained mixtures of soda and potash, with but minimal quantities of lime—one-third to one-half of the amount used at present. Prof. Peligot comes to the conclusion that flint-glass was entirely unknown in ancient times.

FROM the recent report of the secretary of the Société Chimique de Paris, we notice that its membership is at present 383, consisting of 140 members dwelling in Paris, and 243 non-resident. The yearly receipts amount to over 15,000 francs, of which a third is saved for investment. The Society possesses now a capital of 44,000 francs. Its bi-monthly *Bulletin* forms a yearly volume of 1,200 pages, and has a circulation of over 400 outside of the Society.

WE recently drew attention to Winkler's remarkable lunar landscape, now being exhibited in London. Something even more extensive, if not, perhaps, quite so artistic, is to be attempted by an American artist, if he can procure a sufficient number of subscribers. Mr. Henry Harrison, of Jersey City, has already painted a picture of the moon three and a half days old, and although we have not seen it ourselves, it is so highly spoken of by Dr. H. Draper and Mr. Rutherfurd, that we do not hesitate calling our readers' attention to the artist's proposed publication. The picture represents the moon with the terminator at Mount Glacier, showing the earthshine on the surface in shadow in which some of the most prominent features, *i.e.*, the craters Copernicus and Tycho, the Appennine Mountains, and nearly all the "meres" are visible. Having submitted the work, Mr. Harrison tells us, to gentlemen of scientific repute, and being encouraged by their favourable criticisms, he has concluded, if a sufficient number of subscriptions can be obtained, to publish a work under the title of "Telescopic pictures of the Moon," in oil colour chromos (the only medium for facsimile reproduction of paintings) 2 feet in size, with an image of 18 inches in diameter, in six progressive pictures of the following phases:—1. Three days old crescent, terminator at Mount Glacier. 2. Five days old, terminator at the crater Katharina. 3. Seven days old, or first quarter. 4. Nine days old, sunrise at the crater Copernicus. 5. Full moon; and 6. Last quarter. An outline drawing with letter-press description, bearing the names and sizes of all objects, will accompany the work, which will be completed in about a year from the time the first phase has been issued, and will be furnished to subscribers complete for 30 dols., or 5 dols. for each plate. The description will appear gratuitously with the last issue. Subscribers should send full name and address to Henry Harrison, P.O. Box, 179, Jersey City, New Jersey.

A VERY successful experiment has been made at Lockport, New York State, in supplying heat to houses by steam supplied from a central station, in much the same way as gas is supplied. The experimental works in Lockport were commenced last year, and during the late winter about 200 houses in the city were heated from the central supply, through about three miles of piping, radiating from the boiler-house, containing two boilers 16 feet by 5 feet, and one boiler 8 feet by 8 feet. These boilers were, during the winter, fired to a pressure of 35 lb. to the inch, with a consumption of 4 tons of anthracite, costing 4½ dols. a ton during the summer, but one boiler is fired consuming a ton and a half of anthracite in twenty-four hours, and a pressure of 25 lb. per inch maintained. The boiler pressure of 35 lb. in winter, and 25 lb. in summer, is maintained through the entire length of the three miles of piping up to the points of consumption, where there is a cut-off under the control of the consumers. The distribution of heat in the apartments is by means of radiators, consisting of 1 inch pipes 30 inches long, placed vertically either in a circle or as a double row, and connected together, top and bottom, with an outlet pipe for the condensed water, which escapes at a temperature a little below boiling, and is sufficient for all the domestic purposes of the house, or is used as accessory heating power for horticultural and other purposes. The steam has also been applied at a distance of over half a mile from the boilers for motive power, and two steam-engines of ten and fourteen horse-power are worked from the boilers at a distance of half a mile, with but a slightly increased consumption of fuel. The laid on steam is being also used for cooking purposes, for boiling, and even baking, and Mr. G. Maur, F.G.S., who describes the system, witnessed in a house three quarters of a mile from the boilers, a bucket of cold water raised to boiler heat in three minutes by the passage of the steam through a perforated nozzle plunged in the bucket. The operations of the Heating Company have been up to the present time of an experimental character, and from the 200 houses already supplied with the heating connection, the actual cost of the coal that would have been used for heating has been provisionally received in payment, and the amount has left a wide margin over the working expenses, though the company's operations at present cover but a small portion of the area for which they have provided plant.

THE additions to the Zoological Society's Gardens during the past week include two Mandrills (*Cynocephalus mormon*), an Ocellated Monitor (*Monitor ocellatus*) from West Africa, presented by Mr. G. H. Garrett; two Greater Spotted Woodpeckers (*Picus major*), British Isles, presented by Mr. J. A. Cooper; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. N. Portocalis; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Mr. J. C. Witte; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mr. W. W. Spicer; two Indree Owls (*Syrnium indranee*) from Ceylon, deposited; two Common Seals (*Phoca vitulina*) from British seas, a White-fronted Amazon (*Chrysotis leucocephala*) from Cuba, two Oyster Catchers (*Hæmatopus ostralegus*), British Isles, purchased; two Horned Tragopans (*Ceriornis satyra*), an Impeyan Pheasant (*Lophophorus impeyanus*), bred in the Gardens.

THE ROYAL OBSERVATORY

THE annual visitation of the Royal Observatory took place on Saturday week, when the Astronomer-Royal read his Report, which refers to the year ending May 2:

The Report on the buildings and grounds, movable property, manuscripts, library, astronomical instruments, &c., is, as usual, satisfactory. The new railway through the town of Greenwich has apparently had no effect at the observatory.

