THURSDAY, NOVEMBER 11, 1880

DR. SIEMENS'S NEW CURE FOR SMOKE

THE growing obscurity which distinguishes the winter atmosphere of London has disposed men to consider whether it is an indispensable evil connected with the use of coal in great centres of population, or whether means can be found of providing the warmth and comfort which the copious use of mineral fuel affords us without having to pay the penalty of dispensing with the solar ray, of finding ourselves and everything we touch covered with soot, and of occasionally having, even at midday, to grope our way with a feeling akin to suffocation.

I am decidedly of opinion that the evil is one which not only admits of remedy, but that its cure would result from a closer attention to the principles of economy in the use of fuel.

Until within recent years wasteful expenditure was the rule both in the application of fuel to our large manufacturing operations and for domestic purposes, but great strides have been made within the last twenty years to improve our mode of burning fuel both under our steam boilers and in the metallurgical furnace. The Regenerative Gas Furnace, which was the subject of Faraday's last discourse at the Royal Institution in 1862 has contributed its share to this result, combining as it does considerable economy, with the entire absence of smoke from the chimney.

Since by the employment of gaseous fuel results such as these are realised, there seems no *à priori* reason why analogous results should not attend its application on a smaller scale, even down to the means of heating our apartments, which, although a small application in each individual instance, amounts, in the aggregate, to the largest of all the uses of mineral fuel.

Gas-grates have been tried by individuals desiring progress, but I know several instances in which on account of the great comparative expense incurred, and objections raised to the smell, and dry heat, as it is called, in the room, the time-honoured smoky but cheerful coal-fires were reinstated.

A gas-grate that was arranged in my billiard-room in the usual fashion, consisting of three air-gas-pipes with apertures distributed over the fire-grate, and covered with pumice-stone, presented certainly a cheerless appearance, and filled the room (notwithstanding a fair chimney-draught) with fumes, rendering the benefit of the fire a doubtful one. These fumes could not have passed into the room from the upper surface of the pumice-stone owing to its proximity to the chimney; but a little consideration made me come to the conclusion that these gases really proceeded from the ash-pan into the room. The products of combustion set up by the gas flames ascend no doubt so long as they are intensely hot, but in giving off their heat to the inert pumice-stone they rapidly cool, and being heavier than atmospheric air, descend through the grate between the lines of gas flames, and thus reach the apartment. Moreover the gas burnt towards the back of the fireplace takes scarcely any part in providing a red radiating surface in front of the grate, serving only to baffle the draught passing towards the chimney from the room.

The first condition to be realised in an efficient gas-grate consists in suppressing all gas orifices except immediately behind the bottom front bar, and in substituting for the grate a solid dead plate. Instead of using inert matter such as pumice-stone, I consider it far more economical and efficacious to transfer the heat of the gas flames to gas coke or anthracite, which when once heated helps the gas to increase and maintain a sufficient temperature for radiation through its own slow combustion. The gas should not be mixed in the pipe with atmospheric air to produce a Bunsen flame, as is frequently done, because by using the unmixed gas a rich flame is set up between the pieces of coke near the front of the grate, producing to the eye an appearance similar to a well-ignited ordinary coal fire, and the hot carbonaceous matter through which it percolates ensures its entire combustion before reaching the chimney. Heat will however gradually accumulate towards the back of the fire, notwithstanding the suppression of the grate bars, and in order to obtain the utmost economy this heat should be utilised to increase the temperature of the gas flames and of the coke in front of the grate.

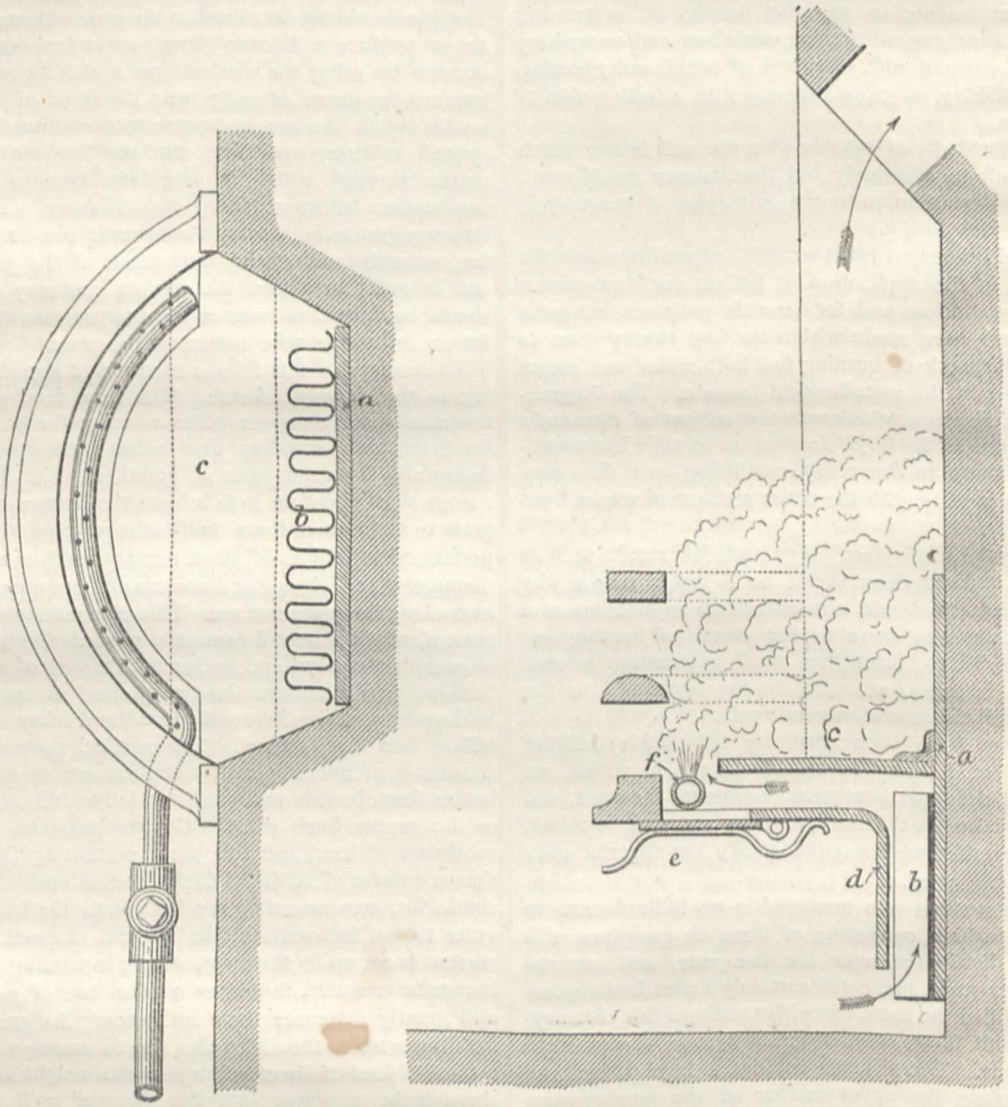
To accomplish this I have constructed a grate according to the annexed sketch. The iron dead plate *c* is riveted to a stout copper plate *a* facing the back of the fire-grate, and extending five inches both upwards and downwards from the point of junction. The dead plate *c* stops short about an inch behind the bottom bar of the grate to make room for a half-inch gas-pipe *f*, which is perforated with holes of about one-twentieth of an inch in diameter placed zig-zag at distances of three-quarters of an inch along its upper surface. This pipe rests upon a lower plate *d*, which is bent downwards towards the back so as to provide a vertical and horizontal channel of about one inch in breadth between the two plates. A trap-door *e*, held up by a spring, is provided for the discharge of ashes falling into this channel. The vertical portion of this channel is occupied by a strip of sheet copper about four inches deep, bent in and out like a lady's frill and riveted to the copper back piece. Copper being an excellent conductor of heat, and this piece presenting (if not less than a quarter of an inch thick) a considerable sectional conductive area, transfers the heat from the back of the grate to the frill-work in the vertical channel. An air current is set up by this heat, which, in passing along the horizontal channel, impinges on the line of gas flames and greatly increases their brilliancy. So great is the heat imparted to the air by this simple arrangement that a piece of lead of about half a pound in weight introduced through the trap-door into this channel melted in five minutes, proving a temperature to exist exceeding 619° F. or 326° C. The abstraction of heat from the back has moreover the advantage of retarding the combustion of the coke there while promoting it at the front of the grate.

The sketch represents a fireplace at my office, in a room of 7,200 cubic feet capacity facing the north. I always found it difficult during cold weather to keep this room at 60° F. with a coal fire, but it has been easily maintained at that temperature since the grate has been altered to the gas-coke grate just described.

This heating arrangement is not however essentially necessary; in several of the grates which I have altered for gas I have simply closed up the space below the bottom bar by means of a close-fitting ash-pan, and introduced the gaspipe behind the lower bar, an alteration which can be effected at very trifling expense, and presents the advantage of great cleanliness, the ash-pan being withdrawn only at intervals of several days for emptying. The appearance of the fire however is in that case much less brilliant than when the hot-air arrangement is added.

In order to test the question of economy I have passed the gas consumed in the grate through a Parkinson's 10-light dry gas-meter supplied to me by the Woolwich, Plumstead, and Charlton Consumer's Gas Company; the coke used is also carefully weighed.

The result of one day's campaign of nine hours is a consumption of 62 cubic feet of gas and 22 lb. of coke (the coke remaining in the grate being in each case put to the debit of the following day). Taking the gas at the average London price of 3*s.* 6*d.* per 1000 cubic feet and the coke at 18*s.* a ton, the account stands thus for nine hours:—



a, Copper plate ¼ inch thick and 10 inches wide at back of grate; *b*, frill of copper $\frac{1}{16}$ inch thick; *c*, iron dead plate riveted to plate *a*; *d*, angle plate with trap-door *e* for removing ashes; *f*, gas-pipe about ½ inch diameter with holes ¾ inch apart.

		d.
62 cubic feet of gas at 3*s.* 6*d.* per thousand	...	2·604
22 lb. coke at 18*s.* a ton		2·121
Total	...	4·725

or at the rate of 0·524*d.* per hour. In its former condition as a coal-grate the consumption exceeded generally two and a half large scuttles a day, weighing 19 lb. each, or 47 lb. of coal, which at 23*s.* a ton equals 5·7*d.* for nine hours, being 0·633*d.* per hour. This result shows that the coke-gas fire, as here described, is not only a warmer but a cheaper fire than its predecessor, with the advantages in its favour that it is thoroughly smokeless, that it can be put off or on at any moment (which in most cases means considerable economy), that it is lit without the trouble of laying the fire, as it is called, and keeps alight without requiring to be stirred.

It may appear strange at first that the use of the separated coke and gas to produce a given effect should be fully as cheap as using the raw material combining the two constituents, but the solution may be found in the

circumstance that in the case of the coke-gas fire no heat flashes up the chimney, but is utilised entirely for raising the coke in front of the grate to the condition most favourable to radiation into the room.

I hold that it is almost barbarous to use raw coal for any purpose, and that the time will come when all our fuel will be separated into its two constituents before reaching our factories or our domestic hearths. Such a measure would not only furnish us with the complete solution of the smoke question, but would be of great value also as a money saving. In conclusion I may observe that I have taken up this question without the idea of profit, and shall be happy to furnish builders and others desirous to introduce the grate here described with the necessary indications to insure success. C. WILLIAM SIEMENS

THE RUSSIAN IMPERIAL YACHT, "LIVADIA"

IN NATURE, vol. xxii. p. 270, we gave an account of this remarkable ship, and stated that we should report the results of her trials to our readers. We there said "it cannot be doubted that her speed will surpass 14 knots," and we pretty plainly intimated that it would, in our judgment, fall substantially short of 17 knots; in point of fact it has fallen between these limits, and nearer the higher than the lower, the average mean speed at the measured distance being 15·864 knots. The details of the several runs, which have not previously been published in London, we believe, are as follows :—

No. of Run.	Indicated H.P.	Speed in Knots.
1	12,267	15·69
2	11,704	15·53
3	12,387	15·83
4	12,437	15·65
5	12,857	15·92
6	12,472	15·65
Average	12,354	15·725

The trials of the *Livadia* were greatly hurried, the vessel going down the river on a Wednesday, making a preliminary run under steam on the following day, Thursday; on Friday she made a run at full speed for six hours, giving an average of 15 knots; and on Saturday she made her measured mile trials. Those who understand the conditions under which these steam trials were made will see at once that it was not possible to obtain the best results with a ship thus put under steam day after day, her boiler tubes getting doubtless more or less foul, and her machinery also falling somewhat out of perfect condition, especially where there were three separate sets of engines to be cared for. The bottom was also foul from having been three months in the wet dock at Fairfield. The effect of haste in making the trials is visible in the variations of horse-power developed upon the runs, there being a difference of more than 1000 h.p. between the power developed, for example, on the second run as compared with that of the fifth. The speeds given above show less discrepancies than the horse-powers, but it can hardly be doubted that the *Livadia* as she is can be driven at over 16 knots under fair conditions, without any alteration whatever. It is, as has been said elsewhere, highly probable that some improvements might be made in the screw propellers, as it is not to be expected that the best conditions were secured at the first attempt. In fact we have evidence that the central screw was set at a pitch different from that of the side-screws, and runs at a different speed; it now appears likely that the pitch should have been the same in all cases, and when the opportunity offers this change will probably be made, and the speed again taken. Other slight modifications will doubtless also be tried, and those of our own naval architects, who have well considered all the facts, have formed the opinion that if all minor causes of interference with the best performance are removed, a speed approaching 17 knots may be reached in the *Livadia*. It needs no words of ours to convince the scientific world that whether any great increase of speed be obtained with this vessel or not, the Russian Government has rendered a vast service to naval science by demonstrating on a large scale and in a public and unquestionable manner, the fact that a vessel whose breadth is enormous, and whose length is but one and a half times her breadth, may with no very inordinate expenditure of power be made to take a high place among the few fastest ships of the world.

But the interest in the *Livadia*, while it is greatest as regards her high-speed trials, by no means ends there. Her steaming performances with diminished steam power are also very interesting. In considering these the reader should remember that in this case as in all cases of fast ships going with reduced power and at reduced speed, the performances are subject to a double disadvantage: first the *weight* of the machinery carried is of course in excess of what is needed to produce the reduced power; and secondly, the friction and other losses are likewise in corresponding excess. For example, when the *Livadia* is steaming say at 11 to 12 knots, she is employing less power than any one of her three sets of engines produces; and if she had not to go beyond such a speed she might dispense with the other two sets of engines and boilers, and thus be relieved of nearly 1000 tons of weight, and of two-thirds of the frictional and other losses which she is obliged to undergo when steaming at 11 or 12 knots with all her engines working at a reduced speed. Bearing these facts in mind, we may now state that the reduced steaming of the *Livadia* is reported officially to have given the following results :—

Aggregate Ind. H.P.	Speed.	Wind.	Tide.
2969	11 knots	With	Slightly
4770	13 ,,	,,	,,
8940	15 ,,	Against	Slightly against
10,037	15¼ ,,	,,	Against

The indicated horse-powers above given were calculated from diagrams, and the speed was taken by log. The results were reported, we know, in perfect good faith, and are a correct indication, in the main, of the relation between power and speed in the *Livadia* with her present screws, &c. They nevertheless appear to us to exhibit on the face of them some slight discrepancy, which is amply accounted for by the fact that the speeds were, as we have said, taken by the log, which does not admit of that minute accuracy which may and ought to characterise measured mile-trial results. The above figures are borne out by the sea-passages of the yacht. She steamed continuously in fair and moderate weather at an average speed of somewhat more than 12 knots with an average expenditure of about 4000 Ind. H.P.

With all the above facts and figures before us we see

clearly how vain have been the prejudices, and how baseless the predictions, which condemned ships of this type as incompatible with even moderately good speeds, and as ridiculous when the attainment of high speed was contemplated. It is with no small feelings of vanity, but with a genuine pride in a great scientific triumph which we ventured to predict beforehand, that we have witnessed the *Livadia's* success. It is a success which England may well envy, and of which the Russian Government may well be proud. Its bearing upon the future of steam navigation cannot fail to be considerable even in the mercantile marine, while it is quite impossible for the war navies of the world to escape its influence. Our long-standing objections to the *Inflexible* and *Italia* types of ship are well known to our readers, the construction of such ships under the name of first-class ironclads being most trying even to the common sense, and much more to the scientific sense, of the country. With the *Livadia* in existence, and with the facilities which such great breadth as hers offers to the production of armoured ships worthy of the name, the exposure of our first-class ships to the destructive effects both of shells and of torpedoes, will not be endured. We congratulate Admiral Popoff upon the established success of the great idea which he was the first to propound, and as the idea would still have remained a mere idea but for the powerful patronage of the Grand Duke Constantine, we gladly recognise again the scientific acumen and that "courage of his opinions" which distinguish His Imperial Highness. By consenting to the trial of so great a naval experiment in a yacht of his own, the Emperor of Russia has secured a sea-palace of great speed, of unexampled accommodation, and of a freedom from rolling and pitching such as no other ship in the world enjoys.

On the last-named points—those of pitching and rolling—we have to record very remarkable results. We are informed on the best authority that in the gale in the Bay of Biscay, with waves running over twenty feet high, when ordinary vessels were seen rolling and pitching heavily, and even when the gale and the sea were at their highest, the greatest roll to leeward was 5 degrees, and that to windward 4 degrees, while the greatest pitch was 4 degrees and the greatest "'scend" 3 degrees. This extreme limitation of motion was most extraordinary, excluding almost all the usual incidents of sea-life. Nothing was secured on board, and nothing fell throughout the storm. There were occasionally heavy blows of the sea under the flat shallow bow, and these caused much vibration at times; but nothing was disturbed, and even the paint is nowhere cracked throughout the wood-built cabins and palaces of the ship.

