THURSDAY, DECEMBER 8, 1881

SMOKE-ABATEMENT EXHIBITION

ON the 30th ult. an exhibition was opened at South Kensington of appliances intended to prevent excessive production of smoke in household grates and in the furnaces and boilers of manufactories, and thus to remove from the fogs of great cities, and especially of London, one of their most offensive constituents, and that which is most potent in darkening the cities over which they spread themselves. The Exhibition is described as "international"; that title is, however, often given on rather a slender basis; and from what we can at present see, the main exhibits are British, although a few interesting objects are sent from Germany, Canada, and France.

The origin of the Committee, which has for the last eight months systematically endeavoured to direct the minds of Londoners to the question of bringing into practical use some means of lessening the smokiness of London, if not rendering London smokeless, is described in the official Report as follows; and as it may be hoped that this Exhibition is only the beginning of a movement of which, with the aid of perseverance, energy, and scientific ingenuity, much may be expected, it is interesting to place the history of the movement upon record.

"The subject of the abatement of smoke, with the view of purifying the atmosphere of London and lessening the deleterious character of London fogs, has been vigorously taken up by the National Health Society during the past year. In the spring of 1880 the subject was brought under the notice of the Committee by Mr. Ernest Hart, the Chairman of Council, as one which he was desirous of taking up actively, with the co-operation of the Committee, and he was requested to take steps to bring the question into a practical form for further proceeding. With this view Mr. Hart placed himself in communication with Prof. Chandler Roberts, F.R.S., Professor of Metallurgy at the School of Mines and Chemist to the Mint, who undertook to make an examination of existing methods of combustion of coal in household grates and in furnaces. Further steps were taken to obtain details of the existing apparatus in use in different parts of the kingdom, and a considerable collection of documents was made, which have been placed at the disposal of the Committee subsequently formed. In July Mr. Hart learned from Miss Octavia Hill, the Treasurer of the Kyrle Society, that that Society was contemplating some action in the like direction, and it was arranged between Miss Hill and Mr. Hart, that with the approval of the respective societies a joint committee should be formed, with the object of continuing the movement. Such a committee was accordingly nominated, and met at the National Health Society's rooms; a definite course of proceeding was resolved on, and a programme was sketched out. Various eminent persons known to be specially informed on the subject (not all connected with either Society) were asked to join the Committee."

Among those who have given most active assistance are Dr. Siemens, Capt. Douglas Galton, Mr. Atchison, and Col. Festing, R.E.; but it is needless to say that all the eminent persons in art, literature, and science who have been asked to join have willingly given the valuable aid of their names, so that the Committee is a very representative one. The Exhibition includes a great variety of exhibits divided into the following sections:—

In *Section A.* will be found: Open coal-fire grates, stoves of all kinds, kitcheners, kitchen ranges, draught-regulators, base burners, and other appliances devised to prevent the liberation of smoke from bituminous coals or to consume anthracite and other smokeless fuel.

Section B.—Gas fires, open grates and stoves, gas producers, and gas-heating apparatus of all kinds for domestic use.

Section C.—Appliances for heating rooms and buildings by hot air, hot water, and steam circulation.

Section D.—Gas engines, boiler furnaces, fire-bars, mechanical stokers, smoke-preventing furnace bridges, and other appliances for steam-engines and for general industrial purposes.

Section E.—Anthracite and other smokeless coals, bituminous and semi-bituminous coals, patent and other fuels.

Section F.—All foreign exhibits. Improvements in chimney flues, ventilating apparatus, and novel inventions for regulating temperature, &c.

Buildings have been fitted up for the purpose of testing the efficiency of grates, stoves, and other appliances suited for domestic use; and trials of various fuels and boiler appliances will also be conducted in the Exhibition Buildings, and at certain factories where facilities have been offered by the proprietors.

The Committee have secured the services of Mr. D. Kinnear Clark, M. Inst. C.E., to superintend the trials under the direction of the Executive Committee. In conjunction with Dr. Frankland, F.R.S., Prof. W. Chandler Roberts, F.R.S., has undertaken to make certain chemical tests in connection with the trials of fuel grates and stoves.

It is not unreasonable to expect that such an exhibition carried out under the direction of a Committee of Experts, which includes Prof. Abel, C.B., Royal Arsenal, Woolwich, A. T. Atchison, M.A., William R. E. Coles (Hon. Secretary), Col. E. R. Festing, R.E. (Science and Art Department, South Kensington), Capt. Douglas Galton, C.B., F.R.S., Prof. Edward Frankland, LL.D., F.R.S. (School of Mines, South Kensington), Sir Ughtred Kay-Shuttleworth, Bart., Dr. Siemens, F.R.S., LL.D., J. Lowry Whittle, Temple, will be of national value. It will tend directly to a better utilisation of coal and coal products, by determining practically and scientifically the means which are actually available for heating houses as at present (and as may be) constructed without producing smoke, as the Committee will be enabled to examine the subject generally and to report for public information upon the relative adaptability of the various coals and appliances to the requirements of every class of the community. Trustworthy information will be obtained upon which to base sufficient and equitable amendments of the existing laws regarding smoke; and the Committee will also ascertain and make known the comparative value of existing appliances for the utilisation of gas for the purpose of heating.