The usual varied astronomical observations have been carried on with the usual diligence, the advantageous observation of the small planets being, however, limited by the want of ephemerides.

To facilitate the observations of stars, a new working catalogue has been prepared, in which are included all stars down to the third magnitude, stars down to the fifth magnitude which have not been observed in the last two catalogues, and a list of 258 stars of about the sixth magnitude of which the places are required for the United States Coast Survey. The whole number of stars in the new working list is about 2,500. An extensive series of observations was made, during the autumn, of about seventy stars, at the request of Mr. Gill, for comparison with Mars, Ariadne, and Melpomene.

Among the observations made we may mention 3,970 transits, the separate limbs being counted as separate observations, and 3,824 circle observations, each requiring a separate reading of the six microscope micrometers. Twenty-nine sketches of Mars were obtained with the great equatorial near his opposition, forming a complete record of the appearances of that planet during the entire rotation. Preparations were made for observing the Transit of Mercury on May 6, but owing to the unfavourable state of the weather no result of importance was obtained. A great amount of work has been done in the reaction of astronononomical observations.

The computations for the "Nine-Year Catalogue" of 2,263 stars, including some supplementary investigations, were completed in the course of 1877, and the introduction has been prepared and sent to the printer. The catalogue is drawn up in the same form as previous catalogues, the only noteworthy alterations being the addition of another decimal place to the R.A.'s and annual precessions in R.A., which are carried to 0s·001 and 0s·0001 respectively. The right ascensions are thus made to correspond more nearly with the north polar distances as regards the degree of accuracy exhibited.

During the past year the sun's chromosphere has been examined with the spectroscope on seventy-nine days (on two of these through part of the circumference only); prominences were seen on fifty-eight days. All the observations, however, tend to show that the solar prominences have been few in number and insignificant in size for many months.

All observations with the spectroscope have been completely reduced; the position-angles of prominences being converted into heliographic N.P.D.; and the displacements of lines in the spectra of stars being reduced so as to exhibit the concluded motion in miles per second, after applying a correction for the earth's motion.

The areas, position-angles, and distances from the sun's centre, of sun-spots and faculæ, have been measured to the end of 1877, and in duplicate July 5, 1877.

The correction of the position-angles and distances for the effects of refraction and distortion, and their conversion into heliographic longitude and latitude, have been pushed forward as rapidly as circumstances would admit after the measurements had been completed. As there is a considerable accumulation of arrears since 1873, which will require many months for their reduction, it has seemed desirable to commence with the year 1876, with the view of including in the volume for 1876 the complete deductions from the measures of sun-spots and faculæ in that year, if they can be prepared for press in time, leaving the complete results for the years 1873 to 1875 to be included in the next volume; the areas, as distinct from positions, having been already printed in the volumes for 1874 and 1875.

The usual magnetical and meteorological observations have been carried on, and considerable progress made with their reduction.

The following are the principal results for magnetic elements in the year 1877:—

Approximate mean westerly declination 18° 57′.

Mean horizontal force . .	3·901 (in English units). 1·799 (in metric units).
Mean dip	67 38 46 (by 9-inch needles). 67 39 54 (by 6-inch needles). 67 40 40 (by 3-inch needles).

Under the head of Extraneous Work, information is given as to the reduction of the Transit of Venus observations.

At the date of the last Report the determination of the longitudes of the British stations was not quite complete (that of Kerguelen being then imperfect). But, under a demand from the House of Commons, a strong effort was made to finish all introductory calculations, and to effect computations of solar parallax by comparing all eye-observations of ingress of Venus among themselves, and all eye-observations of egress of Venus among themselves. The different stages of phenomena at the ingress were discriminated by Capt. Tupman with great care, and Sir George Airy believes with great general success, although Capt. Tupman himself has been induced lately to modify his interpretation of the observers' language in one or two instances. Finally, a report was made to the Government on July 5, giving as the mean result for mean solar parallax 8″·76, the results from ingress and from egress, however, differing to the extent of 0″·11. A more complete calculation by the Astronomer-Royal, including in one series the observations both at ingress and at egress, and recognising the possible errors of R.A. and N.P.D., gave sensibly the same mean result for parallax. This is liable to no error except from the interpretation of observers' language. All has subsequently been re-examined by Capt. Tupman; different interpretations have, in a few instances, been put on the records; several observations from colonial stations have been combined; instead of using different phases in the observations (both of ingress and of egress), attempts have been made to ascertain the one phase of "contact of limbs;" the notes of a few unpractised observers have been rejected, and the result for parallax has been increased to 8″·82 or 8″·83.

The numerous photographs taken at the various stations had been carefully measured by Mr. Burton, and have since been re-measured by Capt. Tupman; and (by photographs of Mr. De la Rue's scale of equal parts) the measure of photographic distortion had been well ascertained. But the results from photography have disappointed Sir George Airy much. The failure has arisen perhaps sometimes from irregularity of limb, or from atmospheric distortion, but more frequently from faintness and from want of clear definition. Many photographs which to the eye appeared good, lost all strength and sharpness when placed under the measuring microscope. It was once remarked to Sir George Airy, "You might as well try to measure the zodiacal light." A final result, 8″·17, the report states, was obtained from Mr. Burton's measures, and 8″·08 from Capt. Tupman's.