In the accident which the *Livadia* met with on her voyage from Brest to Ferrol, by striking heavily downwards upon some floating object or objects during a heavy gale in the Bay of Biscay, with a high and confused sea running, the value of water-tight subdivision has been strikingly demonstrated. The injuries done by the blows were extended by the heavy strokes of the sea under the bluff bow, and several of the forward compartments were filled. A scientific friend who inspected the bow after the compartments were pumped out in the harbour of Ferrol, informs us that in two or three places the bulkhead divisions had evidently been badly struck and made leaky at the bottom, and in one compartment the sea was plainly visible through the broken plating. And yet nothing was known on board of these injuries when at sea beyond the fact (ascertained by "sounding") that a forward compartment of the double bottom had been somehow filled, so effectually was the ship proper preserved from all injury within the double bottom, and so little effect had the filling of the forward spaces upon the trim and behaviour of the ship! The *Livadia* is constructed of steel, and is as lightly built as our own fast steel ships of the latest date; and as a similar accident to the recent one might occur again, as it may to any ship of light draught and great buoyancy, it would no doubt be prudent to add something to the strength of the outer bottom where most exposed to strains and blows; but this is a matter of detail which we leave the naval architect to discuss. The great lesson to be derived from the incident is the immeasurable value of double bottoms and of great compartmental subdivision in sea-going structures. An ordinary large steam yacht not so subdivided might have been lost under like circumstances, and certainly would have been more or less jeopordised and more or less injured internally; in the present case not a particle of injury to the interior of the ship or to her costly fittings was sustained, and hours after the accident, with a very high and confused sea still running, the Lord High Admiral of Russia and his guests dined as safely, as easily, and almost as quietly as if he had been ashore in his summer palace of Orianda.

A MEDICAL CATALOGUE

Index Catalogue of the Library of the Surgeon-General's Office, U.S. Army. Vol. i., A—Berliúski. 4to, pp. 888. (Washington: Government Printing Office.)

THE saying of Hippocrates, that art is long and time is short, is so true, not merely of medical art, but of work in general, that most working men find their lives gliding so quickly away that they do not attempt great works, and very probably would not succeed if they did so. But every now and then we come across men whose energy is so marvellous, and whose power of getting through work is so enormous, that we are struck with amazement at it. Such a man is Dr. Billings, to whose extraordinary energy and perseverance we owe the present work. This purports to be only a catalogue of the Library of the Office of the Surgeon-General of the United States Army, and Dr. Billings takes care to call attention to the fact that it is not a complete medical bibliography, and that any one who relies upon it as such will commit a serious error. "It is," he says, "a catalogue of what is to be found in a single collection; a collection so large, and of such a character, that there are few subjects in medicine with regard to which something may not be found in it, but which is by no means complete." It is not, however, a mere catalogue in the ordinary sense of the word, inasmuch as its contents are not confined to the names and titles of books and their authors. It is also a catalogue of subjects, so that any one wishing to read up a particular subject will find under the appropriate heading a list of the chief works bearing upon it. Nor is this all. There are other catalogues in which a similar arrangement has not only been

attempted but successfully carried out. But this catalogue differs from all others inasmuch as it is the only compilation in which the herculean task of arranging in proper order the contents, not only of books, but of medical periodicals, has ever been essayed. To any person who is aware of the enormous extent of medical periodical literature, and who has had personal experience of the time and labour involved in looking up a few references, it seems almost incredible that any man should have had the courage to venture upon the task which Dr. Billings has successfully accomplished. To give the faintest idea of the work, we take a single heading—Amputation, and we find, besides a large number of works and references under this title itself, several other headings on the treatment of amputation, cases and statistics of amputation, double amputation, history of amputation, intra-uterine amputation, methods of amputation, multiple amputation, sequelæ and after treatment of amputation, spontaneous amputation, amputation in the course of disease, amputation in gunshot wounds, amputation in infants, amputation in joints, amputation in pregnancy, carpal and meta-carpal amputations, tarsal and meta-tarsal amputation, amputations at ankle-joint, amputations of arm, amputations of breast, amputations at elbow-joint, amputations of fingers and toes, amputations of foot, amputations of fore-arm, amputations of hip-joint, amputations of knee-joint, amputations of leg, amputations at shoulder-joint, amputations of thigh, amputations of toes, amputations at wrist-joint, besides cross references to Amputation considered under other heads, such as Gangrene, Hospitals, Surgery, Umbilical Cord, Arteries, Limbs, Osteomyelitis, Spinal Cord, Stumps, Frost-bite, Pregnancy, Pyæmia, Elbow-joint, Breast, Tibia, Ankle-joint, Astragalus, Aneurisms, Arm, Artery, Humerus, &c. On taking a single one of these headings, we find under it nineteen books, and on then attempting to count the references to periodical literature we go along until we come to the end of the letter C, and then stop in despair, for we have already got a hundred references, and find that to proceed to the end of the alphabet will be a work of both time and labour. The wearisomeness of counting the number of references in a small fraction of one sub-head may give the reader some notion of the labour involved in hunting out and writing down the materials, and yet, after all, such idea would be very imperfect, for the labours of Dr. Billings and his assistants have not consisted merely in giving these references. A much greater amount of time and trouble has probably been consumed in the consideration of what should be left out than by the labour of arranging and compiling what should be put in, for in indexing journals and transactions the general rule which they have followed has been that only original articles should be taken, though occasionally important papers in several periodicals, and reprints when the originals have not been in the library, have been indexed. In describing the arrangement of the book we cannot do better than quote Dr. Billings' own words :—

"This catalogue includes both authors and subjects—the names being arranged in dictionary order in a single alphabet. Under the subject-headings are included the titles of original articles in the medical journals and transactions contained in the Library, for which reason the Catalogue is commonly spoken of by those who are familiar with it as the 'Index-Catalogue,' and the name has been adopted as being brief and at the same time distinctive.

"The form adopted is essentially that shown in the 'Specimen Fasciculus' published in 1876, and it has been selected after a careful consideration of the criticisms and suggestions brought out by that fasciculus.

"The great majority of physicians, and especially of American physicians, who have given their opinion, have expressed a decided preference for this form; and although a librarian might find a complete separation of the catalogue of authors from that of subjects a little more convenient, the demand on the part of those who are to use it is very decidedly for the combination here given.

"The following points have been kept in view in the selection and arrangement of the subject-headings :—

"I. Those titles have been selected for subjects for which it is presumed that the majority of educated English-speaking physicians would look in an alphabetical arrangement.

"II. Where there is doubt as between two or more subject-headings, cross-references are given.

"III. Where both an English and a Latin or Greek word are in common use to designate the same subject, the English word is preferred, and references are given from the others.

"IV. As a rule, substantives rather than adjectives are selected for subject-headings. Exceptions occur to this in anatomical nomenclature, as 'Lachrymal duct'; 'Thyroid gland.'

"V. In names of subjects derived from personal names, the latter precede, as 'Addison's disease'; 'Eustachian tube.'

"VI. Local diseases or injuries are as a rule placed under the name of the organ or locality affected, as 'Kidney (*Abscess of*)'; 'Neck (*Wound of*).' There are exceptions to this, in accordance with Rule I., *e.g.*, 'Abscess (*Perinephritic*).'

"VII. Cases in which one disease is complicated with or immediately followed by another are placed under the name of the first disease with the sub-heading '*Complications and Sequelæ*.'

"VIII. When the main subject of an article is the action of a given remedy in general, or its action in several diseases, it is indexed under the name of the remedy; but if it relate to its action in but one disease, it is indexed under the name of the disease.

"IX. The amount of sub-division made under the principal subject-heads depends very greatly upon the number of references to be classed.

"X. As a rule, the references are given from general to more special heads, but not the reverse. It is presumed, for instance, that those who wish to consult the literature on 'Aphasia' will turn to 'Brain (*Diseases of*)' and 'Nervous System (*Diseases of*),' as well as to 'Aphasia,' without being directed to do so by a cross-reference under the latter title.

"XI. Under the name of an organ will be found the books and papers relating to the anatomy and physiology of that organ. Following this usually come the abnormities and malformations of the organ, then its diseases, then its tumours, and lastly, its wounds and injuries.

"Anonymous works or papers are entered in regular order under the first word of the title not an article or preposition. Russian and Japanese titles are transliterated, and a translation is usually appended. Greek *names* are transliterated for the sake of uniformity in type.

"In indexing journals and transactions, the general rule has been that only original articles should be taken, but occasionally important papers are indexed in several periodicals; and sometimes a reprint is indexed when the original is not in the Library.

"The List of Abbreviations of Titles of Periodicals prefixed to this volume shows the journals and transactions which have been indexed to the present time. The right-hand column exhibits the volumes or numbers possessed by the Library, and, negatively, the deficiencies, which it is my earnest desire to fill. The List of Abbreviations is separately paged in order that it may be bound by itself, if desired, for use with succeeding volumes.

"Some of the abbreviations of names of places, especially in the United States, might have been still further shortened if the Catalogue had been intended for use only in this country. But an analysis, by subjects, of so large a collection of medical periodicals is, necessarily, useful in St. Petersburg, for example, as well as in Washington, its measure of utility in any locality being the extent of the collection of medical periodical literature therein. Intelligibility to foreigners, therefore, has been regarded as a quality essential to the abbreviations in question.

"In indicating pagination, the rule is that where the article does not exceed two pages in extent the first page only is given. If it exceed two pages, both the first and last pages are noted.

"The work of preparing this Catalogue began in 1873, and has been carried on persistently, and as rapidly as the amount of clerical aid available and the nature of the work would permit.

"The present volume includes 9090 author-titles, representing 8031 volumes and 6398 pamphlets. It also includes 9000 subject-titles of separate books and pamphlets, and 34,604 titles of articles in periodicals."

The rapid progress of every branch of science, medical and otherwise, and the proportionate, or perhaps we ought almost to say disproportionate, increase of medical and scientific periodical literature, render it exceedingly difficult for the student to keep himself *au courant* with the newest discoveries. The Royal Society's Catalogue of scientific papers conferred an inestimable boon upon scientific men, but it left much to be desired, inasmuch as it gave only the names of authors, and contained no index of subjects. Sometimes, too, its strict confinement to periodical literature is felt as an imperfection, for in cases where discoveries have been published in the form of pamphlets of a few pages, one searches through the Catalogue in the vain expectation of finding them. However, we have hitherto had nothing at all resembling it in medical literature, but now we possess the first volume of a work which greatly excels it both in scope and size. Such defects as the volume possesses are due to the imperfections of the library of which it is a catalogue, and it is to be hoped that all those (and their name must be legion) who profit by the use of this remarkable production, will do their best to enable Dr. Billings to make good the deficiencies.

It is clear that, however complete any catalogue may be at the time of its publication, the constant appearance of new books and pamphlets day by day and month by month must render it more and more defective. In order to supplement this catalogue, and prevent this gradually increasing deficiency from being felt as an evil, Dr. Billings and Dr. Fletcher are now publishing the *Index Medicus*, a monthly classified record of the current medical literature of the world. This is published by F. Leypoldt in New York, and by Trübner and Co. in London. The great labour and expense involved in getting out this monthly index require for it a large circulation. At present, we believe, it is published at a loss, and an increased number of subscribers is urgently requested in order to permit its continuance. We therefore trust that every one who finds his time and labour saved by this Index-Catalogue will show his gratitude to Dr. Billings and those who have assisted him, not only by helping to supply the wants of the library at Washington, but by subscribing regularly to the *Index Medicus*.

We cannot conclude this brief notice without congratulating the United States Government on having in its service such men as Dr. Billings and his able assistants, Doctors Fletcher, Yarrow, and Chadwick, nor without expressing the thankfulness which every medical man owes to them for the great boon they have conferred on medicine in printing and issuing the present Index-Catalogue.

THE PHILOSOPHY OF LANGUAGE

Max Müller and the Philosophy of Language. By Ludwig Noiré. (London: Longmans, Green, and Co. 1879.)

THE substance of this work has already appeared in the German periodical *Nord und Süd*, and the author here tells us that he has reproduced it in an enlarged form and in an English dress in order to do full justice to Max Müller's great merits in clearing the way "for future investigators." He considers that eminent services have been rendered to the cause of linguistic studies by the writings of the illustrious Oxford professor, and four out of the five chapters comprising this treatise are mainly occupied in putting this somewhat obvious fact in the clearest light. But he holds, in common probably with Max Müller himself, that the problem of the ultimate origin of articulate speech has not been solved in the brilliant and deservedly popular "Lectures on the Science of Language." Many difficulties are there removed, much light is thrown upon a great number of obscure points, several abstruse questions are treated with an amazing wealth of illustration, bringing them home to the meanest capacity, and sundry popular views, notably those stigmatised as the "Pooh-pooh" and "Bow-wow" theories, are either exploded, or reduced to their proper value. But the mystery of origin, the inexplicable ultimate residuum of roots, forming the constituent elements of all speech, remains almost unassailed, though distinct service has undoubtedly been done by narrowing down the question to this one issue. A still greater service is done when the gifted writer emphatically declares that these roots "are not, as is commonly maintained, merely scientific abstractions, but they were used originally as real words." This gave the death-blow to the Platonic "types," ideas, metaphysical entities and concepts which had still continued to obscure the subject, and block the way like so much mediæval rubbish. Herr Noiré aptly compares them to the *ova*, whence all animal and vegetable life. "By their development and uninterrupted growth all the known languages of the world have reached their marvellous structure, and become the body of reason and the instrument of mind" (p. 55).

In the last chapter, which will doubtless be read with the greatest curiosity, the author takes up the subject where Max Müller had left it, and develops the theory on

the origin of language, which he had already broached in his "Ursprung der Sprache," specially devoted to that question. The essential peculiarity of the view here advocated is contained in the following passage:—"Language is the CHILD OF WILL, of an active, not of a passive state; the roots of words contain the *proper activity of men*, and receive their significance from the *effects* of this activity in so far as it is phenomenal, *i.e.* visible. Human thought arises from a double root, the subjective activity, or the will, and the objective phenomenon which is accessible to the senses."

Language is further represented as "a product of *association* and of the community of feeling which is developed, intensified, and finally carried to perfection by community of life" (p. 81). Great stress is laid on the fact that human thought has a double root, the subject or individual activity, and its effect in the action, whence it follows that "the life of language stands in an indissoluble relation to the development of human action" (p. 83). The earliest meanings of verbal roots are all said to be "referred to human action," such notions as to dig, strike, scrape, scratch, tear, lying at the root of endless derived and secondary concepts.

Human thought is conceived as "an active process, a self-conscious, self-confident activity, not as a crude materialism imagines, the accidental play of unconscious atoms" (p. 88). This active process is traced to common action, and language itself becomes "the voice of the community" (p. 88). The essence of language consists in the naming of things, while the power of forming a notion of a thing, that is, of a group of phenomena grasped and conceived as one, constitutes the essential difference between man and the brute creation. At the same time man can conceive of things only "because he has the gift of speech, because he can give them a name" (p. 90).

The power of giving names flowed from the power of using signs. "He used signs and thereby attained to the power of using names also; or, in other words, of betokening again by a sound what he had noted before." The transition from one process to the other, attributed to the active will, is stated to be "the most important part of the theory" (p. 92).

Then the power of giving signs to things grows out of the habit of modifying them for his own use. "Men dug caves, plaited twigs, stripped the beasts of their skin, the trees of their bark. Hence was developed the marvellous hitherto unexplained gift of abstraction, and this in the most natural way. Man learnt to conceive a thing as he learnt to create things. His own creations were the first *things* for him" (p. 92). So that language conceives objects only "in so far as human action has touched, modified, reconstructed them; in a word, in so far as they have received *form*." Even such things as exist independently of the human will, or lie beyond the sphere of human action, are nevertheless brought within the sphere of human speech. "They become objects of human thought in the same way as the rest, that is to say, they are named as they would be, if the human hand had formed them" (p. 98).

Such is the line of argument pursued in the attempt to build up a new theory of articulate speech, which is here conceived by an evident disciple of Schopenhauer and the Monistic school, as an emanation of the self-conscious human will, flowing from the power of forming abstract ideas, and dealing primarily and exclusively with such things only as are either the direct creation, or brought under the direct control and modifying influence of man. But this seems to be a complete perversion of the natural sequence of events in the evolution of man and all his faculties. Of these the very highest, next at all events to the moral sense, consequently the latest to be developed, was the conscious will. In the lowest savage tribes it is still often so feeble as scarcely to be distinguished from mere sensation and animal impulse. Yet the speech even of the rudest tribes is almost invariably found to be of a very intricate mechanism, subject to definite laws of structure and harmony, possessed at times of a copious vocabulary, embracing a variety of objects entirely beyond the influence or control of man himself, objects whose names cannot by the most violent straining be traced to those of things created or modified by human action. It is very easy to quote a few instances in support of such a theory as this, especially from such highly imaginative languages as those of the Aryan family, in which analogy and metaphor have had such free play during a long period of comparative culture. But hundreds of such examples would bring us no nearer than we were before to the starting point, to the faculty of naming things and actions, to the reason of certain sounds being selected in preference to others wherewith to name them.

The question still remains unanswered, whence came the "limited store of sounds with which man accompanied his action," and which are said to have in some mysterious way "associated themselves with the objects produced or modified by the action." The difficulty does not lie in the derivation of *cœlum* or *hole* from a primitive root *sku* or *ku*, but in tracing the origin of this root itself, and, in general, of all roots, whether they have to do with human action or not. For it is not for a moment to be supposed that all the roots even of the Aryan family can be identified with the names of things subject to human influence. Such are, for instance, *as* expressive of mere existence, hence passive rather than active, *idh*, *indh*, to burn, whence αἴθω, αἰθήρ, *æstus*, *heat*, &c., words all applicable primarily rather to the powers of nature than of man; *ud*, *und*, to flow, whence ὕδος, *udum*, *undo*, Goth. *wato*, *water*, &c., a purely natural object named directly from a purely natural conception; *svan*, to resound, whence *sonus*, *sound*; *svanitam*, *sonitus*, all words expressive of natural noise, and if Eichhoff is right in connecting the Gothic *sangws* and English *song* with this root, then these human actions can be conceived only as secondary derivatives from the primary idea of natural sound. This is the logical order of sequence, but it is as subversive of the author's theory as are many other Aryan roots which need not here be quoted. Enough has been said to show that this theory, while leaving the real question of origin untouched, will apply in any case to a part only of the original stock of roots in the Aryan family. Nor, as stated, will it help us in the least towards an explanation even of these.