It must be admitted that for years past the air of London has steadily deteriorated, and that in London, which 150 years ago was famous for its roses, it is now impossible to get a rose to blossom or conifers to grow. Homely but practical evidence of the actinic influence of light, which is so essential to the health of plants and animals, was given by Mr. Ernest Hart at one of the many meetings which have been held on the subject, when he mentioned that wax manufacture had been, during the last twenty years, successively driven further and further from the centre of London. Ten years ago it was possible to bleach wax in the sunlight at Shepherd's Bush, but the factory was now removed to near Richmond, as it was found that the bleaching power of the sun for the greater part of the year was almost nullified by the pall of smoke which hangs over the metropolis. We shall not speak to-day of the various appliances of which we have as yet had but a hasty view, but it is only fair to say that there are shown at the Exhibition a number of grates, some of which, such as the new "Everitt" grate shown by Messrs. Barnard, Bishop, and Barnard; Mr. Crane's grate, shown by Deane and Co.; and in some respects the "Excelsior" grate of Mr. Archibald Smith, mark distinct advance. The possibility of consuming the smoke of bituminous coal in ordinary grates by forcing the draught of air and smoke downward through the fire before it is allowed to escape has been shown, as has also the facility with which hard anthracite smokeless coal will burn in open grates without any sort of blower or other such contrivance. In addition to these there is an extremely interesting series of exhibits of mechanical stokers, fire-bars for furnaces, a new gas-kiln which will be shown in operation, as well as Dr. Siemens' gas-regenerator. Some extremely good household stoves and fire-places are sent from Germany and Canada.

DOUBLE-STARS

Observations of Double-Stars made at the United States Naval Observatory. By Asaph Hall, Professor of Mathematics, United States Navy, and Rear-Admiral Rodgers, U.S.N., Superintendent. (Washington: Government Printing Office, 1881.)

WE welcome another addition to our knowledge of the positions and distances of double stars. Prof. Asaph Hall has published a volume containing 1614 observations of such stars made by him chiefly with the 26-inch refractor at the Naval Observatory at Washington. The objects of the observations are two. Firstly, the detection of constant errors of observations by the measurements of double-stars from a selected list, and comparing such measures with those of other observers made as nearly as possible simultaneously; and, secondly, the measurements of double-stars generally.

The list of stars adopted is that prepared by Otto Struve, with a few additions of stars of greater distance. There are 30 stars in all, and 296 complete sets of measures of these have been made, each set consisting of four measures of position and two double measures of distance, except in cases where the stars exceed 3″ in distance, when four were taken. The measures appear to be made with care, and the discrepancies are not greater than may be expected from night to night.

In connection with this subject Prof. Hall has applied a geometrical test to such observations by means of measures of the multiple stars Σ 2703 and Σ 311 and the stars in the trapezium of Orion. He says:—

"In the case of three stars A, B, C, if we take the origin of co-ordinates at A, and observe the angles of position and the distances of B and C only, then these quantities are independent, and we may put their differentials equal to zero. But if we observe also the angle of position and the distance between B and C we have obtained more quantities than the geometrical conditions require, and must adjust the parts of the triangle by the method of least squares."

In the case of the triangles and the quadrilateral there appear to be no important systematic errors.

Prof. Hall gives a detailed account of the use of "rough circles" for setting the instrument on a star. These circles are the edges of the ordinary setting circles divided by lines of black paint on a white ground so as to be read without trouble, a method already adopted in some observatories in this country. He also describes the difficulties he has had with the driving clock, difficulties which are too often experienced with driving clocks of all kinds, and often arising from insufficiency of power and strength of parts to stand varying strains, and often dust and damp, which ordinary clocks do not generally experience. The dome, which is 42 feet in diameter, now turns with more difficulty, and if our experience is worth anything, such a difficulty once commenced will keep on fast increasing, and will very materially militate against the continued use of the instrument beneath it. The flexure of the telescope, which is 31 feet in length, and of the mounting, is small, and the working of the instrument very satisfactory.

A filar micrometer has been used for all the observations, and great care has been taken to test its accuracy, which is all that can be desired; but we note that the wires are illuminated by a lamp held by an assistant, a method somewhat primitive, as Prof. Hall says, and a waste of energy which might, we should have thought, have been useful elsewhere.

In all the ordinary observations four measures of position and two double measures of distances have been taken, and in all cases the head of the observer was kept in an upright or natural position. Owing to this we shall expect to find, on comparison of the list of test stars with others, a considerable error depending on the position of the stars with the horizon. No doubt practice has a great deal to do with it, but we have generally understood that the observations were more accurate and differed less *inter se* when made with line joining the eyes parallel to that joining the stars under observation.

Prof. Hall has included a good many very close stars, and it is to them that the large telescope can be most profitably turned, leaving the wider ones for the small instruments, with which they are well able to deal.