The Report next alludes to the progress made in the numerical lunar theory. The developments of the effect of every possible error (expressed as a symbolical variation) in the co-efficients and arguments of the assumed lunar ordinates upon every term in the three fundamental expansions of—(1) Areas in the ecliptic, (2) Radial forces in the ecliptic, (3) Forces normal to the ecliptic—have been computed and printed. The corresponding solar perturbing forces have been computed entirely for the first of these (care being taken to extend the decimal calculation further for those terms whose effect may probably be increased in solution of the equations, a process in which many figures are almost necessarily wasted), and partially for the second and third. Until all have been completed the Astronomer-Royal cannot draw any positive inference from the comparison of these terms with those of the ordinate expansions; but a cursory collation of those relating to the areas led him to suppose that there might be some error in the computations of the annual equation and related terms. A most jealous re-examination has, however, detected nothing, and has confirmed Sir George Airy's belief in the general accuracy of the numerical computations.

Finally, Sir George Airy strongly urges upon the Board the necessity for the erection of a separate room for the library of the Observatory.

COSMICAL RESULTS OF THE MODERN HEAT THEORY

IN the *Sitzungsberichte der Wiener Akademie der Wissenschaften*, Herr J. Loschmidt has published a treatise on the equilibrium of temperature in a system of heavenly bodies with regard to gravitation, from which we note the following highly interesting details:—"Sir W. Thomson and Clausius simultaneously,[1] drew from their researches the surprising conclusion that the whole universe at some definite period, however remote, would infallibly come to an end. First, all ponderous masses in the universe will eventually have united to one enormous heavenly body; and secondly, upon this body all visible motion will have ceased, all forces having changed to mere molecular motion, which in the shape of heat of universally uniform temperature will be spread in this mass. This state of general death will then last eternally." Herr Loschmidt, in the course of his researches, has arrived at widely different conclusions. He begins by adopting the general view that the sun is in a state of slow progression of cooling, and that the time will unavoidably arrive when his surface will have solidified, long after all his planets have fallen in upon him, and after his upper and partly also his lower strata have assumed very nearly the temperature of the surrounding universal space. But granting that thus a period of rest and death will have arrived for our solar system, Herr Loschmidt maintains, at the same time, that this period cannot be of unlimited duration; the state of things just described can, according to his views, not be a state of equilibrium. "The previous liquid state of the sun has caused a continued mixture of the warmer parts near the centre with the colder ones near the surface. Thus, however, the equilibrium of temperature, which requires a certain increase of temperature towards the interior, was rendered impossible. At the moment of solidification of the external layers the deeper ones will be far colder than the theory of the state of equilibrium demands. Because, according to this theory, the surface should have the temperature of universal space (about − 140° C. according to Pouillet), but this temperature should rapidly increase towards the interior, reaching at the centre the enormous figure of 250,000,000° C. And it is just because at the moment of the beginning of solidification of the sun no such distribution of temperature took place in the interior, that the state above referred to cannot be of eternal duration. During an extremely long period, in spite of the low temperature of his surface, the solidifying sun will constantly absorb radiant heat from the store in the universe and will concentrate this heat in his interior. We suppose, for a moment, that it would be physically possible that this process of absorption is carried on to the end without the inclosed and dissociated gases in the interior breaking through the solidified surface or crust on account of their enormous tension. We then calculate the amount of heat accumulated in the end and find that it would easily suffice to raise the entire solar mass to ⅖ths of that temperature which the state of equilibrium demands at the centre, viz., to 100,000,000° C. This figure is raised if the average molecule of the solar mass, instead of being supposed to be of the density of oxygen, is taken to be of the density of carbonate of lime; in that case it would be 125,000,000° C. We may compare these results to the quantity of heat which was produced during the condensation of the solar system from the cosmical nebula, according to the theory of Laplace and Kant. Helmholtz has calculated that the heat thus generated would suffice to raise the solar mass to a temperature of 28,611,000° C., if it is supposed to have the heat capacity of water. If, instead of water, other substances are taken as starting points, this temperature is considerably raised; so in the case of carbonate of lime or silicic acid, the heat capacity of which is 0·2, the resulting temperature would be 140,000,000° C.

"The close correspondence of both amounts speaks in favour of a *periodicity in the history of solar systems*. In the first portion of its cosmical period the dark solidified body absorbs heat

[1] [Clausius *verified* Thomson's statements about dissipation just as he *verified* (after experiment had proved it) J. Thomson's statement of the lowering of the freezing-point of water by pressure. Some Germans still call this "simultaneous discovery." Helmholtz, at least, does not.—ED.]

from universal space, and thus the temperature in its interior is gradually increased to an immeasurable extent. Then the moment arrives when the exterior crust can no longer resist the rising pressure of the inclosed masses, which have, of course, become gaseous. An explosion must result. The greater part of the mass which is converted into gas is dispersed over a great space, and thus by far the greater part of the accumulated heat is converted into gravitation and force of rotation o fthe dispersed masses. Now the second portion of the solar period begins, which, as a process of condensation of cosmical nebulæ and subsequent slow cooling of the bodies formed by this condensation, has been frequently discussed since the days of Laplace."

This is Herr Loschmidt's idea of the typical course of a cosmical period, if fully developed according to the laws of heat. But he thinks that it is highly probable that this full development can be but rarely realised in the case of a solar system, since the duration of the heat-absorption will generally find a premature end in the impossibility of the external crust resisting the enormous pressure of the inclosed gases until the maximum of temperature is arrived at. "Upon our sun, for instance, in a state of equilibrium of temperature, the surface temperature would be – 140° C., while at a depth of half a (German) mile we already would find a temperature of 3,000° C. Here all known substances would be in a state of liquid incandescence. The solid crust could therefore not be thicker than half a (German) mile. In this case, therefore, the typical course described would evidently be interrupted prematurely by an explosion.