On the whole it is to be feared that our author leaves the matter much where Max Müller left it at the end of his "Science of Language"; for the theory here advocated assuredly does not answer the questions: How do mere cries become phonetic types? How can sensations be changed into concepts? These questions can be answered

only by divesting the mind of all metaphysical vagaries, and approaching the discussion in a spirit of strict loyalty to the established principles of evolution. The universe is not "a mental phenomenon," as Schopenhauer would call it, nor is speech the deliberate product of conscious will. It is an organism which, like all other organisms, had its origin in a germ, and its slow growth and silent development in suitable surroundings, independently of all conscious action. Yet in dealing with a subject of this sort one still feels how much easier it is to refute error than to establish truth. "*Utinam tam facile vera invenire possim quam falsa convincere.*" A. H. KEANE

OUR BOOK SHELF

Easy Lessons in Science. Edited by Prof. F. W. Barrett. I. *Easy Lessons in Heat.* By C. A. Martineau. II. *Easy Lessons in Light.* By Mrs. W. Awdry. (London: Macmillan and Co., 1880.)

THESE excellent little lesson books deserve a wide circulation. Well and clearly written, they are at the same time strictly of the "scientific" rather than of the so-called "popular" style of exposition; there being none of the objectionable sensational element with which certain French works in light science have too greatly familiarised us. The cuts with which the volumes before us are illustrated are numerous, appropriate, and many of them original. In each case the reader is instructed in the simple apparatus needed to repeat the experiments described; so that a teacher who desires to give to young pupils a few elementary lessons in the sciences of heat and light will find here the very text-books most suited to his requirements. Miss C. A. Martineau's "Lessons in Heat" follows the usual order of text-books in that science. The first lesson deals with expansions, the second with notions of temperature, the third tells "how heat spreads," and so forth, and in the concluding chapters some of the fundamental facts of the relation between heat and mechanical work are made known. One experiment which we do not remember meeting with before in the shape in which it is given deserves to be cited. It is a variation on Davy's old experiment with flame and gauze. "Put a bit of camphor *on* the wire gauze, and hold a light *under* it. The vapour of the camphor passes freely through the gauze, catches fire, and burns with a blue flame till the whole of the camphor has been turned into vapour and burned. But the flame does not pass through the gauze to set fire to the solid camphor."

Mrs. Awdry's "Lessons on Light" are no less felicitous in their treatment of the subject. The usual popular text-book on Optics abounds in descriptions of different optical instruments, telescopes, microscopes, kaleidoscopes, and the like, without much trouble being expended upon first principles. But in these lessons first principles claim the prominent place: the first point explained is the law of inverse squares, and the second the geometrical laws of refraction and reflection—and the explanations are admirably yet quite simply done. A most interesting feature is that the latter half of these easy lessons is devoted to physical optics. One chapter on the wave-theory, and two entitled "Measurings" prepare the way for a capital lesson on Diffraction. A lesson on the Spectrum and one on the Rainbow close the series.

We do not say that there is no room for criticism in judging these little volumes. A professed teacher of Natural Philosophy might grumble at the omission of certain things that claim prominence in all the older text-books and in many of the syllabuses of contemporary examinations. Yet we would challenge such critics to produce a more useful, or suggestive, or accurate set of lessons, or one more entirely free from the two besetting faults of sensational popularisation and educational cram.

It is to be hoped that Prof. Barrett will continue his labours in adding to the series he has so ably edited.

Outline of a Course of Natural Philosophy, with Specimen Examination Papers. By Gerald Molloy, D.D. (London: Simpkin, Marshall, and Co., 1880.)

THIS work of 114 pages contains a syllabus-outline of the course of lectures in Natural Philosophy by Dr. Molloy, at the Catholic University of Ireland, and is reprinted chiefly to meet the wants of teachers in intermediate schools. To the syllabus, which is remarkably full and complete, is appended an extensive series of examination papers on all branches of physics except light, electricity, and magnetism, which are promised to follow. These questions, though chiefly elementary, have been carefully prepared, and are a valuable part of the work. In an appendix Dr. Molloy reprints a paper giving an account of his particular form of bichromate battery, which appears to be peculiarly suited to the needs of schools and colleges, where a powerful battery of convenient form is required to be in readiness for occasional use.

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.*]

Sir Wyville Thomson and Natural Selection

I AM sorry to find that Sir Wyville Thomson does not understand the principle of natural selection, as explained by Mr. Wallace and myself. If he had done so, he could not have written the following sentence in the Introduction to the Voyage of the *Challenger*:—"The character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection." This is a standard of criticism not uncommonly reached by theologians and metaphysicians, when they write on scientific subjects, but is something new as coming from a naturalist. Prof. Huxley demurs to it in the last number of NATURE; but he does not touch on the expression of *extreme variation*, nor on that of evolution being guided *only* by natural selection. Can Sir Wyville Thomson name any one who has said that the evolution of species depends only on natural selection? As far as concerns myself, I believe that no one has brought forward so many observations on the effects of the use and disuse of parts, as I have done in my "Variation of Animals and Plants under Domestication"; and these observations were made for this special object. I have likewise there adduced a considerable body of facts, showing the direct action of external conditions on organisms; though no doubt since my books were published much has been learnt on this head. If Sir Wyville Thomson were to visit the yard of a breeder, and saw all his cattle or sheep almost absolutely true, that is, closely similar, he would exclaim: "Sir, I see here no extreme variation; nor can I find any support to the belief that you have followed the principle of selection in the breeding of your animals." From what I formerly saw of breeders, I have no doubt that the man thus rebuked would have smiled and said not a word. If he had afterwards told the story to other breeders, I greatly fear that they would have used emphatic but irreverent language about naturalists. CHARLES DARWIN

Down, Beckenham, Kent, November 5

Geological Changes of Level

In a most friendly notice in your last issue of the *Memoirs* forming the first volume of the official Report of the *Challenger* Expedition, Prof. Huxley takes exception to a sentence in my short Introduction. "There seems to be sufficient evidence that all changes of level since the close of the Palæozoic period are in direct relation to the present coast lines," and he asks in what possible sense this can be the case.

I fully admit the criticism, and that the sentence as it stands does not explain itself.

That it is not a relation of ordinary parallelism Lyell's and D'Orbigny's maps of old coast-lines, a map published by myself in "The Depths of the Sea," and particularly the beautiful later maps of Jurassic, Cretaceous, and Tertiary France by M. Delesse, abundantly show. I have explained my idea of the relation in position between the recent deposits and those of the Tertiary and Secondary periods in "The Depths of the Sea" (pp. 472-476) at some length. I believe that the Jurassic, the Cretaceous, and the Tertiary formations are essentially *marginal* deposits, and that their belts of deposition form approximately a series of contour bands upon an elevation which has persisted throughout a long series of local and general oscillations, the sum of which has raised the whole through a small vertical range. Such oscillations have also, doubtless, affected the bottom of the sea, but nowhere to such an extent as to modify in any important degree the conditions of the abyssal region.

Prof. Huxley says, "There is nothing, so far as I am aware, in the biological or geological evidence at present accessible, to render untenable the hypothesis that an area of the mid-Atlantic or of the Pacific sea-bed as big as Europe should have been upheaved as high as Mont Blanc and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it." I think however he will admit that the following *Challenger* data, if they can be established, afford at least a presumption against an oscillation of such a kind, at all events in post-Triassic times, beyond which it is difficult to stretch even the imagination.

The careful researches of my colleagues, Mr. Murray and the Abbé Renard, with which I have had the advantage of being familiar during their progress, have led us to the belief that (1) the chalk of the Cretaceous period was not laid down in what we now consider deep-water, and that its fauna, consisting mainly of shallow-water forms, merely touches the upper limit of the abyssal fauna; and (2) that no beds exist in the series of known sedimentary rocks which correspond in composition and in structure with the beds now in process of formation in the abyssal sea ("The Atlantic," vol. ii. p. 299).

The hypothesis of the elevation of a mass of land equal to Europe and as high as Mont Blanc in the middle of one of the great ocean basins could in our present state of knowledge be defensible only on the supposition that it was a phenomenon of the same order as the elevation of some portion of our existing continental land, and there is now, to say the least, grave reason for doubting that any rock which is due to accumulations formed at depths over 2500 fathoms, the average depth of the basins to which Prof. Huxley refers, enters into the composition of any existing continent. The present land consists of a set of crystalline rock-axes of various ages, with a long succession of sedimentary deposits, all of which give evidence of having been laid down in water of moderate depth, piled up upon and against them. Such a hypothesis therefore, besides being without a single fact in its support, would be met by a strong adverse argument from analogy, and would be, so far, in a worse case than the hypothesis of the origin of species by natural selection.

I thoroughly agree, however, with my friend Prof. Huxley that "the value of the great work which is now being brought before the public does not lie in the speculations which may be based upon it, but in the mass and the solidity of the permanent additions which it makes to our knowledge of natural facts," and I imagine that all of us who are engaged in that work look upon it as our first and paramount duty to present these natural facts which have been acquired as simply and as effectively as we can. Still the generalisations or impressions, or whatever they may be, of the few men selected to observe these facts are as much a part of the result of the Expedition as anything else, and I think it is also our duty to offer them to our fellow-workers for what they are worth.

C. Wyville Thomson

Bonsyde, Linlithgow, November 6

"The First Volume of the Publications of the 'Challenger'"—A Correction

There is a typographical error in my notice of the *Challenger* publications, published in last week's Nature, for which I should, of course, be disposed to blame the printer, had it not been hinted to me that my handwriting is sometimes not so clear as might be wished.

I appear (p. 2) to agree with the proposition that "the deep-sea fauna presents us with many forms which are the *dried* and but little modified descendants of Tertiary and Mesozoic species."

As few things can be much wetter than the inhabitants of the ocean abysses, this opinion seems to be, to say the least, eccentric.

But "dried" should have been printed "direct," which was the word denoted by my graphic symbols.

T. H. Huxley

4, Marlborough Place, Abbey Road, N.W., November 7

Correspondence of Phenomena in Magnetic Storms

The Astronomer-Royal having lately received from the Observatory of Zi-ka-wei, in China (latitude 31° 12′ north, longitude, from Greenwich, 8h. 6m. east), lithographed copies of the photographic traces of the declination and horizontal force magnets, extending from August 11 to 14, and from August 17 to 20 of the present year, has placed them in my hands for comparison with the Greenwich records. Some particulars of this comparison are herewith annexed. Greenwich time is used throughout.

A general examination of the two sets of curves shows that the disturbances were usually greater in magnitude at Greenwich than at Zi-ka-wei. Comparing the curves in detail, it is found that on August 11, at 10.20[1] a.m., after a quiet period, the declination and horizontal force magnets at Greenwich both made a sudden start, which was the commencement of a magnetic disturbance, lasting until midnight. An apparently equally sudden start (from a quiescent state), in both declination and horizontal force, is shown on the Zi-ka-wei curves, occurring in declination at 10.12 a.m., and in horizontal force at 10.20 a.m. (as nearly as the small scale on which the curves are drawn will allow measures to be made). This first motion was to decrease the west declination and increase the horizontal force at both places. A bold motion in the two Zi-ka-wei curves at 11.30 a.m. (increase of declination, decrease of horizontal force) has corresponding decrease of horizontal force at Greenwich, not accompanied, however, by much motion in declination. And of numerous fluctuations occurring at Greenwich between noon and midnight of the same day, some appear to correspond with motions at Zi-ka-wei, whilst others do not.

A calm state follows at both places, until near noon of August 12. On this day at about 11.40 a.m. the magnets at Greenwich made a further start, and until 4 p.m. the movements were large. A corresponding start is also shown in both the Zi-ka-wei curves (commencing, according to the register, some minutes sooner than at Greenwich), the movements following being similarly large. Afterwards, until 6 a.m. of August 13, considerable oscillation was nearly continually shown at Greenwich, there being especially a large change of declination between 7 and 9 p.m. (August 12); but there is no strongly-marked motion at the latter time at Zi-ka-wei, and the changes are throughout much smaller than at Greenwich. Later on August 13 further oscillations occur at both places, but the separate motions are in no particular accordance. The period of disturbance seems definitely to come to an end at both places at 6 a.m. on August 14.

A period of quiet is broken at Greenwich on August 18, at 1.45 p.m., by a sharp though small movement both in declination and horizontal force (increase of both). There is a corresponding sharp increase (after quietude) of horizontal force at Zi-ka-wei, but no change of declination. A bold increase of declination and decrease of horizontal force at Greenwich at 7 a.m. of August 19 is accompanied by a similar decrease of horizontal force at Zi-ka-wei, but with little change of declination. Bolder changes occur at the latter place at noon, but with comparatively small change at Greenwich. The magnets become quiet at both places at or near midnight of August 19.

The general result of this comparison of Greenwich and Zi-ka-wei curves appears to be that, after a quiet period, the first indication of disturbance, if sudden (it need not be large) occurs simultaneously or nearly so at both places, but that during the

[1] Approximately stated to be 10.30 in my previous letter (Nature, vol. xxii. p. 361), and so quoted by Mr. Whipple (p. 558). The time above given is more exact.

continuance of disturbance the oscillations of the magnets seem to be so locally modified that it becomes difficult to trace correspondence: some movements appear to correspond, and some not. A strongly-marked bend in the trace at one place may appear, as it were, stunted in that at the other place, or may not be perceptible at all. The disturbances appear to die out at pretty much the same time at both places. All this confirms very much what Mr. Whipple has already pointed out as regards Melbourne (NATURE, vol. xxii. p. 558).

M. Dechevrens, in some remarks which accompany the sheet of curves, notes that the disturbance of August 11–14 is the greatest experienced since the establishment of photographic registration at Zi-ka-wei in the year 1877, and he considers that the changes then observed (those of vertical force included, of which he gives no curves) are similar to such as would be produced by a powerful magnet placed in a certain defined position. It may perhaps be here pointed out that the results given by the Astronomer-Royal in his paper, "First Analysis of One Hundred and Seventy-seven Magnetic Storms" (*Phil. Trans.* for 1863) appear to give no support to a theory of this kind, and indeed seem conclusively to show that at Greenwich the observed disturbances cannot be accounted for in any such way.

It should be added that M. Dechevrens reports also that strong earth currents were experienced on August 11 and 12 on the submarine telegraph lines connecting Shanghai with Nagasaki and with Hong-Kong, as well as on the land lines in Japan, so much so that correspondence was frequently interrupted, but that no interruption appears to have been experienced on the occasion of the generally smaller magnetic disturbance of August 18. WILLIAM ELLIS

Royal Observatory, Greenwich, November 6

Meteor

A VERY large and brilliant meteor was observed here at 6h. 41m. p.m. G.M.T., on November 8. Its size was at least equal to one-fourth of that of the full moon, and it lit up the whole garden for about a second and a half. It was pear-shaped. The colour was white, and left behind it a pale red train. Its path was from a point half-way between α and δ Persei to 3° above ν Ursæ Majoris. The sky was rather hazy at the time.

Stonyhurst Observatory, November 9 S. J. PERRY

Condition of Jupiter

ON the evening of the 2nd I had a fine view of Jupiter with my 6-inch Cook's equatorial. The general appearance of the planet was remarkable for the bright colouring of the belts and of the red spot, a circumstance strongly noted by a gentleman who was observing with me, and who had not seen the planet for some time.

I could not however trace the usual white ring round the red spot. Below the red equatorial belt was a row of four or five small irregularly-shaped spots, nearly black in tint, and resembling sun-spots seen under a low power.

These dark spots seem now affecting Jupiter's surface in several parts, and are certainly not usual to it. About 9h. 26m. Satellite I. was occulted. I watched it gradually coming to contact, and at last it seemed to advance on the face of the planet, at least one-half of its diameter appearing to project thereon. It then faded out gradually.

September 3, 1879, at 9h. 8m., with the same instrument Satellite III. reappearing after occultation, was slightly (but certainly) projected on to the disk of the planet. It will be interesting to notice whether the present condition of Jupiter will be accompanied by more than ordinary displays of auroræ, of which symptoms have already appeared.

Guildown, November 6 J. RAND CAPRON

P.S.—Since writing the above accounts reach me of auroræ at Brighton on the 3rd and in the Orkneys on the 4th instant.

Vox Angelica

MANY of your readers may be acquainted with the nature of the Vox Angelica stop on a good organ. It consists of two ranks of pipes of small scale and delicate quality of tone, one of which is tuned slightly sharp, so that a wavy (hence called *Unda Maris*) sound is produced. Now it is possible to obtain very similar effects on an ordinary Estey American organ. Given the viola and violetta stops to be drawn out, wrap a band of india-rubber (an ordinary elastic band does very well) round the neck of the viola stop so that it cannot return completely home, on moderate pressure, and allowing a fraction of an inch to intervene between its true final position when inactive; beats will be heard of intensity depending upon the deviation from complete occlusion of this stop. The nearer the viola stop is to occlusion the more rapid the beats; but it is undesirable to obtain rapidity, as the lower notes are too prominently out of tune in this case. Anybody can, by experiment, determine the proper amount of deviation to be employed, and having done this the effect is remarkably good. On an Estey, the two stops mentioned are the only admissible ones for such an experiment, from consideration of overtones. No doubt some of your readers may adopt a more elaborate and convenient method of regulating the deviation than by elastic bands, after some experiments. It may seem a paradox to obtain beautiful concordant effects by the use of discordant vibrational relations, but it is undeniable that on a first-class organ the Voix Celeste, or Vox Angelica, or Unda Maris, is a most beautiful stop, and is capable of producing perfect *con sordini* effects. GEORGE RAYLEIGH VICARS

Woodville House, Rugby, November 3

Solids and Liquids at High Temperatures

SOME years ago I made an investigation much simpler but somewhat similar to that referred to by Prof. Carnelley in NATURE, vol. xxii. p. 435. An account of the experiments then made was communicated to the Royal Scottish Society of Arts, 1874–75. One of the results of that investigation was that while we do know something about the temperatures at which different forms of matter change from one state to another when a "*free surface*" is present, yet we are utterly ignorant of the temperature at which that change will take place when no "*free surface*" is present. It will be necessary here to explain that a "*free surface*" is any surface of the body under examination at which it is *free* to change its state. A surface of water, for instance, in contact with its own vapour is a "*free surface*" for the water passing into the gaseous state. The surface of a piece of ice in water, again, is a "*free surface*" at which the water may freeze or the ice may melt. And what are known as the freezing, melting, and boiling points of water are the temperatures at which these changes take place when such "*free surfaces*" are present. As to what the freezing, melting, and boiling points are when these "*free surfaces*" are absent, we have at present no knowledge whatever. All we know is that the freezing point is lower, and the "melting" and "boiling points" are higher, than when "*free surfaces*" are present.