OUR BOOK SHELF

Zoological Atlas (including Comparative Anatomy), with Practical Directions and Explanatory Text for the Use of Students. Invertebrata. By D. M'Alpine. 249 Coloured Figures and Diagrams. (Edinburgh and London: W. and A. K. Johnston, 1881.)

THIS Atlas is prefaced by the following remarks:—"In treating of the Invertebrata I have thought it advisable to depart slightly from the plan followed with the Vertebrata. There are five great divisions of Vertebrates recognised by naturalists, and a type or so of each was found to answer the purpose in view; but among Invertebrates the range of structure is immensely greater, and the typical forms are thereby necessarily increased. In order to preserve the just proportions of the subject, and out of the whole make a fair selection, I have treated most of the forms in less detail than the Vertebrates." With the above statement no objection could be found; as to the method of carrying it out, we notice that while four out of the sixteen plates are devoted to illustrations of the group of Protozoa, there is not even a single figure given of the Sponges, nor of the Hydrozoa, nor of the Actinozoa, and for their absence we can find no other excuse than what is given in the above quotation. As to the plates of Protozoa, we perceive that there is no exact indication of the size of the forms figured, unless indeed in a footnote, which states that the forms figured "are all *microscopic*, with the exception of the Nummulites." Now if there is one thing more than another that a student requires to be reminded of while studying "microscopic" forms, it is that they vary immensely among themselves as to size, and it is surely necessary that he should have some definite ideas as to those sizes beyond the range of unassisted vision, such as he may be presumed to have of those objects within this range. Neither has the author been to our mind happy in his selection of forms of the Protozoa "from standard works on the subject." His Atlas is meant for students in this country, and where are they to get specimens to work with of such genera as Protogenes, Vampyrella, Myxastrum, Protomonas, Protomyxa, Lieberkühnia, and the like. The student interested in "pond-life" may possibly admire the exquisite and artistic delineations of their old favourites, *Paramœcium*, *Daphnia*, *Cyclops*, &c., given in the Atlas. The festooned surface of *Paramœcium*, the appendages of *Daphnia* and *Cyclops* are certainly figured as they have never been heretofore. It is really refreshing to turn from the old and well-worn figures to the bold originality of these plates; in them the author has courageously followed the theory of zoological representation laid down by the celebrated German artist with reference to *Camelus*, sp., but is scarcely to be congratulated on the wonderful results he has achieved. Some of the diagrams are acknowledged as from the originals of Huxley and Gegenbaur; these are good.

The Student's Handbook of Chemistry. With Tables and Chemical Calculations. By H. Leicester Greville, F.I.C., F.C.S. (Edinburgh: E. and S. Livingstone, 1881.)

"In the presence of so many good manuals on chemistry, the appearance of another may seem unnecessary," says the author in his preface. For "may seem" read "is," and the sentence expresses a truism. The author's book can, however, scarcely be classed amongst "good manuals." The statements of individual chemical facts are on the whole correct; the general arrangement of the book is clear; yet, considered as a manual of chemistry, the work must be pronounced a failure.

Attempts are made to explain the expressions "atomic weight," "molecular weight," "valency," &c., but without success. Atoms are confused with molecules; the ordinary definitions of these terms are certainly stated, but definitions taken by themselves are, as Hunter said, "Of all things on the face of this earth the most cursed."

Avogadro's law is stated on p. 26, but the conclusion deduced therefrom, viz. "the densities of all the elementary bodies in the gaseous condition are the same as their respective atomic weights, or, the atoms of all the elements in the gaseous state occupy the same space," is untrue, and does not follow from the generalisation of Avogadro.

The Daltonian atomic theory is stated much in the terms which might have been employed before the molecular theory of matter had been propounded. Such statements as that on p. 15, that oxides are called monoxides, dioxides, &c., according "as the compounds contain one, two, three, &c., atoms of oxygen respectively"; or that on p. 13, "that acids are spoken of as monobasic, &c., according as they contain one, two, &c., atoms of hydrogen replaceable by a base," show that the author has failed to grasp the teachings of the molecular theory.

The term "valency," we are told on p. 159, is used to express "the comparative saturating power of the different elements, taking hydrogen as the unit." Such a loose statement as this naturally prepares the way for the full acceptance of the "bond" view of valency, with all its inconsistencies and apparent, but unreal, explanations of facts; so that one need not be surprised to find (p. 160) the expression, hard to be understood by the uninitiated, "the affinity of these bonds."

A sentence on p. 161 may be quoted as a type of the kind of writing to be found in the works of those who are bound by the trammels of this pernicious system. "The disappearance of the active atomicity by twos, which is found to be always the case, has led Dr. Frankland to suggest that the bonds of union so disappearing are engaged in satisfying each other."

That part of the chapter on "The Higher Principles of Chemical Philosophy" which deals with compound radicles is equally unsatisfactory. Sulphuric acid may be assumed to contain the radicle SO_2. "The group SO_2 may be traced all through the compounds of sulphuric acid, thus: $SO_2(OK)_2$ $SO_2(ONa)_2$ SO_2CuO_2." Such a statement is harmful, and only harmful, to the student; in what light other than as an amusing plaything can he regard this conception of compound radicle? Why should he not trace the group SO_3, or the group SO, or the group SO_4 "all through the compounds of sulphuric acid"? Give him pen and paper, and if he have a little fancy he will trace you a most varied and pleasing number of groups "all through" as many compounds as you please.