"The consequences of a solar eruption of this kind are naturally very different under different conditions. Thus with a comparatively small accumulation of heat and corresponding low tension, the result would be simply the return to incandescence of a dark heavenly body, while with greater concentration of heat some portions may be separated from the principal mass and carried to great distances, where, forming themselves into planets, they would revolve round the principal mass in elliptical orbits. This theory, therefore, easily explains the origin of planets, like those of our system, and the manner in which they were carried to their respective places and are provided with their forces of rotation and revolution, and also how after all in the principal solar mass a quantity of heat would remain, which would cause a far higher temperature upon its surface than exists at present upon our sun. The principal solar mass would thus be again enabled to radiate light and heat to its planets and into the universe, until again the moment of solidification and re-beginning of absorption of heat has arrived. The total result under the most varying circumstances always remains the same: *periodicity of the dynamical solar phenomena*.

"If finally we look for proofs for our theory in the heavens, we direct our attention to dark burnt-out suns on the one hand and to suddenly appearing new suns on the other. It is strange that modern times have given examples of both classes of phenomena. As a representative of the first class we have the dark companion of Sirius, calculated in advance by Bessel from the disturbances, and actually seen by A. Clark and Pond in 1862. This enormous mass has only just been rendered visible by the most powerful instruments, although it is nearly seven times the size of our sun. A second example is the companion of Procyon which, though calculated with certainty, has not yet been seen on account of its still greater darkness. Examples of the other class we have in the well-known new stars of Tycho Brahe and Kepler, besides the new star in Corona of 1866 and the one recently seen by Schmidt and others in Cygnus (December, 1876). In both these latter cases eruptions of incandescent hydrogen were proved beyond doubt by spectral observations."

THE METEOR

A METEOR of unusual brilliance was seen of the "fire-ball" type on Friday night by several correspondents. All agree that the time was about 9.50, the moon at the time being in her second quarter, and about 30° above the horizon in the west-south-west. At Twickenham its observed course was from south-west to north-west passing the azimuth of the moon at the time 69° from south to west, at an altitude of about 14°, its path being nearly parallel to the horizon, or declining very slightly towards its disappearance, which was sudden, at 9h. 52m. 30s. Greenwich mean time. Colour, bright emerald green; apparent diameter, about one-third of that of the moon, this being the greater diameter of the elliptical figure. The light thrown by the meteor in this locality was decidedly green. Mr. Lecky, writing from the Scientific Club, states that the course of the meteor was about 90° below the moon, its motion very slow, and it became extinguished rather suddenly, without any apparent bursting, when it had passed about the same distance to the north of the moon. The meteor appeared to Mr. Lecky to be about the same size as the moon. Mr. L. J. Whalley saw it from the Brompton Road. Facing west he saw it pass from south to north, its path being inclined downwards at a few degrees to the horizon, and its altitude about 30°. The fore-part appeared rounded in shape, and of a bright green colour (like nickel sulphate), whilst the tail tapered off, and was of a red to a purplish tint.

Mr. Walter Fowler saw it from Cambridge. Its path, he states, was from south to north, almost parallel with the horizon, with a slight declination northwards. During its course, which lasted about twenty seconds, it emitted innumerable sparks variegated in colour.

Another correspondent saw it from London Street, Greenwich. Its apparent altitude, he states, was about 28° or 30° above the western horizon, and it passed horizontally over the tops of the houses in a direction about two points to the west of north. He observed it for about three seconds. It appeared in passing under the moon to be about 6° or 8° underneath her lower limb, and about the same degree of brightness and equal to it in size. The meteor, he states, had a tail about equal to six or seven diameters of its nucleus; the central part of the tail and the nucleus were of a pale orange hue and fringed with violet rays. The tail was in the line of motion, and was not a perfect cone, but appeared to expand into a fin-like form at the extremity.

Mr. F. J. Richardson, of Dimchurch, near Rugby, observed the meteor, "of considerable size," cross the sky, apparently about 30° above the horizon. The direction of its path was from south to west, and its colour appeared a mixture of orange and green. It remained visible for about thirty or forty seconds, and then suddenly disappeared.

Mr. R. Langdon, writing from Silverton Station, Devon, states that it moved slowly towards Ursa Major, and exploded a little beyond that constellation. Its colours were, first, very pale blue (nearly white), then deep blue, and finally, the several fragments after explosion were blood-red. Dr. Morison saw it from Jersey. When first seen it was about 30° from the zenith in a direction nearly due north. The diameter of its disc, which was apparently circular, was rather more than half that of the full moon, which it far surpassed in brilliancy, shining with a beautiful white light. The meteor descended towards the horizon, leaving a very faint luminous trail behind it, and was lost to sight, while still remaining entire, behind a high wall. It was altogether visible about thirty seconds.

Our Paris correspondent writes that a splendid meteor was seen in the department of Aisne and at Versailles about ten o'clock in the evening, travelling westwards at a small altitude. It was in diameter about one-sixth that of the moon, the brilliancy admirable, and the tail four or five times the length of the moon's diameter. No noise was heard.