The first of these points is too well known to be referred to here. The last point was illustrated in the paper referred to by an experiment in which water was heated in a metal vessel under atmospheric pressure to a temperature far above the "boiling point," when the water exploded and violently ejected itself from the vessel. The superheating of the water was accomplished by carefully excluding all "*free surfaces*" by bringing the water into as perfect contact with the metal of the vessel as possible.

Many experiments were also made to get direct and thermometric experimental illustration of the existence of ice at a temperature above the "melting point," but no satisfactory illustrations were got, on account of the great difficulty of getting quit of "*free surfaces.*" Of course so long as there existed a "*free surface*" at the surface of contact of the ice with the thermometer, the temperature at that part could not rise above the "melting point." It was however shown by indirect evidence that ice may exist at a temperature above the "freezing point" by referring to the well-known and beautiful experiment of passing a beam of light through a block of ice. When this is done with the aid of proper apparatus it is seen that the heat of the ray is absorbed by the ice, and that melting takes place at different points inside the block. Now the presumption is that the heat is absorbed at all points inside the block, but as the melting only takes place at certain points the heat absorbed where there is no melting must raise the temperature of the ice at those points above the "melting point," and the heat there absorbed by the ice will be conducted to the "*free surfaces*," where it is spent in melting the ice.

Now though I was perfectly prepared to find that Prof. Carnelley had succeeded in heating the *inside* of a block of ice to a temperature above the "melting-point," I certainly did not expect so high a temperature as his experiments indicate to be

possible. But what is still more puzzling is how Prof. Carnelley succeeded in burning his fingers with the ice. Our previous knowledge would lead us to suppose that the outside surface of the block of ice was a *free surface*, and that therefore it would be impossible, however high the temperature of the inside of the block, to heat the outside above the "melting point," as we should expect the ice to melt or to sublime at the outside, and keep the temperature at o° C.

These expectations being disappointed, we naturally look to the decreased pressure under which Prof. Carnelley's experiments were made for an explanation of this most unexpected state of matters. Now it is very evident that when dealing with pressures of about one atmosphere, and with temperatures of 120° and 180° C., that pressure, as pressure, has nothing whatever directly to do with the "melting point" of the ice. While this is the case, it is equally evident that it has a most important influence on the surroundings of the ice. At the pressure of 4·6 mm., at which the experiments were made, no water would be present, there would be nothing but ice and water-vapour. Here then appears to be the great teaching of Prof. Carnelley's experiments. *They show that the surface of ice bounded by its own vapour is not a "free surface."* This result is so very unexpected that much consideration will be necessary before we can re-arrange our ideas to meet the new facts.

We might imagine that nothing could be more free than the surface of a body bounded by nothing but its own vapour, yet Prof. Carnelley's experiments seem to say it really is not so, and not being a "*free surface*," we of course know nothing whatever of how high the temperature will require to be before the ice will melt under these conditions.

These experiments of Prof. Carnelley's are so interesting that we wait with impatience a full description of them. His results indicate something new with regard to the influence of a liquid on its melting solid. I observe that Prof. Carnelley's results are doubted by most of your correspondents, but for the present we must accept them when Prof. Carnelley distinctly states that the temperature of the ice was taken by means of a thermometer in contact with the ice.

JOHN AITKEN

Darroch, Falkirk, N.B., October 30

Wire Torsion

IN the letter in NATURE, vol. xxii. p. 604, which we wrote at the request of Major Herschel, who asked for information regarding the connection between tensional and torsional strains of a brass wire, we mentioned that there were many papers scattered through the *Proceedings* of learned societies dealing with the fluidity of metals. There is one communication to which we might specially have referred, as it deals in particular with the torsional yielding of wires under tension, and this is a paper on "Torsion," by Prof. G. Wiedemann, in the *Annalen der Physik und Chemie*, No. 4, vol. vi., 1879, pp. 485-520, and of which a translation is given in the *Philosophical Magazine*, vol. ix., January 1880, pp. 1-15, and February, pp. 97-109. The first part of this paper gives a detailed account of experiments which show :—(1) That a brass wire often subjected to a particular torsion, either in one or in both directions, becomes "killed" for any less torsions, that is, follows Hooke's law for its temporary torsions; (2) that a wire under tension acquires greater torsional set from a given torsional couple than when the wire is unextended; (3) that a wire under even considerable tension may be killed by torsion in alternately opposite directions, that is, it will obey Hooke's law for any tension or torsion less than the stresses actually applied originally. Prof. Wiedemann in the second part of his paper considers the well-known "agitation effects," and enters on an explanation of the phenomenon based upon molecular allineations referring to the magnetisation theory of Weber and Kolrausch which is based on the same idea.

The strains in Prof. Wiedemann's wires were however much ess than in those used in Major Herschel's experiments.

JOHN PERRY

London, November 8 W. E. AYRTON

Heat of Formation of a Compound

IN NATURE, vol. xxii. p. 608, there is a paper on "Recent Chemical Research," in which under the head of work by Thomsen the following law is enunciated :—

"The heat of formation of a compound substance is the difference between the sum of the heats of combustion of the constituent elements of the compound and the heat of combustion of the compound itself." After that it is shown that this is not the true heat of formation of the compound, as many important corrections have to be made. On referring to Berthelot's "Essai de Mécanique Chimique" I find the following :—"The heat of formation of an organic compound from its elements is the difference between the sum of the heats of total combustion of its elements and the heat of combustion of the compound with formation of identical products."

Can any of your readers inform me whether Thomsen or Berthelot first enunciated this law?

Another point is, that Berthelot apparently makes no reference to the corrections for the heat absorbed in dissociating the molecules of the elements, &c.

A. P. LAURIE

Edinburgh, November 1

The Yang-tse, the Yellow River, and the Pei-ho

IN replying to the letter of your correspondent (NATURE, vol. xxii. p. 559) on the subject of my recent paper on these three rivers, I have to thank him for his very probable explanation of the excessive estimate made by Sir George Staunton of the amount of sediment discharged by the Yellow River.

The estimate given in my paper of the water-discharge of the River Plate is *ipso facto* an assumption made by Mr. George Higgin from Mr. Bateman's calculation of the minimum flow of that river, which he found to be 670,000 cubic feet per second. It might have been better, however, if I had added Mr. Higgin's qualifying remark that such an estimate of the mean volume of water was "very much under the mark" (NATURE, vol. xix. p. 555).

The anomaly of the surface current varying in velocity with the same average depth of water has not been unnoticed by myself, though I am unable to give a satisfactory explanation of the difficulty.

H. B. GUPPY

Woodlane, Falmouth, November 6

The Thresher

WHAT is the "thresher"? It is generally assumed to be the fox-shark (*Alopias vulpes*), but in a recent number of *Land and Water*—which I have only just seen—Mr. Frank Buckland says that he believes it to be "the gladiator dolphin or sword grampus" (*Orca gladiator*). This he infers from a drawing of Lord A. Campbell's, of which he gives a copy. The tail, he says, is not that of the fox-shark. But as it is heterocercal it cannot be that of a grampus or any other Cetacean. Whatever it is I suppose that there is no doubt that it throws itself out of the water ("high as the masthead" [of a trawler] one of Mr. Buckland's correspondents avers). Does it do so more than once? Once, many years ago, between Sydney and New Zealand, I saw, what they said was a fight between a thresher and a whale, but there was nothing to be seen beyond a splashing of the water. Last year off Lisbon I witnessed a similar event. Does the sword-fish also attack the whale? Lord A. Campbell, in the letter accompanying his drawing, estimated the length of *his* thresher at "upwards of thirty feet;" this is twice the length given by Yarrell.

FRANCIS P. PASCOE

October 30

Since the above was written I see that Dr. Günther, in his new work on Fishes, says: "Statements that it (the fox-shark) has been seen to attack whales and other large cetaceans rest upon erroneous observations" (p. 322).

"STUDENT" should refer to Newcomb's "Popular Astronomy" with respect to the larger telescopes. For results he must refer to the publications of the Royal and Astronomical Societies, the Washington Observatory, &c.

PAUL LAFARGUE.—We regret we have no further details on the labours of the U.S. Fish Commission in increasing the food supply of the country.

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION

I.

THE sagacious founders of the Zoological Society of London made it a special rule that no dividends or gifts of any kind should be distributed amongst the

members. On the contrary, every Fellow has to contribute an annual sum towards the maintenance of the Society's establishment, unless he prefers to pay a life-composition in lieu thereof. Moreover, the Society are so fortunate as to be unencumbered by borrowed capital. They have consequently no burden in the shape of interest to be provided for. It follows that after putting aside rom their income a sum sufficient to meet the annual expenditure, they are able to devote the surplus to new buildings in the Gardens, and to the acquisition of new and rare subjects for the menagerie. While the supply of lions, tigers, elephants, and other well-known animals must always be kept up for the delectation of the ordinary public, and for the maintenance of the best possible living series of animals, it is also thus in their power to acquire animals of specially scientific value, in which the casual observer would take little interest, and which would, therefore, be quite ineligible except in a scientific point of view. This course of action has been adopted for many years, more especially since the foundation of the office of "Prosector" to the Society. For these special acquisitions not only delight the eyes of the intellectual observer while they live, but furnish the prosector with subjects for his studies when dead. Those who are acquainted with the *Proceedings* and *Transactions* of the Zoological Society of London will be well aware of the amount of work that has thus been accomplished as regards the anatomy of many of the rarer birds and mammals.

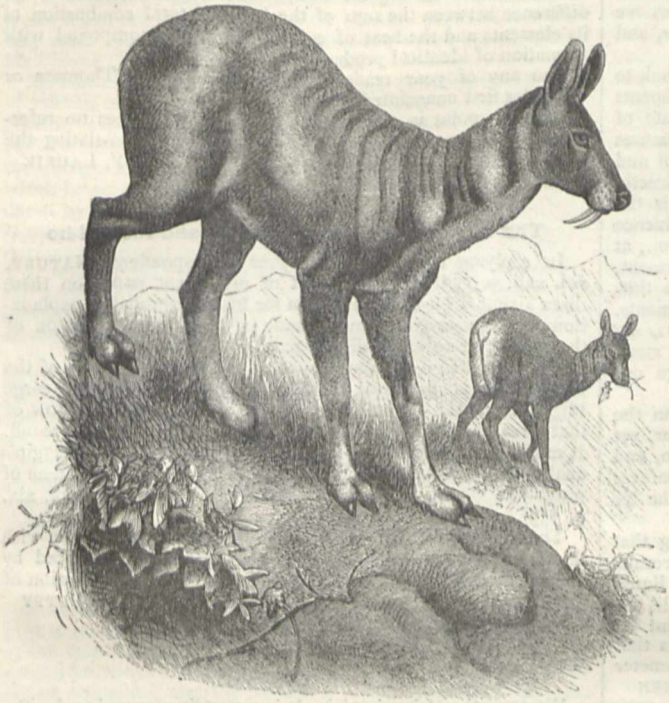


FIG. 1.—The Musk-deer (*Moschus moschiferus*). (From a drawing by Mr. J. Wolf from nature.)

It is, however, by no means by purchase only that rare animals are added to the Zoological Society's collection. Numerous friends and correspondents in almost every corner of the earth are in constant communication with the Secretary of the Society, and are ever endeavouring to obtain specimens that may be acceptable to the collection. In fact the donations have of late years become so numerous that they have not unfrequently rivalled in number and interest the objects acquired by purchase. Taking the acquisitions from these two sources together, there are always a considerable number of objects in the Society's collection that specially invite the attention of the observant naturalist. Amongst these rarities there are at the present moment the following, of which illustrations are given, drawn upon wood by Mr. J. Smit, an artist constantly employed by the Zoological Society.

1. The musk-deer (*Moschus moschiferus*) was well known to the older writers on zoology as the animal that has from long periods of time supplied the "musk" of commerce. This scent is still much in vogue in the East, but in Western Europe has been long superseded by more refined perfumes, though it may be remarked that one of the fashionable dealers in Bond Street still keeps a stuffed musk-deer in his window, and is doubtless ready to supply the product in question.

FIG. 2.—The Japanese Wolf (*Canis hodophylax*).

The musk-deer was until recently usually associated with another group of mammals to which it has really very little affinity. Dr. Gray and other systematists united it with the Chevrotains (*Tragulus*) of India and tropical Africa—a group of ruminants remarkable for their small size and hornless heads, and presenting somewhat of the appearance of diminutive antelopes. M. Alphonse Milne-Edwards of Paris was, we believe, the first naturalist to show that this allocation was unnatural. In his excellent essay on the Chevrotains, published in 1864, M. Milne-Edwards proved conclusively that these little-understood animals constitute a peculiar family of ungulates quite distinct from either the Bovidæ or Cervidæ, and in fact in some respects approaching more nearly to the pigs (Suidæ). The correctness of these observations has been since fully demonstrated by Prof. Flower, Mr. Garrod, and other systematists.

The musk-deer therefore remains unique in its own group, and constitutes a special division of the Cervidæ

or deer-family, remarkable for its absence of antlers in both sexes, the extraordinary prominence of the canine teeth (well shown in the illustration), the musk-producing organ, and other peculiarities.

It is to the great exertions of Sir Richard Pollock, K.C.S.I., lately Commissioner at Peshawur, that the Zoological Society are indebted for their living examples of the musk-deer, the only specimens, it is believed, that have ever been brought to Europe in captivity. A female of this animal was first received from Sir Richard Pollock in 1869. Although it did not live long in the Gardens, it gave Prof. Flower an opportunity of preparing a most valuable paper on its anatomy.[1] The same generous donor presented in 1877 a pair of this scarce animal, obtained from the Cashmere Hills, of which the male, now in excellent condition and fully adult, still survives, and is the subject of the accompanying illustration.

The musk-deer is found throughout the mountainous districts of Central and Eastern Asia, ranging, as the recent Russian explorers have shown, into Amoorland. Southwards it extends into the Himalayas, but is here, as Jerdon tells us, only met with at great elevations, rarely descending in summer below a height of 8000 feet, and extending as high as the upper limits of the forests.

Hodgson says that the musk-deer is "solitary, living in retired spots near rocks or in the depths of the forests: they leap well, but cannot climb nor descend slopes well. They rut in winter, and produce one or two young, usually in the cleft of a rock. In six weeks the young can shift for themselves, and are driven off by the mother."

The musk-deer, as stated by Jerdon, is wonderfully sure-footed, and over rocky and precipitous ground perhaps has no equal. It appears to eat chiefly grasses and lichens. If twins are produced the two are kept apart, it being very solitary in its habits, even in infancy. The musk is milky for the first year or two, afterwards granular. The dung of the males smells of musk, but the body does not, and females do not smell of it in the slightest degree. The flesh is dark red, and the young is considered to afford the best venison in India.

The musk-deer is much sought after by the hunter for its musk, many being shot and snared annually. A good musk-pod is valued at from ten to fifteen rupees. The musk as sold is often much adulterated with blood, liver, &c. One ounce is about the average produce of the pod.

2. The species of the genus *Canis* known as wolves—that is *Canis lupus* and its representative forms—are widely spread over the northern hemisphere, extending in the Old World as far south as Abyssinia (*Canis simensis*) and India (*Canis pallipes*). In North America the larger *Canis occidentalis* take their place in the Arctic regions and Rocky Mountains, but as it goes south, gradually gives place to the very distinct prairie-wolf (*Canis latrans*), which seems to range as far down as the Central American Isthmus.

The existence of a true wolf in Japan has been known to us since 1847 from its description and figure in Temminck and Siebold's "Fauna Japonica," under the name *Canis hodophylax*. But this animal has been very little known in Europe except from the specimens in the Leyden Museum, and as it is altogether omitted in Dr. Gray's Catalogue of the Carnivores, appears to be not even represented in the well-stored galleries of the British Museum. It is to an active correspondent in Japan—Mr. H. Heywood Jones—that the Zoological Society are indebted for their unique specimens of this scarce carnivore, which is now very difficult to be procured, having been driven into the recesses of the wooded mountains.

In general form and proportions the Japanese wolf much resembles its well-known congener of Europe, but is of inferior size and more slender make. According to Siebold its native name is "Jamainu."

3. The Tufted Umbrette (*Scopus umbretta*) or "Hammerkop" of the Cape Colonists, is a well-known bird both to natives and travellers all over Central and Southern Africa, but in Europe has only hitherto been recognised as a somewhat scarce object to be found in the principal museums. The example now in the Zoological Society's Gardens, which was acquired a few weeks ago by purchase from a dealer in Liverpool, is, it is believed, the only living specimen yet brought to Europe. The umbrette has been usually placed by systematists among the storks, and by Prof. Reinhardt was supposed to be the nearest ally of the *Balæniceps rex* (without doubt a Ciconiine form). But those who have studied its nimble gait and active habits, as shown in life, will not readily agree to this opinion. Nothing can well be more different from the staid, stolid demeanour of the stork than the lively action of the umbrette, which rather reminds one of a curlew or sand-piper. It is probable, however, that its real place will be found to be amongst the spoonbills and ibises (Plataleidæ), a group usually associated with the storks, although it must be recollected that the late Prof. Garrod maintained that (as "Schizorhinæ") the Plataleidæ would be better placed with the Limicolæ. When the present specimen dies the question of its position will be quickly decided by the Society's prosector,

FIG. 3.—The Tufted Umbrette (*Scopus umbretta*).

[1] "On the Structure and Affinities of the Musk-Deer (*Moschus moschiferus*, Linn.)," by William Henry Flower, F.R.S., V.P.Z.S.—P.Z.S., 1875, 159.

but long may we wait, it is to be hoped, before this event shall happen.

Of the curious nesting habits of *Scopus* we have excellent accounts from Brehm, Heuglin, and other naturalists who have visited the Upper Nile. But one of our own countrymen, a not less active or experienced observer—has likewise written a most interesting account of this bird's economy, and we cannot do better than transcribe a part of it.