The tabulation of facts concerning groups of elements and compounds is a good feature in this book, and likely to prove very useful to the student. The chapters dealing with organic chemistry are clear and succinct: had the author contented himself with recording leading facts, and left the "principles of chemical philosophy" alone, he would have produced a book of some merit, although not of merit sufficient to warrant him in adding another "Manual of Chemistry" to the list which is already so much too long.

LETTERS TO THE EDITOR

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

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

The "Eira" Arctic Expedition

Those who advocate the despatch of a Government vessel in search of Mr. B. Leigh Smith's expedition betray only a partial acquaintance with the circumstances of the case. His having failed to return this season is no evidence whatsoever of his having met with disaster; for previous to his departure from England, certain people well understood that he was prepared to spend the present winter far north if he found it worth while to do so. It was this which prevented me from going with him (natural history work on hand precluding my absence from London for upwards of a year); for as I had collected plants and animals with him on a former expedition in Spitzbergen, he invited me to accompany him on his present trip to Franz-Josef Land. The *Eira* was well-provisioned for upwards of eighteen months, and in summer time fresh meat in abundance can be secured, which, hung up in the rigging, will keep good for almost an indefinitely long period. Thus the expedition has provisions enough for at least another year and a half from the present time, and there would be no need for them to starve two years hence. It is therefore rather early to begin to feel uneasy about their safety on account of provisions.

The detention of the *Eira* in the north is more probably due to her being "beset" than to her having been "nipped" or run aground. Unless she has foundered before stores could be got out of her (when nothing could be done by any search-expedition towards enabling the crew to survive the winter), Mr. Smith and his men are doubtless having a fine time of it up there, in one sense of the words. If it came to the worst they would not be obliged to abandon the ship simply on account of her being hopelessly "beset," until the spring of 1883, because they could afford to wait for the chance of her being liberated next summer or autumn. Then, if she were clearly inextricable, they would do what is done by the crews of whalers under similar circumstances—haul boats or sledges, laden with provisions, over the ice to some place where, in the ordinary course of events, they could not fail to fall in with walrus-hunters, or from whence they might take a departure in their own boats to the most convenient country. Mr. Smith, to my personal knowledge, always counted upon being able to effect a safe retreat by these means, without unusual difficulty, if he should lose his ship: the despatch of an expedition from England in search of him never entered into his calculations. This will amply account for his not naming a *rendezvous*. In the Arctic regions it is best not to be tied down beforehand to any one *route* where there is a choice of several, lest if emergency arise it prove to be *pro tem.* precisely the most difficult of all.

In view of the above facts it appears premature to demand the equipment of a vessel to rescue the *Eira* as a matter of immediate urgency, although, if nothing be heard of her by this time next year, an expedition during the season of 1883 might be a reasonable precaution by no means uncalled for. If people want a ship to be sent out next year, why should not the agitation be an honest one for an Arctic expedition pure and simple?

Thorncombe Vicarage, Chard, Dec. 3 A. E. EATON

Helophyton Williamsonis

AT the late York meeting of the British Association two of my indefatigable auxiliaries in the work of Carboniferous investigation, Mr. Wm. Cash, F.G.S., of Halifax, and Mr. Thomas Hick, M.A., B.Sc., of Harrogate, described, under the name of *Hymenophylloides Williamsonis*, a new stem of a plant, which they had obtained from the Halifax beds. This plant is an extremely interesting one, since its cortical layer exhibits the large, open, longitudinal lacunæ, formed by dissociation, so common amongst aquatic plants. It is still more interesting since the septa separating the large lacunæ are rotate, each one consisting of a single layer of cells, and the whole combining to constitute a network with vertically elongated meshes. This arrangement approaches too closely to that seen in the living Marsileaceæ, to be overlooked in considering the possible affinities which it may indicate. The structure of the central vascular bundle as well as of its component vessels differs decidedly from that of the recent Marsileæ and their allies. But it differs still more widely from Myriophyllum, with which the generic name given to it by my two friends associates it. This circumstance alone makes it important to change the name. As yet we have found no trace of an angiospermous phanerogam in the Carboniferous beds, and any name suggesting the probability of the existence of such is apt to be misleading. But apart from this suggestion of improbable affinities a second reason exists for changing the name. Urrger has already adopted that of Myriophyllites for a genus of Tertiary plants, and the two names approach too nearly to make it desirable that both should be retained. One point appears to be indisputable:—The structure of the bark already referred to indicates either a marsh or an aquatic plant—an interesting fact, since it is the first example of such a plant from the palæozoic rocks that has hitherto come under my notice. We have numerous so-called aquatic roots described by various authors—and possibly they may be what they are affirmed to be, though we have no proof that such is the case; but I think that no such doubts can exist in reference to our new plant. Under these circumstances I propose for this plant the generic name of *Helophyton*, a name which involves no foregone conclusions as to its botanical affinities. Detailed figures of it will appear in the next (12th) part of my memoirs "On the Organisation of the Plants of the Coal-measures.