Mr. Denning, of Bristol, writing to the *Times*, states that the meteor had a very long path, almost horizontal, from east to west, which it traversed with a gradual motion, casting off a short train of sparks as it sailed along, and showing sensible variations in the brilliancy of its pear-shaped nucleus. The position of the observed part of its path was noted from 1° above the star Spica Virginis to 6° above the moon, but to include the whole extent of its visible course the line must be extended in each direction, and have a length of at least 75° from, say, slightly below Alpha Libræ to slightly above Alpha Leonis, running almost parallel with the ecliptic. The meteor was considerably brighter than Venus, and perhaps equal to a body one-fourth of the moon's diameter. Mr. H. Middleton Rogers states that while walking along a footpath close to Knole Park, he saw it passing apparently from south to north, very nearly parallel to the horizon, with a very slight declination towards the north. When he first saw it it was about 5° from the moon, (taking the moon's diameter roughly at half a degree.) It passed slowly along about 3° below the moon, or about 30° above the horizon, and continued its course for about 20° further towards the north, when it suddenly disappeared. The light was of a very pale green, as nearly as possible like the light of a glow-worm highly intensified. As it passed under the moon its brilliancy caused the moon to look of a muddy yellow colour—

like a street lamp in a November fog. A *Times* correspondent at Cheltenham says that the path of the body was almost due east and west, and the apparent time of flight about 20". The meteor was also observed at Southampton, Tunbridge Wells, and Beckenham.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

The Sedgwick Memorial Committee (Cambridge) have passed the following resolution, which has been sent to the Vice-Chancellor:—"That a communication be made on behalf of the Committee to the University to the effect that a sum of about 12,000*l*. is now at their disposal for a memorial to the late Prof. Sedgwick, and that the Committee are prepared to apply this money towards the erection of a new geological museum when a plan satisfactory to the Committee has been approved by the Senate."

On the nomination of Prof. Miller, Mr. W. J. Lewis, M.A., Fellow of Oriel College, Oxford, has been approved as Deputy Professor of Mineralogy for twelve months, from October 1, 1878, Prof. Miller assigning to Mr. Lewis two-thirds of his stipend.

Mr. J. A. Ewing, B.Sc., F.R.S.E., has been appointed Professor of Mechanical Engineering in the University of Tokio, Japan.

SCIENTIFIC SERIALS

Bulletin de l'Académie Royal de Belgique, No. 1, 1878.—In researches on Daltonism, here described, MM. Delbœuf and Spring used a solution of fuchsine between two convergent plates of glass (the red is wanting in M. Delbœuf's sight). Thus a suitable thickness of red could be readily selected, and it was found that colours previously confounded showed notable differences. A solution of chloride of nickel interposed between objects and the eye produces in non-Daltonians the same confusion as that of Daltonians. Fuchsine opposes and destroys the effect of chloride of nickel: so that the non-Daltonian in whom the latter produces confusions ceases to have these when he looks also through the fuchsine. Daltonism is regarded as merely an exceptional exaggeration of a peculiarity found in all eyes to a certain degree.—M. Terby furnishes fifteen figures of Mars as observed during the opposition of 1877.—The physiol ogical action of *Gelsemine*, on respiration, circulation, and temperature, is described by MM. Putzey and Romiée.—M. de Koninck announced that his son found, in the Ardennes, the very rare mineral carpholite, hitherto only met with in the Harz and Bohemia.

No. 2.—From experiments with regard to the fertilising action of the grey chalk of Ciply, in Belgium (which contains 11·50 per cent. of phosphoric acid), M. Petermann concludes that bicalcic phosphate, called precipitated phosphate, and the phosphates of iron and alumina, have the same agricultural value as the phosphoric acid of soluble phosphates, that is, their phosphoric acid may be immediately assimilated by plants. He therefore advises the disuse of the Cipley Chalk, and he considers it can only be utilised in agriculture after its transformation into precipitated phosphate. (M. Stas thinks this conclusion too absolute.)—M. Quetelet reviews observations of the movements of the magnetic needle at Brussels from 1828-76. The magnetic line diverges very little from a central axis, with which it makes an angle of about 5°. It turns round this axis in a direction opposite to that of the earth's diurnal motion; the angle described annually is about 42'·2, and the complete revolution would appear to be effected in 512 years. The secondary movements and accidental displacements do not sensibly affect the principal secular movement.—M. Donny recalls experiments he made, in 1843, with Prof. Mareska, on liquefaction of gases. They often compressed air (with a hydraulic pump) in the capillary part of a manometer to more than 500 atm., and M. Donny thinks they may have liquefied the gas without knowing it.—MM. Navez describe a combination of an induction coil with the telephone for speaking at great distances. The induced currents are sent into the line, while the sending instrument is inserted in the local circuit connected with the battery. The receiving telephone is somewhat modified.—The subjects for prizes offered by the Academy for 1879 are announced in this number.

Reale Istituto Lombardo di Scienze è Lettere. Rendiconti, vol. xi. fasc. iv.-vi.—We note the following papers in these numbers:—Deformative hypertrophy of the nails, by M. Sangalli.—Claustrophobia, by M. Verga.—Some experiments with the telephone, by M. Serpieri.—On the dominant diseases of the vine, by MM. Garovaglio and Cattaneo.—On the kinematics of a solid body, by M. Bardelli.—Lecture experiment (illustrating liquefaction of gases), by M. Brugnatelli.—An experiment on electrostatic induction, by M. Cantoni.—On a case of heterogenesis observed in nature, by MM. Battista and Corrado. —Reduction of argentic and ferric chloride, by M. Tommasi.—Geological observations on the Carso di Trieste and the valley of the Recci with reference to water supply, by M. Taromelli.

THE *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg* (t. xxiv. No. 4) contains the following papers of interest:—Development into converging series of the odd negative powers of the square roots of the function $1 - 2\eta U + \eta^2$, by Dr. J. Backlund.—Variation of the volume of liquids through the effect of temperature, by M. Avenarius.—On some new forms of crystals of ilmeno-rutile, by P. Jeremejew.—On the development of excrescences (cephalodia) on the thallus of *Lichen, Peltigera aphthosa*, Hoffm., by M. Babikoff.—On a new case of divisibility of the numbers of the form $2^{2^m}+1$, found by the Rev. J. Pervouchine, by V. Bouniakowsky.—A note on the opposition of planets during 1877, by A. Sawitch.—On an extremely slight earthquake observed by means of a very delicate level on May 10, 1877, by M. Nyrén.