"The *Hammerkop* (literally hammerhead)," says Mr. Layard in "The Birds of South Africa," "is found throughout the Colony and all the way to the Zambezi, frequenting ponds, marshes, rivers, and lakes. It is a strange, weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fishes, &c. At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics.

"They breed on trees and on rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing. The entrance is a small hole, generally placed in the most inaccessible side. The eggs, three to five in number, are of a pure white, axis 1″ 9‴; diam. 1″ 4‴.

"On my late friend Jackson's farm, at Nel's Poort, there is a singular rocky glen between two hills. In this spot a beautiful permanent spring called 'Jackalsfontein' takes its rise. Of course, in consequence, there are a few wild almond and other trees, and the place is a little oasis amid the barren mountains. It is a favourite resort of wild animals, hyænas, leopards, jackals, &c., and here Mr. Jackson has constructed one of his most successful hyæna-traps. On the ledges of the rocks in this secluded spot a colony of Hammerkops have built for years. Some of the nests are quite inaccessible, while others can be reached with a little trouble. I counted six or eight within fifty yards, and some of them contained at least a large cartload of sticks. Mr. Jackson told me they occupied the same nest year after year, and added to it or repaired it as required. About some that I visited I found brass and bone buttons, bits of crockery, bleached bones, &c. Mr. Jackson said if a 'Tottie' lost his knife or tinder-box on the farm, or within some miles of the place, he made a point of examining the hammerkops' nests, and frequently with success, the birds, like the 'Bowerbird' of Australia, embellishing their dwellings with any glittering or bright-coloured thing they can pick up."

A SUCCESSFUL AFRICAN EXPEDITION

AFRICA is overrun with explorers of all nationalities. Too often of late have we had to read of failures, of abortive attempts on the part of expensively-equipped expeditions to reach the field of their work, or of deaths by fever or assassination after the first difficulties were overcome. In spite of all, however, the unprecedented activity of recent years in this favourite field of exploration has pretty well filled up, with the leading features at least, that great blank space in the heart of the continent which in the rude maps of our schoolboy days was marked "unexplored." In the very centre of that space there is still however a blank, giving ample scope for work for the numerous Belgian expeditions that have hitherto done so little. It was to fill up this blank to some extent that the Geographical Society, about two years ago, obtained subscriptions to send out an expedition under young Keith Johnston, who had inherited an enthusiasm for geographical work quite worthy of the name he bore. As his subordinate and as geologist to the expedition, the Society appointed another young Scotchman, Mr. Joseph Thomson, a pupil of Prof. Geikie, who recommended him to the Geographical Society. To him, we grieve to say, it has been left to tell the story of the expedition, which he did, and did well, on Monday night at the opening meeting of the Geographical Society. This expedition is remarkable in many respects, in some points more remarkable than any other African expedition that we know of. The outline of its story is soon told. With 150 of the best men that could be found in and around Zanzibar Keith Johnston left that place in May, 1879, and striking at once to the south-west, made for the north end of Lake Nyassa, which was the real starting-point for fresh work. Little more than a month after the start, young Johnston, who seemed to have the nerve and stamina of an athlete, succumbed to the malarious influences of the coast region, and was buried by his companion at Behobeho, to the north of the Lufiji river. Mr. Thomson, inexperienced youth of twenty-two though he was, was equal to the emergency. With admirable tact and nerve he took his place as the sole leader of the expedition, and accomplished even more than the work which the Society had chalked out for it. By an unexplored route, through barren wastes and over lofty mountains, through the sneaking Wakhutu and the warlike Mahenge, he and his followers made their way till their eyes were gladdened and their weary spirits refreshed by the sight of the waters of Nyassa. Thence, after brief rest, they resumed their march over the lofty and undulating plateau, which they found occupied the region between the north end of Nyassa and the south shore of Tanganyika. Leaving here the bulk of his followers, Mr. Thomson, with a handful of men, trudged his way over the rugged western shores of Lake Tanganyika, to visit the Lukuga and settle the question whether it was an outlet or an affluent of the lake, a question, which, one would think, could be easily solved, but on which Stanley and Cameron published diametrically opposite statements. After visiting the missionary station near the mouth of the river, and running across to Ujiji, Mr. Thomson returned to the Lukuga and traced it for some miles of its downward course. After barely escaping from the murderous Warua with their lives, the party sailed down the lake, and rejoining their companions made the return journey to Zanzibar along the usual caravan route with unprecedented rapidity, in about a year after the expedition set out under their late chief. Mr. Thomson declared with just pride that all this was accomplished without the shedding of a drop of blood for either offensive or defensive purposes; with one exception he brought all his men back "in the best of health and condition"; he has collected certain information about a considerable region which no white man had previously visited; he has solved one of the few remaining great problems of African geography; and he has located with certainty a great salt lake (Hikwa) whose existence previously had only been based on native rumour. Mr. Thomson is a trained geologist, and as such he has doubtless seen more than almost any previous explorer. He tells us of the metamorphic schists and gneiss which compose the mountains of the great central plateau; of the many extinct volcanic cones that lie around the north-west end of Lake Nyassa, and of the metamorphic clay slates, felspathic rocks and volcanic porphyries and tuffs that look down on the lake from the north and north-east. His further geological insight may dispel some of the illusions that seem to be abroad as to the abounding wealth of the African interior. Much of the country between the coast and Nyassa is barren waste; and the chief characteristic of the region between Nyassa and Tanganyika he found to be "utter barrenness and the absence of anything worth trading for." Instead of the mountains of iron and the miles of surface coal, nowhere did he see a single metal in a form which a white man would for a moment look at as a profitable or workable speculation; there is very little more iron, he

maintains, than is sufficient to supply the simple wants of the natives. Coal he saw none, and he does not believe that such a thing exists over the wide area embraced in his route. This may be discouraging, but it is wholesome, and may prove a check to the wild schemes sometimes broached by speculators for opening up the African interior. From the Chimboya Mountains to the south-east of Tanganyika Mr. Thomson found numerous streamlets flowing southwards, doubtless to join the Chambeze, which, after passing through many a lake and levying tribute from a region one million square miles in extent, pours its almost Amazonian volume, as the Congo, 3000 miles below, into the bosom of the broad Atlantic. The much-debated Lukuga he found, as Mr. Hore had found shortly before him, to be a broad and rapid river, flowing westwards from the Tanganyika Lake to the Lualaba, as the Congo here is called; and Lake Hikwa he saw was a fine sheet of water with no outlet, lying among the lofty mountains, which stretch away east from Southern Tanganyika. What may be the extent and value of the purely geographical observations obtained by Mr. Thomson we have no means of knowing; doubtless in this respect the expedition suffered in the death of Mr. Johnston, who was a trained geographer. But in other respects, in information as to the structure of the country, the nature of its products, and the character of its varied peoples, the expedition under Mr. Thomson has been fruitful to a high degree; altogether it is one of the best pieces of original work which our not too energetic Geographical Society has ever done. Mr. Thomson's well-written and well-read paper was received with enthusiasm by an unusually distinguished audience. We trust to be able very shortly to give details concerning both the geography and geology of the Central Plateau from Mr. Thomson's own hands.

UNITED STATES WEATHER MAPS, DECEMBER, 1878

IMPORTANT changes took place this month in the distribution of the earth's atmosphere as compared with what obtained during the previous month, and these were accompanied with at least equally important changes in the geographical distribution of the temperature.

If a line be drawn from Texas to Newfoundland across the Atlantic, the north of France and Germany, thence curving round to south-eastward through the Black Sea, the Caucasus, India, the East India Islands, and Australia to the south island of New Zealand, it is found to pass through a broad and extended region where atmospheric pressure was throughout considerably below the average of December, and this low pressure was still further deepened at various points along the line. Again, another line passing from Australia through the Philippine Islands, Japan, Mantchooria, Behring's Straits, and Alaska, also marks out an extensive region where pressure was uninterruptedly below the mean.

On the other hand atmospheric pressure was above the average, and generally largely so, over the United States to west of long. 90°, over Greenland, Iceland, Farö, Shetland, and over a large portion of the Old Continent bounded by a line drawn from Lapland round by Lake Balkhash, Canton, Pekin, to at least the upper waters of the Lena. Another area of high pressure extended from Syria, through Egypt and East Africa to the Cape; and part of a third area of high pressure appeared in the north island of New Zealand.

As regards North America, the greatest excess of pressure, 0·196 inch above the average, occurred in the Columbia Valley, from which it gradually fell on proceeding eastward to a defect from the average of 0·146 inch about Lake Champlain and to northward, rising again to near the average on the north of Nova Scotia. To the north-east and north of this region exceedingly high pressures for these regions and the season prevailed, being 0·635 inch above the average in the north-west of Iceland, 0·500 inch in the south of Greenland, and at the three stations in West Greenland, proceeding northwards, 0·445, 0·402, and 0·346 inch.

West Greenland being thus on the west side of the region of high pressure which occupied the northern part of the Atlantic, and on the north-east side of the area of low pressure in the States and Canada, strong southerly winds set in over the country, and the temperature rose at the four Greenland stations proceeding from south to north to 1°·1, 8°·8, 12°·1, and 14°·4, above the averages. As the centre of lowest pressure was in the valley of the St. Lawrence about Montreal, strong northerly and westerly winds predominated to southward and westward, and there consequently the temperature was below the average, the deficiency at Chicago and St. Louis being 9°·5; and winds being easterly and northerly in California, temperature there was also under the average. On the other hand, in the New England States, the greater part of the Dominion of Canada, a considerable portion of British America, and in West Greenland, as already stated, temperature was above the average. Pressure was much higher at St. Michael's, Alaska, than it was to south-westward at St. Paul's, Behring Straits, and in connection therewith and with the prevailing winds, the temperature at St. Paul's was 2°·9 below the average, whereas at St. Michael's, where strong southerly winds prevailed, the temperature rose to 12°·0 about the normal. Hence whilst the continent of America presented striking contrasts in the distribution of pressure in December, 1878, it presented still more striking contrasts in the distribution of the temperature. Along Baffin's Bay the excess of the temperature above the normal was 14°·4, and at Behring Straits 12°·0, but in the south of Lake Michigan it was 9°·4 below it. In this last case the change of temperature from November to December was probably unprecedented, the mean for November having been 13°·7 above the average (NATURE, vol. xxii. p. 516), whilst the December temperature was 9°·5 below it, the difference being 23°·2!

Turning now to Europe, it is seen that Iceland lay on the east side of the patch of high pressure which overspread that region, northerly winds consequently prevailed, and with them a lowering of the temperature to 7°·2 below the average. The contrast this offers to West Greenland is very instructive. In both localities pressure was unusually high, but they occupied different positions, the one on the east and the other on the west of the same area of high pressure, with the inevitable result, of opposite prevailing winds, accompanied in the one case with a temperature 14°·4 above the average, and in the other 7°·2 below it. Hence as regards the temperature at the surface of the earth, it is not the height of the barometer which rules, but the situation of the locality with respect to areas of high and low pressure; or to put it more popularly, it is the winds which are chiefly concerned in the distribution of the temperature.

In Europe the area of lowest pressure occupied the southern shores of the North Sea, extending thence, though in a less pronounced form, to south-eastward. Hence over the whole of Western Europe winds were north-easterly, northerly, and in the south-west of Europe westerly; thus everywhere, from the North Cape to the north of Italy, temperature was below the normal, in some cases very greatly so, the deficiency being 10°·4 in the south of Norway, and 12°·2 in the south of Scotland. This is [the lowest monthly mean temperature known to have been recorded in Scotland since thermometric observations began to be made.

On the other hand, to the east of this area of low pressure, winds were southerly, and consequently temperatures were high. In some localities in Russia an excess of about 15°·0 occurred, and even over a large proportion

of European Russia the excess rose to 9°·0. This region of high temperature extended eastward into Siberia, as far as the Irtish, or to where the centre of the greatest excess of pressure prevailed. To the eastward of this area of highest pressure winds were northerly, and low temperature prevailed over the whole of the eastern part of Asia, the deficiency at Nertchinsk, on the Upper Amoor, being 6°·8 below the normal. Here, again, just as happened in America, places having the atmospheric pressure equally high above their average presented the strongest contrasts of temperature. Thus at Nertchinsk pressure was 0·154 inch, and at Bogoslovsk 0·211 inch above their respective averages; but at Bogoslovsk, on the west side of the anticyclonic patch of high pressure, temperature was 15°·0 above, whereas at Nertchinsk on the east side it was 6°·8 below the average.

This time of the year being the summer of the southern hemisphere, pressure falls to the annual minimum in Australia, but during December, 1878, this annual low pressure was still further diminished. Pressure at this season also falls to the annual minimum in the North Pacific and North Atlantic, and we have seen that the low pressure of these regions was likewise still further diminished. But in the case of the Atlantic it was accompanied with a vitally important difference. The centre of lowest pressure of the North Atlantic in winter, which is commonly located about Iceland, was removed many hundreds of miles to southward, and an unwonted development of extraordinarily high pressure appeared to northward, overspreading the extensive region of, at least, Baffin's Bay, Greenland, Iceland, Farö, and Shetland.

It was to this region of high pressure that the extreme severity of our British weather at the time was due. This high-pressure region was intimately connected with, and in all likelihood occasioned directly by the atmospheric movements resulting from the enormous extent of low pressure to southward, with its large centres of still lower pressures in the United States, mid-Atlantic, and the North Sea, where pressures were respectively 0·146 inch, 0·322 inch, and 0·307 inch below the normals. If future inquiry establish such a direct connection between the areas of low and high pressure, it is evident that when we come to attempt, on scientific grounds, to forecast the weather of the coming season for the British Islands, we must look to the Atlantic for the data on which the forecast is to be based.

In the winter months pressure rises to the annual maximum over Central Asia, and in America about the region of the Rocky Mountains. In December 1878, however, pressure rose in both regions greatly above its usually very high average, the excess being nearly a quarter of an inch in the valleys of the Yenisei, Obi, Irtish, and Tobal, about lat. 60°, and 0·200 in America in the Columbia Valley. It follows therefore that with the singular outstanding exception of the high-pressure area of Greenland, the meteorological peculiarities which make December, 1878, so memorable, arose out of a distribution of the earth's atmosphere, essentially the same that commonly obtains at this time of the year, but the usual irregularities in the distribution of the pressure appeared in more pronounced characters.

We have now had the pleasure, through the courtesy of the late General Myer, of presenting our readers with a series of Twelve of these unique Weather Maps, which open out a new future to meteorology. The map for December, 1878, closes the series which appears in NATURE. The questions which a perusal of these maps raises are of first importance, whether we consider the atmospheric changes they disclose, these being repeatedly so vast as to stretch across four continents at one time, besides being often profoundly interesting from their influence both on the food supplies and the commercial intercourse of nations; or the large problems hereby presented, with hints toward their solution, which underlie physical geography, climatology, and other branches of atmospheric physics. We have thus had shown us from month to month, in a way not hitherto possible, the great atmospheric changes as influenced by oceans and continents, including the important parts played in bringing about these changes, by mountain ranges, extensive plateaux, and physically well defined river basins. Much yet, however, remains to be done, principally by extending the network of observation in order that the Weather Maps may show, in an approximately adequate manner, the meteorology also of the North Pacific and the southern hemisphere. Till this be done many fundamental questions cannot be discussed, such as the inter-relations of the different continents and oceans of the globe in their bearings on successive meteorological changes; and the important inquiry as to whether the pressure of the earth's atmosphere be practically a constant from month to month, and, if not, what are the conditions or forces on which the observed differences depend. For the bringing of this great international work to so happy a consummation, we look with confidence to the War Department of the United States, since this implies no more than a continuance of the same energy and enlightened liberality that have won for the Americans their high position in meteorology.

SEARLES VALENTINE WOOD

PALÆONTOLOGY has sustained a severe loss in the death of the veteran explorer of the English Pliocene deposits. Born towards the close of the last century, the late Mr. Wood was from an early age an ardent collector and student of the fossils so abundantly found in the crag-pits of East Anglia. At this period the facilities for collecting the fossils of the English Pliocene strata were much greater than at present. Fresh pits for the purpose of obtaining the shelly marls and sands, which were then extensively used for manure, were continually being opened in the counties of Norfolk and Suffolk, while at the present time the new chemical manures have caused the crag to be quite neglected by agriculturists. The geologist who visits the Eastern Counties at the present day to study the Pliocene has to content himself with such exposures as he can find in old pits, now often overgrown with vegetation and which are used as sheepfolds or stackyards.

Mr. Searles Wood, as he himself said, was born within sight of one crag-pit; he resided for a great part of his life in the crag country, and hoped to be buried within sight of a crag-pit.

In the year 1839 Mr. Searles Wood joined the Geological Society of London. The following year was marked by the establishment of the London Clay Club by seven earnest students of fossils, of whom we believe only Prof. John Morris, formerly of University College, London, still survives. The object which the members of the London-Clay Club set before themselves was the figuring and describing of the British Tertiary fossils.

The London-Clay Club was the forerunner of, and became merged in, the Palæontographical Society of London. This Society has published between thirty and forty volumes, which have appeared annually, and has accomplished a most valuable work in the illustration of our British fossils.

At a very early date Mr. Searles Wood and his friend the late Mr. Frederick Edwards agreed to divide between them the work of describing the mollusca of the English Tertiary formations. The absence of marine Miocene formations in this country divides our British Tertiaries into two great groups, the Older Tertiaries, in which the great majority of the mollusca belong to extinct species

and the Newer Tertiaries, or crags, in which a large proportion of the forms belong to species still living in the seas of some portion of the globe. Mr. Searles Wood naturally chose the latter group for his study, and Mr. Edwards the former.

Upon the great task he had set before himself Mr. Searles Wood appears to have entered with characteristic energy, and in 1847 the Palæontographical Society was able to issue its first volume, which was entirely from the pen of Mr. Wood, and consisted of a description of the Crag Univalves, illustrated by twenty-one plates. In the years 1850, 1853, and 1855 Mr. Searles Wood was able to publish the parts of his descriptions of the Crag Bivalves, illustrated by thirty-one plates.

It soon became evident however that Mr. Edwards had taken upon his shoulders a lion's share of the work, and his friend Mr. Wood, having completed his own task, had to come to the aid of his fellow-student of the Tertiary fauna. It was then agreed that Edwards should complete his description of the Older Tertiary Univalves and that Wood should take up the description of the Bivalves. Between the years 1859 and 1877 Mr. Searles Wood published his descriptions of the Eocene Bivalves, illustrated by twenty-seven plates.