WM. C. WILLIAMSON

Victoria University, Manchester, December 3

The Pronunciation of Deaf-mutes who have been Taught to Articulate

MY attention has just been drawn to the remarkable statement of M. Hément (*C. R.*, xciii. p. 754), that deaf-mutes who have been taught to articulate speak with the accent of their native district; and to the equally remarkable letter of Mr. Wm. E. A. Axon, published in NATURE (vol. xxv. p. 101), in support of the same proposition.

I may say in this connection that I have during the past few years examined the pronunciation of at least 400 deaf mutes who have been taught to speak, without remarking any such tendency as that referred to above. It is true that in a few cases dialectic pronunciations are heard, but it always turns out upon investigation that such children could talk *before they became deaf*. The peculiarity is undoubtedly due to unconscious recollection of former speech, and cannot correctly be attributed to heredity.

M. Emile Blanchard (*C. R.*, xciii. p. 755) has directed attention to the harsh and disagreeable character of the utterance of many deaf-mutes who have been taught to articulate, but it has been found in America that this can be overcome by suitable instruction. I am happy to be able to say that I have heard from congenitally deaf children perfectly distinct and agreeable articulation.

The mouths of deaf children are in no way different from our own.[1] Deaf mutes do not naturally speak the language of their country for the same reason that we do not talk Chinese—*they have never heard the language*. They are dumb simply because they are deaf; and I see no reason to doubt that all deaf-mutes may be taught to use their vocal organs so as to speak at least *intelligibly*, if not as perfectly as those who hear.

In most, if not in all, of our American Institutions for the deaf and dumb, articulation is now taught as a special branch of education; and in many of our schools all instruction is given by word of mouth, as it has been found that large numbers of deaf children can be taught to understand spoken words by watching the movements of the speaker's mouth.

So successful has articulation-teaching proved in America and in Europe, that dumbness will soon be universally recognised as a mark of neglected education.

ALEXANDER GRAHAM BELL, Ph.D.
(Nat. Col. for Deaf Mutes, Washington)

London, December 5

The Function of the Ears, or the Perception of Direction

I SEE the above to-day in NATURE (vol. xxiv. p. 499) as a matter brought before the British Association at York, and as I can forward some results of experience, I beg to send the following:—In the cold season of 1868 I had to cut a straight line through dense forest half a mile long, between two given mounds, and availed myself of the known capability of Asamese in telling direction in such cases. Placing a man on one mound to shout now and then, a party of us went to the other mound and listened. On hearing the shouts I placed a long thin bamboo on the ground pointing from a peg in the direction of the shouts. While the men were clearing a space around I put another small peg in the ground, marking where the point of the bamboo fell. I took the bamboo up, and made the head man relay it himself, which he soon did, almost exactly where I had pegged it; thence we cut a true straight line, setting up peeled rods at every 50 yards, and eventually came out at 24 feet from the mound, in a distance of 45 chains. The jungle was dense, and we could never see more than about 12 or 14 yards in front. Lately having moved to a place where there are five tea-gardens in a semicircle around me, at distances of 5, 6, 4, 4½, and 4½ miles distant, I have heard several gongs in the early morning, and taking the bearing of the most audible, plotted it on the Government map, when it came out exactly among the houses in the "station" of the one at 4 miles; a repetition on other mornings confirms the direction. Distance does not seem any drawback, provided the sounds are loud enough; for in the great

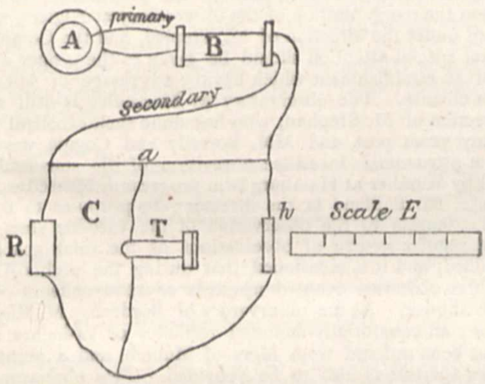
[1] I have examined the vocal organs of several hundred deaf-mutes, and while I have observed the most extraordinary differences in the size and shape of the palate, and in the appearance of the tongue, I have observed the same peculiarities in the mouths of hearing children, who talk perfectly well. The proportion of malformation of the vocal organs among deaf-mutes is certainly not greater than among hearing children. We occasionally meet with cases of cleft-palate, of double rows of teeth, and of tongue-tie, but such cases are altogether exceptional, and the vast majority of deaf-mutes have vocal organs as perfect as our own.

earthquake of January, 1869, the direction of the loud banging sounds like artillery was carefully marked against a peak in the Naga Hill range. Bearings by the prismatic compass subsequently sent to Calcutta to Dr. H. B. Medlicott, turned out to be within 3° of the true line to Cheduba and Ramree, the active volcanic centre, 550 miles off. I cannot exactly see how the difference of the *intensity* assists us in directing to the sound. I find I judge that best by facing it and remaining still, and verify the direction best by *looking* (with the eyes only) about 10° to right, and then 10° to left, which, if I do not move the head, soon enables me to fix by eye the direction pretty close.