Morphologisches Jahrbuch, vol. iv., supplement, dedicated to Carl von Siebold.—On the cranial skeleton of alepocephalus, a clupeoid fish, by Prof. Gegenbaur, two plates, 42 pp.—Fossil vertebræ, by C. Hasse, dealing with the relationship of the genus Selache; two plates. The author believes this genus to have developed from Carcharodon in the tertiary period.—The gorilla's brain and the third frontal convolution, by Prof. von Bischoff, a controversial article referring to Prof. Broca's researches and views.—Contribution on the coral family Antipatharia, by G. von Koch.—The disposition and development of elastic tissue, by L. Gerlach, with two beautiful plates.—The development of the muscular structure of the human foot, by G. Ruge, 36 pp. one plate.

THE *Notizblatt des Vereins für Erdkunde zu Darmstadt* (iii. xvi. Nos. 181 to 192) contains some interesting statistical data from the Hessian Central Statistical Office. The papers of geological interest are: On the crystalline lime of Auerbach on the Bergstrasse, by R. Ludwig.—On the minerals found in the cavities of the melaphyr from Traisa and in the basalt of the Rossberg, by the same.—On the minerals and fossils found near Hering (Hessen), by the same.—Comparative account of the products of all Hessian mines during the years from 1860 to 1876, by Herr Tecklenburg.—On the fauna of the real Cyrene emery of Sulzheim, near Woerrstadt (Hessen), by Dr. O. Boettger.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 2.—"Preliminary Notes on Experiments in Electro-Photometry." By Prof. James Dewar, F.R.S., Jacksonian Professor, University of Cambridge.

Edmond Becquerel, in the year 1839, opened up a new field of chemical research through the discovery that electric currents may be developed during the production of chemical interactions excited by solar agency.

Hunt, in the year 1840, repeated, with many modifications, Becquerel's experiments, and confirmed his results.

Grove, in 1858, examined the influence of light on the polarized electrode, and concluded that the effect of light was simply an augmentation of the chemical action taking place at the surface of the electrode.

Becquerel, in his well-known work, "La Lumière," published in 1868, gives details regarding the construction of an electro-chemical actinometer formed by coating plates of silver with a thin film of the sub-chloride, and subsequent heating for many hours to a temperature of 150° C.

Egeroff, in 1877, sugested the use of a double apparatus of Becquerel's form, acting as a differential combination, the plates of silver being coated with iodide instead of chloride.

The modifications of the halogen salts of silver when subjected to the action of light have up to the present time been used most successfully in the production of electric currents, and although mixtures of photographically sensitive salts have been shown by Smee to produce currents of a similar kind, yet no attempt has been made to examine the proper form of instrument required for the general investigation of electrical actions induced by light on fluid substances.

This subject has occupied my attention for some time, and the completed investigation I hope to present to the Society. In the meantime the following description will give an idea of the method of investigation.

A little consideration shows that the amount of current produced by a definite intensity and quality of light acting during a short period of time on a given sensitive substance in solution, is primarily a function of the nature, form, and position of the poles in the cell relatively to the direction in which the light enters, and the selective absorption, concentration, and conductivity of the fluid.

Diffusive action taking place in such cells complicates the effects and is especially intricate when insoluble substances are formed. In order to simplify the investigation in the first instance, poles that are not chemically acted upon, and a sensitive substance yielding only soluble products on the action of light, were employed. For this purpose platinum and chlorous acid or peroxide of chlorine were selected.

The best form of cell had one of the poles made of fine platinum wire fixed as closely as possible to the inner surface where the light enters, the other pole being made of thicker wire placed deeper in the fluid.

As the action is confined to a very fine film where the light enters, the maximum amount of current is obtained when the composition of the fluid is modified deep enough to isolate temporarily the front pole in the modified medium. Under these conditions the formation of local currents is avoided, and the maximum electromotive force obtained.

In cells of this construction the amount of current is independent of the surface of the fluid acted upon by light, so that a mere slit sufficient to expose the front pole acts as efficiently as a larger surface. This prevents the unnecessary exhaustion of material, and enables the cell to be made of very small dimensions. By means of such an apparatus the chemical actions of light and their electrical relations may be traced in many new directions.

The amount and direction of the current in the case of chlorous acid is readily modified by the addition of certain salts and acids, and thus electrical variation may be produced, resembling the effects observed during the action of light on the eye. . . . .

Certain modifications taking place in chlorous acid that has been prepared for some time increase its sensibility, and as a general result it is found that the fluid through these alterations increases in resistance. We have thus an anomalous kind of battery where the available electromotive force increases with the resistance. The addition of neutral substances which increase the resistance without producing new decompositions, improves the action of the cell.

Care has to be taken to use the same apparatus in a series of comparative experiments, as infinitesimal differences in the contact of the active pole render it difficult to make two instruments giving exactly the same results. Cells have been constructed with two, three, and four poles, and their individual and combined action examined. Quartz surfaces have also been employed instead of glass, thus enabling the chemical opacity of different substances to be determined.

The electrical currents derived through the action of light on definite salts are strong in the case of ferro- and ferri-cyanide of potassium, but remarkably so in the case of nitroprusside of sodium.