Additional discoveries of fossils having afforded Mr. Wood fresh materials, a supplement to the "Crag Mollusca" was published by him between the years 1871 and 1873. This work was illustrated by twelve plates, and included a very valuable memoir on the strata from which the fossils were obtained, written by his son, Mr. Searles V. Wood, jun., and Mr. Harmer of Norwich, who have both done so much good work in unravelling the complicated problems connected with the geology of East Anglia.

Nor did the zeal of Mr. Wood allow him to rest even here; for in 1877, in spite of his advanced age, we find him commencing a supplement to his own and Edwards's work on the Eocene mollusca.

In the year 1860 the Geological Society recognised the great services rendered to science by Mr. Searles Wood by presenting him with the blue-riband of geology, the Wollaston Medal. Prof. Phillips, who, as president of the year, handed the medal to Mr. Searles Wood, spoke in terms of well-merited praise of the important works which were the result of his patient, persevering, and successful labours.

Mr. Searles Wood and his friend Mr. Edwards were remarkable examples of a type of scientific man which, happily for us, is far more common in this country than in any other. They were both engaged in the legal profession, but found time in their leisure hours to accomplish most excellent and useful scientific work. In the volumes of the Palæontographical Society the work of amateurs like Searles Wood, Edwards, and Davidson appears side by side with that of Richard Owen, Edward Forbes, and John Phillips. The subscriptions of the members cover the cost of engraving and printing, but all other charges are defrayed by the authors, who expect and receive no kind of payment for their important labours.

The valuable collection of Tertiary fossils made by Edwards and Searles Wood have fortunately been secured by the authorities of the British Museum for our National Collection. They will in the New Natural History Museum at South Kensington be more accessible for study than at Bloomsbury, and as they contain great numbers of type specimens, will be invaluable for purposes of reference to both British and foreign palæontologists.

Mr. Searles Wood, as Treasurer of the Palæontographical Society, took the heartiest interest in its success, to which his own labours have to such a great extent contributed. Those who had the pleasure of a personal acquaintance with Mr. Searles Wood will ever remember the kindly and genial manners by which he was distinguished. J. W. J.

NOTES

THE following is the list of officers and council of the Royal Society nominated for the year ensuing. The election will take place as usual on St. Andrew's Day, November 30:—President — William Spottiswoode, M.A., D.C.L., LL.D.; Treasurer—John Evans, D.C.L., LL.D.; Secretaries—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D.; Foreign Secretary—Prof. Alexander William Williamson, Ph.D.; other members of the Council—William Henry Barlow, Pres. Inst. C.E.; Rev. Prof. Thomas George Bonney, M.A.; George Busk, F.L.S.; Right Hon. Sir Richard Assheton Cross; Edwin Dunkin, V.P.R.A.S.; Alexander John Ellis, B.A.; Thomas Archer Hirst, Ph.D; William Huggins, D.C.L., LL.D.; Prof. John Marshall, F.R.C.S.; Prof. Daniel Oliver, F.L.S.; Prof. Alfred Newton, M.A., Pres. C.P.S.; Prof. William Odling, M.B., V.P.C.S.; Henry Tibbats Stainton, F.G.S.; Sir James Paget, D.C.L.; William Henry Perkin, Sec. C.S.; Lieut.-General Richard Strachey, R.E., C.S.I.

IT is proposed to erect a monument to Spallanzani in Scandiano, where the distinguished naturalist was born in 1729. A committee for the promotion of the scheme has been formed there, and at Reggio and Modena. A monument in marble is contemplated, more or less splendid according to the sum provided, and it will be inaugurated on August 21, 1885 (if circumstances do not allow of an earlier inauguration). The committee meanwhile propose (if practicable) to publish a new and accurate edition of the writings of Spallanzani, including some which have not hitherto appeared. Contributions are hoped for not only from Italians, but from foreigners generally among whom the work and principles of Spallanzani are honoured.

M. LEON HUMBLOT, a well-known *naturaliste-voyageur*, has just returned to Paris from Madagascar with large and valuable collections. Amongst the living specimens (destined for the Menagerie of the Jardin des Plantes) are two examples of the aye-aye (*Chiromys madagascariensis*), which, M. Humblot maintains, it is now more difficult to procure in Madagascar than in Europe; a pair of the rare carnivore *Cryptoprocta ferox*, and specimens of several of the smaller lemuroids. M. Humblot has also brought a valuable series of mammals and birds in skin and a large collection of orchids.

NO naturalist who visits Florence should omit to inspect the series of Italian vertebrates which has been brought together in the Reale Istituto degli Studii superiori, by the exertions of Prof. H. H. Giglioli. The collection embraces a series of authenticated specimens of mammals, birds, reptiles, batrachians, and fishes from every part of Italy and the adjoining districts which belong essentially to the same fauna, arranged in systematic order, and is far more complete than any other Italian collection of the same sort. Prof. Giglioli is preparing a catalogue of this collection as a basis for a new "Fauna Italica."

ON the 1st inst. a very fine Naval and Marine Engineering Exhibition was opened in the Corporation Galleries, Glasgow, altogether probably the finest exhibition of the kind we have had in this country. It is divided into five sections:—1. Naval architecture, including war vessels, sailing ships, paddle and screw steamers, yachts, dredges, and miscellaneous craft, boats and life-boats; (2) Marine engineering, including engines and parts of engines, boilers and boiler appliances, &c., governors; (3) Equipment, including anchors, boat-lowering apparatus, pumps and hydraulic machinery, steering-gear, telegraphs, windlasses, &c., machines and tools; (4) Navigation and harbour works; (5) Miscellaneous. The first section is of special interest, containing models of vessels of all ages and of all kinds, from

the *Henry Grace de Dieu* (A.D. 1514) down to the *Livadia*, many of these models having been lent by the Admiralty. Prefixed to the carefully compiled catalogue is a sketch of the rise and progress of steam navigation, more especially on the River Clyde, by Mr. W. J. Miller, C.E. The success of this exhibition is largely due to the energy and tact of the Curator of the Glasgow Industrial Museum, Mr. James Paton.

"THE Journal of the Indian Archipelago," founded and edited by the late J. R. Logan, which was published at Singapore, and ceased to appear some years since, has always been accepted by ethnologists as a valuable contribution to Malayan literature. Some of the early volumes, especially the first, have long been out of print, but Mr. David Logan, the son of the late editor, who was recently in England, has reprinted the scarce ones, thus enabling complete sets of the work to be obtained. Messrs. Trübner are, we believe, the agents in London.

THE very large and extensive entomological collection made by the late Jno. Miers, F.R.S., has been presented to the Ashmolean Museum at Oxford, and is now being studied and incorporated by Prof. Westwood. This collection is particularly rich in Brazilian insects, and thus becomes peculiarly valuable for the Oxford collection, which was, compared with other regions, poor in the neotropical fauna.

THE British Museum will shortly acquire the splendid collection of Heteromerous Coleoptera formed by Mr. Frederick Bates.

SOME unbelievers insisted that the submarine crannog described by Mr. Ussher at Ardmore, Co. Waterford, was only the remains of an old salmon weir; the late storms however seem to have set this theory at rest, as they have cut out the peat to seaward of the crannog and exposed the ancient kitchen midden, also additional piling not previously known.

AT the last meeting of the St. Petersburg Society of Naturalists Prof. Wagner exhibited the hydroids and medusæ of the White Sea he has brought home, giving a detailed description of ten species of medusæ he has discovered in that sea.

AT the last meeting of the St. Petersburg Horticultural Society M. Wolkenstein exhibited a new variety of vine which grows and fruits at Warsaw and Riga. M. Wolkenstein thinks it might fruit even at St. Petersburg. We notice also a communication by Prof. Regel on apples.

PROF. SILVANUS THOMPSON has an interesting article in the current number of *Brain* on "Optical Illusions of Motion."

WE learn from a paper published by M. Goulishambaroff in the *Journal* of the Russian Physical and Chemical Society, vol. xii. fasc. 5, that the whole of the naphtha region of the Apsheron Peninsula has an area of 4·3 square miles, which may be divided into two parts: that of Balakhany, which has given naphtha since the oldest times; and that of Sabountchi, which was explored only in 1873. The first part contains forty-seven naphtha-wells, of which only twenty-eight are productive, and yield together 6,192,000 lb. of naphtha daily. The density of this naphtha varies from 0·855 to 0·885, the average density being 0·8675; whilst the naphtha of the Sabountchi region has a density of from 0·820 to 0·860, and is extracted to an average quantity of 6,622,000 lb. The density varies from the most different causes: it varies in different wells, and usually it might be said that in the same bore the density diminishes with the depth; however, heavy naphtha is received also from very near to the surface; usually it becomes heavier when the evaporation of volatile gases is rendered easy by local circumstances. Contrary to established opinion, M. Goulishambaroff proves that the naphtha of the Apsheron Peninsula contains volatile products of a density of 0·62, but no use is made of them because of the imperfect means of purifying. The amount of photogene received varies very much, namely, from 15 to 85 per cent., the naphtha which has a density of 0·890 to 0·900 giving the lowest, and that of a density of 0·820 giving the highest, percentage; the most usual kinds of naphtha (density 0·863 to 0·870) usually give from 35 to 40 per cent. of photogene. It shows, he stated, however, that thorough measurements of the coefficient of dilatation of naphtha having not as yet been made, there remains a certain want of precision in the determinations of its specific weights.

ON the night of the 3rd inst. a magnificent display of aurora was seen from various parts of the country. We have received several communications on the subject. Mr. E. W. Prevost writes from Cirencester that the display was visible there from 6 p.m. up to about midnight. "The glow, which extended over an angle of about 100°, rose upwards to a height of 20°, leaving the central portion comparatively dark. Faint streamers occasionally showed themselves, reaching 35° in height. A shifting of the streamers from east to west was noticeable, the illuminated arc being at times extinguished on the eastern side, this extinction progressing slowly towards the centre of the arc, when the light would reappear at the eastern side. At no time, as far as I observed, did the light disappear on the western side; the colour was of a greenish-yellow and the wind due north." From Bootham, York, November 3, Mr. J. Edmund Clarke writes: "There is quite a brilliant aurora this evening, first noticed about 6.30 as a diffused light shifting from north-east to south-west, with occasional streamers. Now (7.30-8.45 p.m.) it forms a low bright arch of considerable intensity. I said 'first seen about 6.30,' but at 4.40 I called the attention of a friend to some sharply-defined red streamers in the north-east, which I then took to be sunlight. On August 12 last, about ½ to ¾ hour after sunset, my attention was called to streamers precisely similar, in every respect like those of the aurora. But careful observation showed that these were certainly radiating *from* the sun, and not converging *towards* the magnetic pole. It is certainly my impression that such was the case to-night, but being busy I did not take any special pains to ascertain. Of course this double coincidence may be a pure accident, but is it not possible that the minute substances reflecting the solar rays are actually modified by the electric field, so as to produce this remarkably distinct variety of rays? P.S.—8 p.m. Brilliant streamers from the bright arch, with some corruscations." Prof. Reilly, of the Royal College of Science for Ireland, writes that in Dublin the display was very fine. "The principal beam appeared as if slowly moving from west to east, and had a direction quite parallel to the pointers of the Great Bear. It reached at the time when seen quite up to the Polar Star. The lights were observed at earlier hours, one person having mentioned to me 6 o'clock p.m." In Orkney it showed itself as one of the most brilliant displays of aurora borealis seen for a long time. The whole northern horizon was one dark mass of clouds with a sharply-defined edge, and from these the aurora shot up in beautiful coloured streams to nearly the zenith, covering the clear sky above the clouds from north-east round to north-west. Occasionally the aurora took the form of a gigantic rainbow, and the light was as bright as moonlight.

A SMART shock of earthquake occurred on the 9th inst. throughout Southern Austria, from Vienna to the Adriatic and the frontiers of Bosnia. In the capital a rather violent shock was felt at a quarter to eight. Numerous telegrams have been received by the Meteorological Bureau at Vienna stating that shocks were felt at Serajevo, Derwenta, Brod, Pola, Trieste, Zilli, Klagenfurt, Fünfkirchen, Odenburg, Marburg, Laibach, and Gross-Kanischa. In Agram, the capital of Croatia, three shocks of earthquake occurred, a period of an hour intervening between the second

and third. One of them, which lasted ten seconds, was so powerful that not a single house remained uninjured. A general panic reigns in the town. Many of the inhabitants, including the Cardinal-Archbishop, have taken to flight. It is impossible to estimate the whole extent of the damage. The number of persons injured is at present estimated at thirty.

THE eruption of Vesuvius continues to increase in activity. Two large streams of lava are at present (November 8) flowing from the crater to the base of the cone.

IN Prof. Huxley's article on the *Challenger* Publications last week, line 11 from top of p. 2, col. 2, should read "*direct* and but little modified descendants," instead of "*dried*," &c.

OUR ASTRONOMICAL COLUMN

HARTWIG'S COMET (1880 *d*).—In a circular issued by Prof. Winnecke from the Observatory of Strasburg on the 1st inst., he gives reasons for assuming that the comet detected by Dr. Hartwig on September 29 may have a much shorter period than was conjectured in his first circular. On calculating parabolic elements from the Strasburg observations of September 29 and October 8, and one by Prof. Auwers at Berlin on October 17, MM. Ambronn and Wislicenus, students in the University of Strasburg, found the middle observation could not be more closely represented than with an error of something over two minutes of arc. Prof. Winnecke, as was stated in our previous notice, considered he had reason for suspecting the identity of Hartwig's comet with that of 1506, and a further examination of the historical descriptions has led him to direct attention to the comets of 1382, 1444, and 1569, and with the perihelion passage fixed to July 13, 1444, and October 15, 1569, he finds geocentric positions which he regards as in sufficient agreement with the records. A period of revolution of about 62½ years is therefore obtained, and an ellipse with this period has been adapted by Dr. Schur and Dr. Hartwig to the observations on September 29 and October 14 and 24. The resulting elements are as follow :—

Perihelion Passage, 1880, September 6·58949 M.T. at Berlin.

Longitude of perihelion	83 33 28	M. Eq. 1880·0.
,, ascending node ...	44 33 30	
Inclination	38 8 56	
Log. excentricity	9·990180	
Log. semi-axis major	1·196457	
Log. mean diurnal motion	1·755321	

The error of the place deduced from this ellipse on October 14 is + 28″ in longitude and the same in latitude, and it is remarked that the error in longitude does not admit of being destroyed without an increase of error in latitude. This, however, Prof. Winnecke suggests, may arise from the assumed period of 62½ years being really a multiple of the true one. The comet approaches near to the orbit of Mercury at the ascending node, though at the present time not sufficiently close to occasion any change in the character of the orbit. Still at some past epoch the effect of perturbation may have brought the orbits into coincidence or nearly so, and Prof. Winnecke hints that the planet Mercury might have been the means of impressing an elliptical form on the comet's orbit.

It is clearly a case in which those observers who are in the possession of very powerful instruments may render most material service towards deciding whether we have to do with a comet of comparatively short period. If it is practicable to secure good observations for position after the next period of moonlight, it may then be possible to obtain evidence *pro* or *con*, by direct computation of the orbit, though unfortunately observations did not commence until the comet had reached the extremity of the parameter, or in other words had attained an angular distance of 90° past the perihelion point.

DISCOVERY OF A COMET.—Lord Lindsay notifies the discovery of a comet at his observatory, Dunecht, during the night of the 7th inst., by Mr. Lohse in the constellation Lacerta ; the position at 15h. 30m. in R.A. 22h. 45m. 54s., Declination 42° 33′·7 ; daily motion in R.A. + 6m. 58s., in Decl. + 1° 8′. This is far from any position which the expected comet of 1812 could occupy on the above date.

CERASKI'S VARIABLE STAR.—Mr. Knott obtained a very complete observation of the descending and ascending light-curve of this newly-detected variable on November 2 ; the minimum appears to have occurred about 11h. G.M.T. The period will be somewhat less than 2½ days.

PHYSICAL NOTES

PROF. LORENZ has given in *Wied. Ann.*, No. 9, a development of his theory of "refraction-constants" (published before in Danish), and described experiments bearing on it. The problem contemplated was to find that function of the refractive index, freed from dispersion, and of the density of a body, which is constant with varying density of the body, supposing the molecules themselves unchanged. It is assumed that bodies consist of molecules in whose intervals light is propagated with the same velocity as in vacuous space ; further, that the bodies are isotropic, and their molecules of spherical form. Herr Lorenz arrives at a simple expression for the refraction-constant, the constancy of which, as also the correctness of the assumption as to light moving with the same velocity in the intervals of molecules as in vacuo, had to be proved. He determined the refraction constants of several bodies in the liquid and the vaporous states, viz., ethylic ether, ethylic alcohol, water, chloroform, ethylic iodide, ethylic acetate, and sulphide of carbon. The refraction was determined with sodium and lithium light, and at temperatures of 10°, 20°, and 100°. He found that in passage of the substances from the liquid to the vaporous state the refraction-constant varies very little (only about 5 per cent. at most). Dispersion also showed great constancy. Another Danish physicist, K. Prytz, has extended the inquiry to some ten other substances (*loc. cit.*), and confirmed the assumption of refraction constants.

WITH regard to electricity, Herr Hoorweg (*Wied. Ann.*, No. 9) divides all bodies into two groups, (*a*) those in which the conductivity rises with the temperature (dielectrics), and (*b*) those in which it decreases with rise of temperature (adielectrics). He endeavours to prove by experiment (1) that both dielectric bodies with adielectric, and adelectric with each other, yield contact electricity ; (2) that this electricity has always the same sign as that which arises with gentle friction or pressure. (The sometimes different action of strong friction is ascribed to the influence of the raising of temperature.) Not only does electricity arise through the different heat-motion at the places of contact of two heterogeneous substances, but this cause is fully sufficient to explain all development of electricity.