Sibsagar, Asam, October 27 S. E. PEAL

An Audible Photometer

IN your issue of September 22 (vol. xxiv. p. 491, British Association Reports) Mr. Lant Carpenter mentions an idea of his about an "audible photometer." The same idea occurred to me some six months ago. As my plan seems to be much more simple than Mr. Carpenter's, dispensing with intermitting beams and rotating disks, perhaps you will allow me a little space to describe it. I require only one photophonic receiver, whereas Mr. Carpenter mentions "two precisely similar receivers," which is difficult, if not wholly impossible, to obtain. A is a small battery, B an induction-coil with the ordinary vibrating magnetic interrupter, and with a high-resistance secondary coil; C is the Wheatstone-bridge combination, S E a selenium cell, with its working surface



turned to the scale E; R is a high resistance of about the value of the selenium cell; *a* is a sliding contact, T a high-resistance telephone. Now I place on the scale E a standard candle at a distance *d* from selenium cell, and move the sliding contact till no sound is emitted from the telephone. Then the wire connections are left wholly unaltered, and the candle is taken away. Now I place the light I wish to compare with the standard candle on the scale E, and move it along the scale till the telephone is again silent. Be the distance of the light from the selenium cell now D, then its luminous intensity is

$$\frac{D^2}{d^2} \text{ standard candles.}$$

As, on after-thought, I greatly doubted the fitness of selenium for photometric purposes (which doubts became the stronger the more I read about the subject), I did not pursue my idea, which could only result in an addition to the long list of practically useless photometers. The above may perhaps be used as a college experiment for demonstrating the law of the square of distances. J. W. GILTAY

Delft, November 21

Extraordinary Atmospheric Phenomenon

I INCLOSE a paragraph from the Glasgow *Evening Citizen* of this date relating to that peculiar form of lightning known as fire-balls. The explanation of the explosion in the funnel is, I think, erroneous, it having been caused by the explosion of the fire-ball, thus driving out the smoke by the fire-doors. The aurora was very bright here on Wednesday evening, showing Piazzi Smyth's line with a small direct vision spectroscope. Before the eye became sufficiently sensitive for measurement, clouds cut off the bright part. The aurora was a general bright northern glow without streamers, and was observed brightest a little after eight (p.m.). These notes may be of use to you in connection with those of other observers. J. B. HANNAY

Cove Castle, Loch Long, N.B., November 25

Extraordinary Phenomenon of the Storm

Those on board the Campbelton Steamer *Kinloch* (Capt. Kerr), which left Greenock on its usual run about half-past eleven o'clock on Tuesday morning after the storm that raged during the night, had a somewhat extraordinary experience while passing down the Firth. The vessel was enveloped in a dense shower of hail, and for some time it was awfully dark, and occasionally the vessel was lit up by vivid flashes of lightning. One of the flashes was very bright, and its shape was something like that of the arteries of the human body, with a central column all shattered and broken. About noon, while opposite the Cloch Lighthouse, and not far from the shore, the captain observed immediately over the ship what appeared to be a series of clear balls of lightning, each about a foot in length, and resembling a chain, except that they were disconnected. This phenomenon was quickly succeeded by an explosion in the funnel of the steamer, and several balls of fire upon the bridge running about, and then bounding off into the water. The first impression of the spectators was that something had exploded on board, but on inquiry it was found that this was not the case. The mate stated, however, that a ball of lightning had almost struck him where he stood. A fireman rushed upon deck to see what had happened, as the engine-room was filled with smoke, and a choking sensation was experienced below. The explanation appears to be that a portion of the lightning had passed down the funnel until its force was spent by the fire, and the sudden recovery of the draught of the funnel afterwards accounted for the loud report that was heard. The captain, in his long experience at sea, never encountered such a pheno enon before, and it may be taken as an indication of the extraordinary atmospheric forces which had been at work during the storm, and which seemed to centre in this locality.

Papin

IN the review of my "Life and Letters of Papin"[1] in NATURE, vol. xxiv. p. 378, the hope is expressed that I might succeed "to fill the *lacunæ* in the career of this remarkable man." The only important blank remaining now in our knowledge of Papin's life consists in our ignorance of the time of his death. We may rest assured that he died in London, and therefore this blank is not likely to be filled but by a person who is familiar with the city and its inhabitants of the present and of the beginning of last century. Papin died about 1712. During 1709 he lived at "Madam Portal chez M. Charron, apothécaire dans Compton Street, proche St. Anne." As it is not probable that he changed his lodgings before his death a search in the registers of the district to which Compton Street belonged (if they are in existence) would lead to results equally important for the history of science and for that of technology. Maybe a reader of this note who enjoys such opportunities will render me his assistance in this thankful task.