Of organic acids the tartrate of uranium is one of the most active. A mixture of selenious acid and sulphurous acid in presence of hydrochloric acid yields strong currents when subjected to light in the form of cell described. The list of substances that may be proved to undergo chemical decomposition is very extensive, and full details will be found in the completed paper.

Geological Society, May 8.—Henry Clifton Sorby, F.R.S., president, in the chair.—Charles Preller Sheibner, Ph.D., was elected a Fellow of the Society.—The following communications were read:—On the glacial phenomena of the Long Island, or Outer Hebrides (second paper), by James Geikie, F.R.S. In this paper the author gave some additional notes on the glaciation of Lewis, and a detailed account of the glacial phenomena of Harris and the other islands that form the southern portion of the Outer Hebrides. In concluding, the author pointed out that we may now arrive at a true estimate of the thickness attained by the ice-sheet in the north-west of Scotland. If a line be drawn from the upper limits of the glaciations in Ross-shire (3,000 feet) to a height of 1,600 feet in the Long Island, we have an incline of only 1 in 210 for the upper surface of the ice-sheet; and of course we are able to say what thickness the ice reached in the Minch. Between the mainland and the Outer Hebrides it was as much as 3,800 feet. No boulders derived from Skye or the mainland occur in the Till of the Outer Hebrides, and this was explained by the deflection of the lower portion of the ice-sheet against the steep wall of rock that faces the Minch. The under part of the ice that flowed across the Minch would be deflected to right and left against the inner margin of the Long Island; and the deep rock-basins that exist all along that margin are believed to have been scooped out by the grinding action of the deflected ice. Towards the north of Lewis, where the land shelves off gently into the sea, the under strata of the ice-sheet were enabled to creep up and over the district of Ness, and thus gave rise to the lower shelly boulder-clay of that neighbourhood, which contains boulders derived from the mainland. The presence of the overlying interglacial shell-beds proves a subsequent melting of the ice-sheet, and a depression of the land for at least 200 feet. The overlying shelly boulder-clay shows that the ice-sheet returned and overflowed Lewis, scooping out the older drift-beds and commingling them with its bottom moraine. The absence of kames was commented upon, and shown to be inexplicable on the assumption that such deposits are of marine origin; whilst if they be of torrential origin their absence is only what might be expected from the physical features of the islands. The only traces of post-glacial submergence are met with at merely a few feet above present high-water mark.—Cataclysmic theories of geological climate, by James Croll, F.R.S. Communicated by Prof. Ramsay, F.R.S. The author commenced by calling attention to the great diversity of the hypotheses which have been brought forward for the explanation of those changes in the climate of the same regions of the earth's surface which are revealed by geological investigations, such as alterations of the relative distribution of sea and land, of the ecliptic, and of the position of the earth's axis of rotation, all of which, he maintained, have proved insufficient or untenable. Sir William Thomson has lately maintained that an increase in the amount of heat conveyed by ocean-currents combined with the effects of clouds, winds, and aqueous vapour, is sufficient to account for the former prevalence of temperate climates in the Arctic regions, and this view, the author stated, he had himself been contending for for more than twelve years. He thinks, however, that alterations in the eccentricity of the earth's orbit is the primary motive cause, whilst Sir William Thomson believes this to be the submergence of circumpolar lands, which, however, in miocene times, appear to have been more extensive than at present. He pointed out that a preponderance of equatorial land, as assumed by Sir Charles Lyell to account for the milder climate of Arctic regions in miocene times, would rather tend to loss of heat by rapid radiation into space, whilst water is remarkably powerful as a transporter of heat, so that, in this case, equatorial water rather than equatorial land is needed. In speaking of the glacial climate, the author maintained that local causes are insufficient to explain so extensive a phenomenon. He indicated that we are only too prone to seek for great or cataclysmic causes, and although this tendency has disappeared from many fields of geological research, this is not the case in all. His explanation of the causes of a mild climate in high northern latitudes is as follows:—Great eccentricity of the earth's orbit, winter in perihelion, the blowing of the south-east trades across the equator perhaps as far as the tropic of Cancer, and impulsion of all the great equatorial currents into northern latitudes; on the other hand, when, with great eccentricity, the winter is in aphelion, the whole condition of things is reversed; the north-east trades blow over into the southern hemisphere, carrying with them the great equatorial currents, and glacial conditions prevail in the northern hemisphere. Thus those warm and cold periods which have prevailed during past geological ages are regarded by the author as great secular summers and winters.—On the distribution of ice during the glacial period, by T. F. Jamieson, F.G.S. The author believes that a study of the distribution of ice during the glacial period proves that the greatest accumulation of snow took place in precisely those districts which are now characterised by a very heavy rainfall, and he pointed out how exactly this is in accordance with the views of Prof. Tyndall as to the conditions most favourable to the development of glaciers.