HERR NARR has lately obtained some interesting results in experimenting further on the behaviour of electricity in gases, and especially *in vacuo* (*Wied. Ann.*, No. 9). In the middle of a hollow brass sphere on a glass support was suspended a metallic ball by means of a platinum wire passing (insulated) through a metallic stopper to an electrometer. Vacua could be produced in the sphere. A charge of electricity imparted to the conducting system underwent the same process of dispersion *in vacuo* as where the space was full of gas. The outer surface of the hollow sphere, one minute and also one hour after the charging, had the same electricity as the conducting system. Herr Narr further finds that the process of dispersion in gas-filled space is not perceptibly influenced by the hollow sphere being insulated or being connected to earth, if the original charging be done while the sphere is connected to earth ; the dispersion constant diminishes in both cases, at least at the beginning. But if the conducting system be charged while the hollow sphere is insulated, the latter has in this state one minute, and likewise one hour to one hour and a half after, electricity of the same sign with the conducting system, and the first connection of the hollow sphere to earth occasions a temporary outflow. Herr Narr shows reasons for believing that the electricity on the hollow sphere finds its way through the gas-space.

A NEW series of experiments of extended range, by Herr Roth, on the compressibility of gases, is described in *Wied. Ann.*, No. 9. The relations between pressure, volume, and temperature, in the case of carbonic acid, sulphuric acid, ammonia, and ethylene, are studied. The results are mainly confirmatory of van der Waal's formulæ.

A NEW balance designed to be easily transportable, light, and yet stable, without fixing to the table, and to serve in inspection of widely various weights (by Government officials in Hungary), was lately brought before the Buda-Pesth Academy by Herr von Krasper (see *Wied. Beibl.* No. 9, p. 638). Among other features,

the prism-shaped steel bed, on which the middle knife-edge rests, is easily drawn out with the finger from the swallow-tail shaped rollers between which it is passed in the body of the balance. The beam can thus be easily removed and replaced. The balance rests on four feet. The stopping and raising arrangement is contained in a horizontal frame. Each weighing scale hangs on a conical point. Passing on to the reading, we find that the accuracy with which the balance works is, with 20 kg. weight, 2mg., with 500, 3½ mg.; and this is gained by substituting for the pointer an optical arrangement on the beam, consisting of two achromatic glass prisms, which render parallel the rays from opposite directions and send them to a telescope placed before the balance. At the two sides of the balance, about 2m. to 4m. from the middle knife-edge, two scales are set (best on the walls of the room); the images of these scales move in the field of the telescope beside each other in opposite directions, and so the corresponding divisions can be read off. These readings are independent of vibrations of the telescope, and are much more exact than those with telescope and cross threads, not to speak of the common pointer. The arrangement also permits of the centre of gravity of the balance being placed lower, the stability increased, &c. The weight of the balance is scarcely 20 kg., though both scales can carry 20 kg. weight.

EXPERIMENTS by Forbes in 1831 and by some others since seemed to warrant the view, now commonly held, that the metals fall into the same series as regards conduction of electricity and conduction of heat, that the quotient of the heat conductivity by electric conductivity is nearly constant. Herr H. F. Weber, inclined to doubt this as contradicting the view (proved for gases and liquids) that the amount of heat transferred within a substance from layer to layer is most intimately connected with the specific heat of unit volume, made new experiments in this relation (which he has described to the Berlin Academy). He measured the heat-conduction by observing the cooling of various metal rings in a space at constant temperature, and the electric conducting power of the same rings, by noting their deadening effect on the oscillations of a magnet. The result confirmed his anticipations, the quotient of heat-conduction by electric conduction being found in the closest connection with the specific heat of unit volume. Experiments by a different electrical method for metals conducting electricity badly (lead, bismuth, &c.) and for mercury gave the same result. (Ten metals in all were examined.) On the other hand, non-metallic conductors of electricity do not show the relation in question; *e.g.* the heat-conduction of carbon is at least twenty to thirty times greater than that calculated from the electric conductivity and the specific heat. Thus the relation seems to be connected with the metallic nature of the substance. Herr Weber found the heat-conducting power of all the solid metals examined to decrease with increasing temperature, but at a considerably less rate than the electric conductivity. He further offers explanations of the erroneous view adopted, noting, *inter alia*, that the experiments in one case, though exact, were on too few metals, and these had nearly the same specific heat.

PROF. R. B. WARDER of Haverford College (Pennsylvania) and Mr. W. P. Shipley have investigated the configurations assumed by floating magnets in a magnetic fluid. They have modified Prof. Mayer's original experiment by surrounding the vessel of water with a coil of wire traversed by a current, thus producing a field of force which, while still symmetrical about the centre, differs in several respects, the lines of force not being so greatly concentrated near the centre. Diagrams of various configurations are given by these experimenters in the *American Journal of Science* for October. As even a single one-fluid cell produces a current sufficient to show these results, they ought to be easy of repetition.

A COMPREHENSIVE memoir on the theory of the radiometer, by M. Mees, appears in the *Proceedings* of the Amsterdam Academy, and (in pretty full abstract) in *Wied. Beibl.*, No. 7. The author, after criticising the various theories that have been enumerated, which he arranges in three classes, offers his own explanation of the phenomena (which cannot be briefly stated here).

A FEW months ago we drew attention to certain results published by Herr Exner of Vienna, relative to thermoelectricity, and which were at variance with all the body of evidence existing in that branch of science. Herr Exner had in fact asserted that an antimony-bismuth couple possesses thermoelectric powers only so long as one of the two metals is in contact with oxygen or with a gas capable of acting on one of them. The wish we then expressed that some independent observations might be made by other physicists has met with a response across the Atlantic. Prof. C. A. Young of Princeton, N.J., communicated to the recent meeting of the American Association a paper on the thermoelectric power of a platinum-iron couple *in vacuo*. The crucial experiment was made with an exhausted glass tube containing an iron wire with platinum terminals, the terminals being again fastened to iron wires leading to a galvanometer. The tube was exhausted to one-millionth of an atmosphere. On laying the apparatus in the sunlight and alternately shading the internal or external junctions an electromotive force could be produced, which was found to be equal in every case. The conclusion Prof. Young draws from the experiment is that Exner is wrong in his statement that thermoelectric electromotive force is due to the action of the gaseous media in which the metals are plunged. The experiment was conducted in Mr. Edison's laboratory at Menlo Park.

GEOGRAPHICAL NOTES

THE glacier of the Zarafshan, one of the greatest in Central Asia, which has hitherto been very imperfectly known, was explored during this summer by MM. Mushketoff, geologist, and Ivanoff. The exploration was quite successful, and at the last meeting, October 26, of the Mineralogical Society at St. Petersburg, Prof. Mushketoff read a paper on his explorations. The lower extremity of the glacier is at the height of 9000 feet. The Galtcha people, who inhabit the upper valley of the Zarafshan, have never ascended the glacier; they say that on the summit of it there are two great pillars of stone, between which the traveller must go, and that the pillars would certainly crush together if any one ventured into the icy solitude. On August 25 the party began the ascent of the glacier on a very steep slope covered with blocks and moraines. A tunnel, no less than 3500 feet long, runs under the glacier, being the bed of the Macha River. After two days' travel the party had done seven miles on the glacier. The temperature during the day was as high as 40° Cels., and during the night as low as − 8°; some Galtchas who accompanied the party fell ill with fever. On the fourth day the party reached the first watershed, or rather the first iceshed; the whole length of the glacier to this point was sixteen miles, the width being one mile; six other glaciers, each of which is greater than the greatest Alpine glaciers, fed the principal one. At the head of it there is a wide *cirque* opening to the east; several peaks around it reach 20,000 feet. The descent on the other slope of the mountain ridge was far more steep and difficult than the ascent; the crevasses are very numerous and the glacier has several great "ice-falls," the inclination of which is no less than 50 degrees; the party was compelled to make use of small anchors and to cut steps in the ice. Two men were unwell and quite unable to go further when the party reached the foot of the eastern slope, after a very difficult journey.

THE last number of the *Izvestya* of the Russian Geographical Society contains a letter from Dr. Miklukho-Maclay. After having visited the islands of New Caledonia, Lifu, New Hebrides, Admiralty, Louisiade, &c., he reached, about the end of January, 1880, the south-eastern coast of New Guinea; here he explored several points of the coast, and thence went to the islands of the Torres Strait and to Somerset, to study the population of Northern Australia. On his voyage from Vaïhan Island to Sydney he stopped at several points of the eastern coast. From Sydney M. Maclay proposes to go to Japan, and thence to return to Russia. During his stay in Brisbane he was very kindly received by the local government and by private persons, who have much facilitated his anatomical studies by allowing him to work in the old museum and to make use of the photography of the topographical department. The journey in the interior of Queensland was very much facilitated by the cordial reception he received from the squatters, and by the kind permission to travel gratuitously along all the railways. M. Maclay expresses, in a letter addressed to the *Golos*, his thanks to the Australians for the reception he met from them, and wishes that all men of science were so kindly received in Russia. On August 12 he was in the house of J. B. Bell at Jimbor, near Dallby. The Russian public subscription has already reached 606*l.* which he received at Sydney.

A GOOD example is being set by the Tashkent College. During the summer fourteen pupils of the College, under the

direction of their Professor of Natural History, M. Shelting, made an excursion in the Ala-taou Mountains. Numerous measurements of heights were made during the journey, good zoological, botanical, and geological collections, for the Museum of the College, were made, and a detailed diary of the excursion was kept by the scholars. The students of the Tashkent Normal School, as well as the pupils of the College of Verny, have also made scientific journeys for the exploration of the neighbourhood, and we learn that the College of Orenburg has requested tickets at reduced rates from the railway company for undertaking next summer a series of explorations in that little known but very interesting province. We cannot but wish that the colleges and schools of Western Europe would follow these examples; what an excellent training in natural science might thus be given, and what a mass of valuable information might be collected.

THE members of the scientific expedition which was sent out by the St. Petersburg and Moscow Societies of Naturalists for the exploration of the White Sea and of the Murmanian coast of the Arctic Ocean, and which consisted of Professors Wagner, Bogdanoff, Tsenkovsky, and eight students of the University, have returned after having done some very successful work; they bring home very rich zoological and geological collections. Professors Wagner and Tsenkovsky stayed throughout the summer at the Solovetsky Islands; M. Lavroff in Kandalaksha Bay; Prof. Bogdanoff travelled along the whole coast to Vadsö; MM. Koudravtreff and Pleske, geologists, have travelled from Kandalaksha to Kola; others have explored the flora and the fauna of the ocean; Prof. Bogdanoff has also studied the fishing.

BARON A. VON HUGEL is now engaged in writing a work upon Fiji, where he travelled and spent some time, making extremely extensive and complete anthropological collections. The work will be more particularly an ethnological one, and most of the weapons, fabrics, and other ethnographic articles are being figured to accompany the text. The crania collected by Baron von Hugel have already been acquired by the Royal College of Surgeons, and exhaustively described by Prof. Flower.

WE notice the appearance of an important work published by the Russian Geographical and Economical Societies in the first volume of a "Collection of Materials for the Knowledge of the Russian Commune." It contains detailed descriptions of the communes of the Governments Ryazan, by M. Semenoff, president of the Russian Geographical Society, MM. Litochenko, Zlatovratsky, Mme. Yakouchkin, &c.; a very complete bibliographical index of the literature concerning the communes of Russia and of Western Europe.

A TELEGRAM has been received at St. Petersburg from Col. Prejevalsky, dated from Urga, the 1st inst., stating that during the spring and summer of this year he surveyed a part of the basin of the Upper Hoang-ho and the Lake Koko Nor. He also passed through Alashan, in the centre of the Gobi desert, to Urga. Col. Prejevalsky states that during the expedition he traversed a distance of 7200 versts, and that he has succeeded in obtaining valuable scientific results.

THE death is announced, on his passage home from West Africa, of Count de Semellé, who has been recently exploring on the Lower Niger.

THE new *Bulletin* of the Société Khédiviale de Géographie contains a paper by General Purdy-Pacha on the country between Dara and Henfiah El Nabass, together with a map of that portion of Darfur, and another on Medina twenty years ago, by Col. Mohamed Sadik-Bey, illustrated by two engravings.

THE Church Missionary Society have received news that the Rev. P. O'Flaherty, their new agent in Uganda, and Mr. C. Stokes, with the Waganda chiefs and a large caravan, started from Saadaui for the interior on August 9, but in little more than three weeks Mr. O'Flaherty was taken ill at Kidete, and will be unable to proceed to the Victoria Nyanza at present.

THE same Society have also received letters from various members of the Nyanza mission, giving a much more favourable report of their position in Uganda than had reached England some time back. Rev. G. Litchfield had in consequence of ill-health made an attempt to push northwards to Lado, in order to consult Dr. Emin Effendi. In this he unfortunately failed, being stopped by Kabba Rega, the king of Unporo, who has seized M'ruli and other posts vacated by the Egyptians since Col. Gordon's departure. Mr. Litchfield accordingly returned to Rubaga, and, crossing the lake, proceeded to Upui, hoping eventually to get to Upwapwa, where Dr. Baxter is stationed.

MESSRS. CAMERON AND PIGOTT, of the China Inland Mission, have made a journey of eight months through a great part of Manchuria and a portion of Mongolia. From the treaty port of Newchwang Mr. Pigott went on to Moukden, while Mr. Cameron proceeded along the coast in an easterly direction by the borders of Corea, and then northwards to Moukden. They next journeyed through part of Mongolia into Kirin, which at first they found fertile and well-wooded, but afterwards the country became wild, poor, and sparsely populated. The city of Kirin was reached by a long steep descent through fine scenery. Fine teams of oxen were here met with, comparing favourably with some of our best breeds. After spending a few days at Kirin the two missionaries returned overland to Peking, passing the Great Wall at Shan-hai-kwan or Ling-yü-hsien.

MESSRS. RILEY AND CLARKE, of the same Society's station at Chungking, have recently paid a visit to some Lolo villages in Southern Szechuen. These mountaineers for the most part live in inaccessible fastnesses beyond the reach of the Chinese authorities, and are not confined to Szechuen and Yünnan, but under the designations of Laos and sundry other names are found throughout the extensive regions of Annam, Siam, and Burmah. Hardly anything is yet known of the Chinese Lolos and their manners and customs, but before long the agents of the China Inland Mission in the south-west will, it may be hoped, find means to collect information regarding them.

ON A DISTURBING INFINITY IN LORD RAYLEIGH'S SOLUTION FOR WAVES IN A PLANE VORTEX STRATUM[1]

LORD RAYLEIGH'S solution involves a formula equivalent to $\frac{d^2v}{dy^2} - \left(m^2 + \frac{\frac{d^2T}{dy^2}}{T - \frac{n}{m}}\right)v = 0.$

Where v denotes the maximum value of the y-component of velocity;

,, m ,, a constant such that $\frac{2\pi}{m}$ is the wave-length;

,, T ,, the translational velocity of the vortex-stratum when undisturbed, which is in the x-direction, and is a function of y;

,, n ,, the vibrational speed, or a constant such that $\frac{2\pi}{n}$ is the period.

Now a vortex stratum is stable, if on one side it is bounded by a fixed plane, and if the vorticity (or value of $\frac{dT}{dy}$) diminishes as we travel (ideally) from this plane, except in places (if any) where it is constant.

To fulfil this condition, suppose a fixed bounding plane to contain ox and be perpendicular to oy; and let $\frac{dT}{dy}$ have its greatest value when $y = o$, and decrease continuously, or by one or more abrupt changes, from this value, to zero at $y = a$ and for all greater values of y.

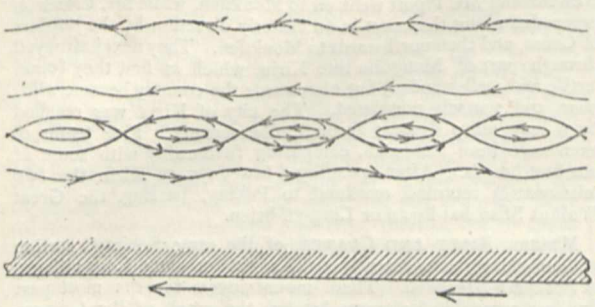
It is easily proved that the wave-velocity, whatever be the wave-length, is intermediate between the greatest and least values of T. Hence for a certain value of y between 0 and a, the translational velocity is equal to the wave-velocity, or $T = \frac{n}{m}$. Hence for this value of y the second term within the bracket in Lord Rayleigh's formula is infinite unless, for the same value of y, $\frac{d^2T}{dy^2}$ vanishes.

We evade entirely the consideration of this infinity if we take only the case of a layer of constant vorticity ($\frac{dT}{dy}$ = constant from $y = o$ to $y = a$), as for this case the formula is simply

$$\frac{d^2v}{dy^2} = m^2v,$$

[1] By Sir William Thomson. British Association, Swansea, Section A.

but the interpretation of the infinity which occurs in the more comprehensive formula suggests an examination of the stream-lines by which its interpretation becomes obvious, and which proves that even in the case of constant vorticity the motion has a startlingly peculiar character at the place where the translational velocity is equal to the wave velocity. This peculiarity is represented by the annexed diagram, which is most easily understood



if we imagine the translational velocities at $y = 0$ and $y = a$ to be in opposite directions, and of such magnitude that the wave velocity is zero; so that we have the case of standing waves. For this case the stream-lines are as represented in the annexed diagram, in which the region of translational velocity greater than wave-propagational velocity is separated from the region of translational velocity less than wave propagational velocity by a cat's-eye border pattern of elliptic whirls.

MINERAL RESOURCES OF NEWFOUNDLAND

ORES of copper have been found in all the older formations in Newfoundland, from the Laurentian gneiss at the base, to the Carboniferous series at the summit, the qualities of which vary greatly with the age and condition of the rocks with which they are associated. Thus in the Laurentian series the rich ores of variegated and sometimes grey sulphide of copper are more frequent than any other, and are for the most part in white quartz veins intersecting the strata; but while these ores have in many cases been found on analysis to yield at the rate of from 50 to 70 per cent. of metal, the quantities available at any one place hitherto tested have never yet been found sufficient to warrant an outlay of capital.

In the succeeding series, which I conceive to be the equivalent of the *Huronian* of *Canada*, and have provisionally called *intermediate*, as being intermediately situated between rocks of the Laurentian and Primordial Silurian ages, very rich ores of copper are likewise well known at many parts, chiefly in white quartz veins, and also in faults and dislocations, particularly near the junction with the fossiliferous Primordial, in which cases the indications may sometimes be regarded as favourable for the probable future development of mines. Several attempts have already been made in this direction at various parts of the distribution of the series, but except at a few places, chiefly near the junction with the newer formations, with but slender prospect of a successful issue.