I avail myself of this opportunity of correcting a few slight mistakes which have found their way into the otherwise excellent *résumé*. Not Papin but Leibnitz is the author of the letter of February 4, 1707, which contained the first idea of the "hot-air engine." Leibnitz is therefore the inventor of the same. That boat, in which Papin left Cassel in 1707 to sail to Bremen, was not a "steam propeller boat," but a small ship with paddle-wheels to be worked by the sailors. It was not Papin's intention to proceed to England in that boat. He left Cassel with proofs of the favour and goodwill of the Landgraf, which remained unchanged to the end. Lastly, before Papin no steam-engine existed; he is the real inventor of the same, for he in 1690 first announced the idea, and tested it by experiments of utilising the pressure of steam as motive power for engines. This, his first engine, had a piston inside a cylinder. Such an arrangement was not at all new at that time; other machines had the same, as, for instance, the gunpowder engine of Huyghens, which suggested the invention of Papin. Leibnitz corresponded with the inventor about this engine much later, and made valuable propositions, but the correspondence of these

[1] Leibnizen's und Huygens' Briefwechsel mit Papin, nebst der Biographie Papin's und einigen zugehörigen Briefen und Artenstücken. Bearbeitet und auf Kosten der Königlichen Preussischen Akademie der Wissenschaften herausgegeben von Dr. Ernst Gerland. Berlin, 1881. Verlag der Königlichen Akademie der Wissenschaften.

two *savants* did not commence before 1692. It is therefore out of the question to credit Leibnitz with the invention of the steam-engine or even with the application of the piston principle in the steam-engine. E. GERLAND

Cassel

A Question for Naturalists

MR. PAUL DU CHAILLU, in his "Land of the Midnight Sun," tells us that "the time of dropping the horns in a herd (of reindeer) varies from March to May." This may be true as regards the young males up to two or three years of age, and of the does, but it is questionable as regards the full-grown males. If my memory serves me correctly, the full-grown bucks brought to this country with some Lapps a year or two ago, and exhibited at the Aquarium, shed their horns in December or January. The experience of a gentleman—one of the highest authorities in such matters—who holds a most important position at the Zoological Gardens, supports my view. Can the Lapps have two kinds of reindeer which shed their horns at different seasons? I know that the full-grown male reindeer of the barren grounds of America drop their horns in the latter part of November and in December (which does away with the erroneous idea that this animal used the broad brow antler as a shovel for clearing away the snow so as to reach his food); the young buck of two or three years retains his horns until spring, and the full-grown female does not shed her horns until May or June, usually after having dropped her calf. J. RAE

4, Addison Gardens, November 19

Earthquake Vibrations

IN a note in your issue of August 25 on my account of the earthquake of March 8, 1881, felt in Japan, it is said "that from the phenomena of the shock and from experiments on artificial earthquake waves produced by letting an iron ball weighing about one ton fall from a height of about thirty-five feet, Mr. Milne agrees that the waves that are felt are transverse to the line of propagation of the shock." Lest it should be thought that all the earthquakes which shake the residents in Japan are composed of transverse vibrations, allow me to make the following brief statements:—

1. In the earthquake of March 8 my seismographs chiefly indicated east and west motions, whilst time observations made in Yokohama, as compared with similar observations made in Tokio, showed that the earthquake must have travelled up from the south. This particular earthquake, as recorded in Tokio, might therefore be called a transverse or diagonic shock.

2. In other shocks normal or direct vibrations are the most prominent. These shocks might be called euthutropic.

3. Others again are compounded of direct and transverse motions, and might therefore be called diastrophic. Thus my records of the shock of July 5, 1881, very clearly showed a variation in the direction of the motion of the ground. At the commencement of the shock the motion was N. 112° E.; 1½ second after this the direction was N. 50° E.; ¾ second more it was N. 145° E.; and after a similar interval N. 62° E. These and other changes were very clearly indicated in the diagram written by a double-bracket seismograph.

4. Anaseismic shocks, or those where vertical motion is prominent, which vertical motion may sometimes be a component of the transverse motion, appear to be rare.

5. In the artificial earthquakes produced by the blow of a falling ball the seismographs very clearly wrote both normal and transverse vibrations. When bracket-ring seismographs were used, these two sets of vibrations could be separated and their respective velocities, &c., measured. When a single component seismograph was used, the resultant motion due to the composition of these two sets of vibrations was recorded. The results of these experiments, which experiments were made in conjunction with my colleague Mr. T. Gray, will very shortly be published. JOHN MILNE

Imperial College of Engineering, Tokio, Japan, October 13

The Geological Survey of Italy

MY friend Mr. W. Topley, in his interesting account of the Italian Geological Survey (NATURE, vol. xxv. p. 86), is quite right when he states that the geological surveyors seem now to have definitely fixed the position of the Carrara marbles in the Trias. If, however, he means to imply that the geological world at large will accept this decision, I fear he is mistaken. The patient toil, spread over many years, and carried on by M. Coquand with more than due regard to Buffon's advice to geologists, "*Il faut voir beaucoup et revoir souvent*," gives him such authority when speaking on the structure of the Apuan Alps and the Campigliese, that nothing but the most absolute proof that he is wrong in regarding the metamorphic marbles of Carrara, as well as those of the Pyrenees (St. Béat, &c.), as being of Carboniferous age, will prevent foreign students of Italian geology from accepting his views on the matter. I have read, I think, all that has been written in Italy by De Stefani and others on the point in question since the publication in full of M. Coquand's mature conclusions in the *Bulletin de la Société géologique de France*, in 1874, and I still regard his position as entirely unassailed. In 1876 I published in the *Geological Magazine* a short *résumé* of M. Coquand's results, to which I would refer any who are interested in the subject. G. A. LEBOUR