Zoological Society, May 21.—F. D. Godman, F.Z.S., in the chair.—A communication was read from Lieut.-Col. R. H. Beddome, C.M.Z.S., containing the description of a new genus and species of snakes, of the family of Calamariidæ, from Southern India, proposed to be called *Xylophis indicus*.—Mr. P. L. Sclater, F.R.S., read the tenth of a series of reports on the collection of birds made during the voyage of H.M.S. *Challenger*, containing an account of the birds of the Atlantic Islands and Kerguelen's Land, and of the miscellaneous collections made by the expedition.—Mr. J. Wood Mason, F.Z.S., described several new or little known Mantidæ from India, Australia, and other localities.—Mr. H. W. Bates, F.Z.S., read a paper containing the description of new genera and species of Geodephagous Coleoptera from Central America, belonging to the families Cicindelidæ and Carabidæ.—Mr. G. French Angas, C.M.Z.S., read the description of a new species of *Tudicula*, which he proposed to name *T. inermis*.—A communication was read from the Marquis of Tweeddale, F.R.S., being the ninth of his contributions to the ornithology of the Philippines. The present paper gave an account of the collection made by Mr. A. H. Everett in the Island of Palawan, and contained the descriptions of nine new species, namely, *Tiga everetti*, *Dicrurus palawanensis*, *Broderipus palawanensis*, *Trichostoma rufifrons*, *Drymocataphus cinereiceps*, *Brachypus cinereifrons*, *Criniger palawanensis*, *Cyrtostomus aurora*, and *Corvus pusillus*. The collection likewise contained three examples of the remarkable *Polyplectron emphanes*, of which the locality was previously unknown, and specimens were excessively rare.—Prof. A. H. Garrod, F.R.S., read a paper in which he gave a description of the tracheæ of *Tantalus loculator* and of *Vanellus cayennensis*.—A second paper by Mr. Garrod contained some notes on the anatomy of the Great-headed Maleo (*Megacephalon maleo*).

Victoria (Philosophical) Institute, May 31.—Annual Meeting; the president, the Right Hon. the Earl of Shaftesbury, K.G., in the chair.—From the annual report it appeared that the number of members is now 756.—The Address was delivered by Principal Rigg, D.D., and contained a review of various systems of philosophy now popular.

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Academy of Sciences, June 3.—M. Fizeau in the chair.—The following among other papers were read:—Direct determination at sea of the azimuth and route of a ship, by M. Faye. This is for iron ships, and involves keeping the ship some time in a fixed direction indicated by the log-line and determined astronomically. The log is slightly modified in form.—New researches on the fossil mammalia of South America, by M. Gervais. The author has examined the recent collections of MM. Ameghino, Brachet, and Larroque, from the province of Mines, in Brazil, and some parts of the Argentine Republic. He is able to add some new details about the Toxodon, and describe, *inter alia*, a new species of Machairodus, and two new species of Glyptodon (the species of which, he estimates, certainly exceed a dozen).—On the chalk of the Central Pyrenees, by M. Leymerie. He finds there a bed immediately under the first eocene layer, containing quite a special marine fauna, among which are numerous urchins.—M. Cornu was elected member in the section of physics in place of the late M. Becquerel.—Direct fixation of carbonic acid, sulphurous acid, and phtalic anhydride, on benzine; synthesis of benzoic acid, hydride of sulphophenyl, and benzoylbenzoic acid, by MM. Friedel and Crafts. The authors suppose in these syntheses an organo-metallic combination of aluminium by the reaction of the chloride of this metal on the hydrocarbons.—On the manufacture of cast manganese and on the volatility of manganese, by M. Jordan. More than 100,000 kil. of this cast manganese (from treating ores of manganese in the blast furnace) have already been supplied to French steel works. Manganese is volatile at the temperature of metallurgical furnaces; and this fact explains several anomalies remarked in the manufacture of very manganesised products.—On Daltonism; sanitary precautions, and preventives, by M. Favre. There are in France more than 3,000,000 persons affected with Daltonism; the number of women affected is to that of men as 1 : 10. Nine out of ten cases can easily be cured in youth; the best means being methodic exercise on coloured objects. This should be attended to in all schools, and mothers should seek to develop the chromatic sense in their children. No one should be admitted to the service of railways, the navy, or schools of painting, without being examined in colours. No Daltonians should be charged with service involving the use of coloured signals.—Information was given regarding observation of the transit of Mercury in the United States.—On the densities of vapour, by M. Troost. He describes the behaviour of vapour of acetic acid, hyponitric acid, sulphur, and hydrate of chloral. Sulphur vapour behaves like ozone, whose density is independent of pressure, and whose transformation into oxygen takes place in proportion as the temperature is raised.—On metallic allotropy, by M. Schutzenberger. By electrolysis of metallic solutions, allotropic varieties of other metals besides copper (*e.g.* lead) may be got. It is impossible to decide by direct experiment whether or not allotropic copper contains occluded hydrogen eliminable at 100°. In any case the proportion of hydrogen could not exceed 0·03 per cent.—Method of determination and separation of stearic acid and oleic acid proceeding from saponification of tallow, by M. David. The principle of this process is based on the new fact that when into an alcoholic solution of oleic acid one pours acetic acid drop by drop, a moment comes when, suddenly, the oleic acid separates completely.—On the structure of nerves in invertebrates, by M. Cadiat. In crustacea, insecta, and annelida, the nerves have no myeline, which in vertebrates is found between the cylinder axis and the wall proper of the tube (the grey fibres of the great sympathetic excepted). In gasteropodous and acephalous molluscs the sheath of Schwann is almost always wanting.—On the relations between the volume of motor or sensitive cells of nervous centres, and the length of passage of the impressions transmitted, by M. Pierret. The dimensions of the nerve-cells are in direct ratio of the distances which the motor incitations proceeding from them, or the sensitive excitations reaching them, have to traverse.—There were several other papers on chemical subjects, determination of arsenic in volumes, reciprocal combinations of metallic sesquisulphates, some combinations of platinum, nitrogenised acids derived from acetones, cyanide of ethylene, researches on peptones, &c.

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ERRATA.—In Mr. Broun's article on Cosmic Meteorology, vol. xviii. p. 152, 1st column, line 7, for 464, read 8,464; and p. 153, 2nd column, line 16, for "relate to magnetical and meteorological phenomena," read "relate magnetical to meteorological phenomena."