By reference to the Custom House returns of exports I find that the amount and value of copper ore shipped at St. John's between the years 1854 and 1864 inclusive was as follows:—Ore, 627½ tons, value $22,980=4,596*l.* sterling. The places where this ore was raised are not specified, but I believe it was all derived from rocks of intermediate age, by which the greater part of the Peninsula of Avalon is occupied.

In addition to the above export from St. John's, 544 tons, valued at $19,179 were exported between the years 1875 and 1879; but a considerable, if not the larger portion of this ore was produced from Tilt Cove and other of the early openings in Notre Dame Bay.

Although the presence of copper is frequently indicated by stains of green carbonate and small nests of yellow sulphuret in the lower Primordial strata, I am not aware of any instances where the ores occur in mass, or in intersecting veins or lodes, except it may be close to their immediate junction with the older series on which they repose unconformably or butt up against in faults. At some parts of their distribution, such as in the islands of Conception Bay, these older Silurian rocks are but very little disturbed, resting in nearly a horizontal attitude, and scarcely at all altered; at other parts, such as Trinity Bay, St. Mary's Bay, Langlois Island of the Miquelons and elsewhere, they are greatly disturbed by intrusions of igneous rock, and occasionally to some extent metamorphosed; but they are almost everywhere crowded with organic remains, the types of which indicate the ages they represent, to extend from the horizon of Primordial or Cambrian to the newer Potsdam Group of the United States and Canada. Strata representative of Potsdam, Calciferous, and Levis ages, containing abundance of typical fossils, are extensively displayed on the western and northern parts of the island, the former in many cases resting directly on Laurentian gneiss unconformably; but, except it may be to a very limited extent in Canada Bay, near the Cloud Mountains, I am not aware of any deposits older than the Potsdam at these parts, nor have I seen indications of the presence of the Huronian or intermediate system north of Bonavista Bay, or anywhere near the western shores. Galena in calcareous veins is of frequent occurrence in these Lower Silurian rocks, but except in small isolated crystals or patches the ores of copper are particularly rare, and in no case such as to be considered economically valuable.

But the cupriferous formations proper of Newfoundland, according to my view of the structure, lie unconformably above all the former, and consist mainly of a set of metamorphic and igneous rocks, corresponding exactly in mineral character and condition with the rocks of the Eastern Townships of Canada described by Sir Wm. Logan under the title of the Quebec Group. I am quite aware that these views, as regards the structure, are at variance with those entertained by several distinguished geologists in Canada (whose opinions, however, do not seem to be very unanimous on the subject); and there cannot be a doubt that in many cases the evidences appear to be so contradictory at different localities that the difficulties in arriving at the truth are exceedingly great. Nevertheless, so far as my own observations go, and I have studied the succession at nearly all parts of their distribution in Newfoundland, I am led to the conclusion that the stratigraphical position of this metamorphic group belongs to a horizon intermediate between the Calciferous and Hudson River group, probably chiefly of Chazy age, which is in accord with the structure of Sir W. E. Logan.

The group consists of chloritic, dioritic, and felsite slates, interstratified with compact diorites, bands of red jasper, dolomites, great masses of serpentine, or serpentinous rock, and volcanic products. In nearly all these rocks the ores of copper are more or less disseminated; but it is amongst the schistose portions, especially the clorite slates, that they seem to be most abundant, and it is in rocks of that quality chiefly where the principal mining operations have hitherto been conducted. At some parts of the distribution these rocks are distinctly stratified, the lines of deposit being well displayed in layers of different quality: beds of jasper, conglomerate, &c. The whole series is magnesian, more or less, but particularly towards the top, which appears to be the horizon of the serpentinous masses, with large accumulations of volcanic ash. Towards the base the rocks become calcareous, the cliffs of strata much incrusted with carbonate of lime; and some strata of a pure white crystalline limestone occur which are fossiliferous. The fossils are too obscure to be identified with certainty; but one form bears a strong resemblance to a *Maclurea*, another to a *Bellerophon*, a third to a *Murchisonia*, and some rather large-sized *Encrinite* stems. Near the horizon of this limestone moreover we find a set of black slates which contain graptolites. Vast intrusive masses of granitoid rock, and great dykes of greenstone melaphyre and other traps intersect the formation.

The only mines of importance in active operation up to the present time are all situated in Notre Dame Bay, and these are Union Mine Tilt Cove, Betts Cove Mine, Colchester, in south-west arm of Green Bay, Little Bay Mine, Rabbit's Arm, and Seal Bay. Many openings and minor workings have also been made at various parts of the bay, at each of which the ores of copper were more or less indicated, some of which may eventually, when capital and skilled labour are brought to bear, be found sufficiently remunerative to be worked to advantage.

It will be seen by the annexed memoranda that the total value of the copper and nickel ore extracted since 1854, but by far the larger proportion since 1864, when the Union Mine Tilt Cove was first opened by Mr. Smith McKay, amounts to nearly one million sterling.

Memoranda showing the Quantities and Values of Copper and Nickel Ores exported from the Island of Newfoundland in the undermentioned Years

Years.	Parts cleared from.	Copper.	Nickel.	Value.	Value of nickel ore.
		Tons.	Tons.	Dollars.	Dollars.
1854 to 1864	St. John's	627½[1]		22,980	
1875 to 1879	,,	544½[1]		19,179	
	Total St. John's ...	1,172		42,159	
1869	Union Mine Tilt Cove	5,938	30	190,016	7,200
1870	,,	4,218	88	134,976	8,800
1871	,,	1,924	7	61,568	700
1872	,,	4,774[3]	8	152,768	25,60
1873	,,	5,414	233	189,490	9,320
1874	,,	4,346	—	104,304	—
1875	,,	4,838	17	179,c06	1,360
1876	,,	6,464	28	232,704	2,800
1877	,,	5,389	—	194,004	—
1878	,,	4,450	—	97,966	—
1879	,,	1,964	—	35,352	—
	Total Tilt Cove ...	49,719	411	1,572,154	32,740
1875	Bett's Cove	6,280		232,360	
1876	,,	18,670		456,481	
1877	,,	42,065		1,093,768	
1878	,,	31,370		690,140	
1878	Regulus	750		34,500	
1879	,,	26,421½		475,587	
	Total Bett's Cove ...	125,556½		2,982,836	

The ores returned for 1878–79 were largely derived from Little Bay Mine and partly from Colchester, all belonging to the Bett's Cove Mining Company.

Thus the total value of the ores of copper and nickel exported since 1854 amounts to $4,629,889, or nearly £1,000,000 sterling.

ALEX. MURRAY

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—In Groups C and E of the Higher Local Examination this year there were respectively fifty-four and ninety-nine candidates; five obtained a first class in Group C (Mathematics) and eight a first class in Group E (Natural Science); nine candidates failed in Group C, and twenty-six failed in Group E. Three candidates answered the questions in Differential and Integral Calculus, and showed considerable knowledge. In botany a fair average of proficiency was attained; in geology the papers were below the average. In zoology inferior text-books had been too much preferred, to the exclusion very largely of practical work. The work in chemistry was unequal, but some candidates showed a very good acquaintance with the details of manipulation. Physics can scarcely be said as yet to be studied by the candidates. In physiology the answers were in some cases accurate and to the point, but the majority of candidates failed.

The elections to the Council of the Senate were made on Monday, and show in a very practical manner that residents are in favour of considerable improvement in University matters. Only one member who approves of the retention of Greek as a universal subject in the "Little-go" was elected, viz., Mr. G. F. Browne, whose place in the Council is due to his active work in connection with the University Local Examinations and his knowledge of the intentions of the University Commissioners, as one of their secretaries.

[1] Chiefly from Huronian rocks.
[2] Partly from openings in Notre Dame Bay.
[3] Cloanthite and Millarite.

Dr. Phear, Professors Cayley and Liveing, and Mr. Peile, are among those who were elected to the Council well known for their scientific eminence and breadth of view.

Prof. Stokes, Lord Rayleigh, and Mr. Vines were added to the Council of the Philosophical Society at its annual meeting.

Mr. Forbes, Prosector to the Zoological Society, has been elected to a Fellowship at St. John's College.

AT an examination held on Wednesday, October 27th ult., Mr. M. Milburn, of Longtoun, was elected to a vacant bursary in connection with the "Young" Chair of Technical Chemistry, Anderson's College, Glasgow. The bursary, which is of the value of 50*l.*, and tenable for three years, is the gift of Mr. James Young, LL.D., F.R.S., of Kelly and Dullis, founder of the Chair.

SCIENTIFIC SERIALS

Journal de Physique, October.—Experimental verification by S. Carnot, of the principle he discovered, by M. Lippmann.—Apparatus and experiments for elementary demonstration in optics, by M. Gariel.—Influence of velocity of propagation of sound in the shock of elastic bodies, by M. Elie.—New form of plates for air pumps, by M. Terquem.—*Proceedings* of the Physical Society of St. Petersburg (including papers, in abstract, on the chemical and photographic action of light, the transmission of the current in water with unequal platina electrodes, variations of volume and coefficient of elasticity of palladium and its alloys under the influence of absorbed hydrogen, &c.).

Rivista Scientifico-Industriale, No. 18, September 30.—On the relation between terrestrial storms and the planetary relations of the solar system, by Prof. Zenger.—Excursions (geological) in the neighbourhood of Modica, by Prof. Lancetta.—Palæontological studies in Bohemia, by Prof. Fritsch.—Beats, the third sound of Tartini, and the differential resultant sounds of Helmholtz, by Dr. Crotti.

No. 19, October 15.—New registering pluviometer, by S. Grimaldi.—New apparatus with petroleum heating, by S. Esser.—On a new variety (Rosterite) of Elban beryl, by Prof. Grattarola.

Kosmos, July 1880, contains a translation of Prof. Huxley's "The Coming of Age of the Origin of Species" (*vide* NATURE, vol. xxii. p. 1).—Dr. Ernst Krause's sketch of the developmental history of the History of Development.—Dr. H. Müller, the importance of Alpine flowers in connection with the "flower theory."—H. Schneider, observations on some apes.—Prof. Dr. Caspary, the conception of a soul and its significance in connection with modern psychology.—Short contributions and extracts from journals (among the short articles is one on the resemblance between flowers and fruit, by Hermann Müller, and on the occurrence of a five-toed example of *Archibuteo lagopus*, by W. von Reichenau).

August, 1880.—Dr. Oscar Schmidt, the severance of species and natural selection.—Dr. Ernst Krause, sketch of the developmental history of the History of Development, No 2.—Dr. Herman Müller, on the development of the colours of flowers.—Prof. A. H. Sayce, on the history of writing (translation).—Short contributions and extracts from journals.—Literature and critical notices.

Revue des Sciences Naturelles, September.—M. Mathias Duval, on the development of the spermatozoa in the frog (plates 3 and 4).—M. Lavocat, on the construction of the extremities of the limbs.—Dr. A. Godron, on the absence of a glume in the lateral spikelets of Lolium.—M. Leymerie, sketch of the Pyrenees of the Aude.—Notices of French memoirs on zoology, botany, and geology.—Bibliography and notice of the death of Dr. A. Godron.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 4.—Prof. H. E. Roscoe in the chair.—The following papers were read:—On the compounds of vanadium and sulphur, by E. W. E. Kay. The author shows that the products obtained by Berzelius are oxy-compounds, that the substance obtained by Berzelius in the dry way is a true trisulphide of vanadium V_2S_3; the disulphide and pentasulphide have also been prepared and are described in the present paper.—On the atmospheric oxidation of phosphorus and some reactions of ozone and peroxide of hydrogen, by C. T. Kingzett. The author concludes that in the above oxidation both ozone and peroxide of hydrogen are formed, the former

passes on in the current of air, the latter remains in the water in which the phosphorus is oxidised. In several experiments the proportion of peroxide of hydrogen to the ozone formed was as 1 to 2.—On the action of zinc ethyl on benzoylic cyanide, by E. Frankland and D. A. Louis. The product of this reaction, an amber-coloured jelly, was first decomposed and then extracted with alcohol, about 3 per cent. of a substance $C_{24}H_{19}NO_2$, named provisionally benzcyanidin, crystallising in colourless needles, was obtained. Besides this body an unstable substance was obtained which could not be purified, but which on oxidation with bichromate gave propiophenone $C_9H_{10}O$. —On the action of zinc-ethyl on cyanogen, by E. Frankland and C. C. Graham. The product of this reaction was a solid mass, which on heating to 120° yielded a colourless liquid which was propionitrile C_3H_5N., the other product of the reaction being zinc cyanide.—On bismuth and bismuth compounds, by M. M. P. Muir, G. B. Hoffmeister, and C. E. Robbs. The relative stabilities towards heat and reducing agents of the oxides, and towards heat of the hydrates are discussed, also the action of chlorine and bromine on the oxides. An attempt is made to give structural formulæ for these bodies, in which bismuth is trivalent.—On the colour-properties and relations of the metals copper, nickel, cobalt, iron, manganese, and chromium, by T. Bayley. The author has carefully compared the colours of solutions of salts of the above metals and various mixtures thereof, and especially those mixtures which yield colourless or neutral grey solutions.—Action of diazo-naphthalin on salicylic acid, by Percy Frankland.—On the basic sulphates of iron, by Spencer Pickering.—Fourth report on researches in chemical dynamics, by C. R. A. Wright, E. H. Rennie, and A. E. Menke.—On some naphthalin derivatives, by C. E. Armstrong and N. C. Graham.—On acetylorthoamidobenzoic acid, by P. P. Bedson and A. J. King.

VIENNA

Imperial Academy of Sciences, October 21.—On the propagation of ball and cylinder waves of finite width of vibration, by Dr. Tumlirz.—On the law of convulsive action (continued), by Prof. Stricker.—On the blood vessels of the valves of the heart, by Dr. Langer.—On the question of arrangement in the pyridin and chinolin series, by Dr. Skraup.—Experiments on the magnetic behaviour of iron, by Herr Haubner.—On the relation of the daily and yearly variation of temperature to the sun spot period, by Herr Liznar.

PARIS

Academy of Sciences, November 2.—M. Edm. Becquerel in the chair.—The following papers were read :—New observations on the etiology and prevention of *charbon*, by M. Pasteur. He gives a letter written by Baron von Seebach (Saxon Minister in Paris) to M. Tissandier in 1865, stating facts which afford striking confirmation of M. Pasteur's views as to the causes of the disease.—On the heat of formation of ethers formed by hydracids, by M. Berthelot. In these experiments he used his calorimetric detonator.—Heat of formation of sulphide of carbon, by M. Berthelot. The combustion of liquid sulphide of carbon liberates +246·6 cal. (Favre and Silbermann obtained 258·5 cal., but they overlooked the formation of sulphuric acid). Sulphide of carbon is formed with absorption of heat from its solid elements, but there is probably liberation of heat from gaseous sulphur and carbon.—On volcanic thunderstorms, by M. Faye. In paroxysmal eruptions the enormous amount of steam ejected causes volcanic thunderstorms, which are quite distinct from ordinary thunderstorms, especially in the absence of gyratory movements, the complete immobility of the volcanic storm (which is confined to the column of ascending clouds), and the fact that no flashes occur without the presence of ashes. The phenomena are very much those of the Armstrong electric machine. Further, there is never any mention of hail; and M. Faye thinks it is probably never produced, as it is the product of vast gyratory movements not found in volcanic clouds. He suggests the desirability of studying directly the traces of electricity in the vapours rising from the crater of Vesuvius.—On photographs of nebulæ, by M. Janssen. The photography of a very bright nebula is now comparatively easy, if one content oneself with the most luminous part, but extremely difficult if a complete image be sought comparable to those given by our large instruments. The latter is what we especially require, with a view to studying the important questions of variations of nebular structure, and calls for many able workers, furnished with the best instruments. M. Janssen is preparing observations of the kind at Meudon.—Observations of planets and comets, at Marseilles Observatory, by M. Stephan.—On the winter-egg of phylloxera, by M. Valery-Mayet. It seems certain that the hygrometric state of the air, generally very dry in Languedoc (where the author is), is the great obstacle to production of the winter egg. Whenever the sea-winds, which always blow in autumn, bring that region to the conditions of the climate in the west, the egg is produced.—Elements of the orbit of the new planet (217) discovered by M. Coggia.—On the resolution of algebraic equations; examination of the method of Lagrange, by M. West.—On linear differential equations with rational coefficients, the solution of which depends on the quadrature of a rational function of the independent variable, and of an irrational algebraic product, by M. Dillner.—On a property of uniform functions of a variable connected by an algebraic relation, by M. Picard.—On the application of the photophone to study of the sounds which occur on the sun's surface, by Prof. Bell. This was suggested by Mr. Bell in visiting the observatory at Meudon. M. Janssen put all the instruments at his disposal, and an opportunity was taken to explore a solar image 0·65 m. in diameter with the selenium cylinder. The phenomena were not sufficiently marked to justify one in affirming success, but Mr. Bell is hopeful of succeeding. M. Janssen has suggested the method of passing rapidly before an objective which should give conjugate images on the selenium apparatus, a series of solar photographs of one spot taken at intervals sufficient to show notable variations in the constitution of the spot. This is to be tried.—On the oxidation of mannite, by M. Pabst.—On the ferments of albuminoid matters, by M. Duclaux. There are certainly over a hundred species, and of these he only knows twenty at present (the physiological conditions, *i.e.* of their existence). Previous classifications prove useless. He gives some general *traits*. *Inter alia*, in milk the ferments change the caseine into soluble albumen, but while the aerobian ferments do this in a slow and regular way, the anaerobians do it with liberation of carbonic acid and hydrogen, part of which becomes sulphuretted hydrogen or even phosphides of hydrogen. In cheese-making the predominance of the aerobians has been unconsciously favoured. All the ferments studied are found in full activity in the stomach. They secrete soluble ferments, which are added to those of the organism.—Inoculation of symptomatic *charbon* by intravenous injection, and immunity conferred on the calf, the sheep, and the goat by this process, by MM. Arloing, Cornevin, and Thomas.

CONTENTS