OUR ASTRONOMICAL COLUMN

THE PROVINCIAL OBSERVATORIES OF FRANCE.—We have before us the "Rapport adressé par le comité consultatif des observatoires astronomique de province, à M. le Ministre de l'Instruction Publique," signed by M. Lœwy, as reporter. In the year 1880 a great impulse appears to have been given to what is termed the reform of French astronomy, a considerable grant having been obtained by the Minister of Public Instruction, which allowed of most material improvement in the equipment of the several observatories of the provinces. Stress is laid upon the reorganisation of the observatory at Algiers, which is placed under the direction of M. Trepied, and the Committee urge that special attention should be given to the proper equipment of an establishment which has the advantage of so exceptional a climate. The observatory at Marseilles is still under the direction of M. Stephan, who has done such excellent work for many years past, and MM. Borrelly and Coggia were the assistant-astronomers in 1880: a revision of the star-catalogue formed by Rümker at Hamburg is in progress at Marseilles. At Toulouse, M. Baillaud is the director; he proposes to devote special attention to the observation of the variable stars. In 1880 a regular course of observations of the solar spots was maintained, and it is mentioned that during the nights August 9–13 three observers counted upwards of 1200 meteors of the Perseus shower. At the observatory of Bordeaux, M. Rayet is director; an equatorially-mounted refractor of 14-inches aperture has been ordered from Merz of Munich, and a second of 8-inches aperture is also to be provided. Two observers were engaged in 1880 upon a revision of the charts of Chacornac. The observatory at Lyons includes four stations, three of them devoted to meteorology: the astronomical station is at Saint-Genis-Laval, where M. André is director, and the principal instrument in process of construction in 1880 was a meridian-circle of 6-inches aperture by Eichens. The State-subvention to these observatories is 81,000 francs, and further funds are provided by the cities of Bordeaux, Marseilles, and Toulouse for their respective establishments.

The Report is a very encouraging one in its bearing on the advancement of practical astronomy in France.

DENNING'S COMET.—Dr. Hartwig has corrected his first ellipse with the aid of an observation by Prof. Winnecke on November 19, in addition to earlier ones at Marseilles and Strasburg, and now finds the period of revolution 8·8334 years, or 3226·4 days. With the corrected orbit the nearest approach to the orbit of Jupiter occurs in 222° 35′, heliocentric longitude, where the distance is 0·154, the comet is at this point about 593 days before perihelion passage. It approaches nearest to the orbit of Venus 5·6 days after perihelion passage in longitude 30° 45′, where the distance is only 0·0226, while in longitude 82° 35′, about 36·7 days after perihelion passage the comet's distance from the earth's orbit is at a minimum of 0·0346.

A NEW COMET.—A Dunecht circular issued on November 22 contained elements of a comet from observations made by Mr. Wendell at the observatory of Harvard College, U.S., on November 17, 19, and 20. Prof. Winnecke has observed this comet as follows:—

	Strasburg, M.T.				R.A.				Decl. N.		
	h.	m.	s.		h.	m.	s.		°	′	″
Nov. 25	9	54	33	...	0	30	39·46	...	63	52	2
26	6	3	31	...	0	25	25·44	...	62	35	21

These places differ considerably from the ephemeris telegraphed to Dunecht.

THE PRESSURE ERRORS OF THE "CHALLENGER" THERMOMETERS[1]

II.

XI. *Accurate Measurement of Great Pressures.*

IT will be obvious from what has been said, especially as regards the old apparatus which was carried about in the *Challenger*, that one of the most essential requisites of the whole investigation was the accurate measurement of pressure. All the ordinary forms of pressure-gauge were found to be untrustworthy. It was necessary that in all cases the pressure should be measured with certainty to about 1 per cent. No attempt was made to secure any greater degree of accuracy, as the indications of the thermometers themselves could not in any case be trusted to less than 0°·1 Fahr.

The basis on which, after a great many trials, I finally founded my determination of pressures, was Amagat's[2] remarkable measurements of the volume of air and other gases at high pressures. Amagat's data were obtained in the most direct and satisfactory manner, inasmuch as he measured his pressures by means of an actual column of mercury extending sometimes to 300 metres, and more. All other means of measuring pressure are as it were valueless in comparison with this. We know by these experiments the compressibility of nitrogen, and of air, up to pressures of at least two and a half tons weight per square inch, with almost all desirable accuracy.

All that was necessary therefore in order to determine the pressures in the operating cylinder, and thus to calibrate the gauges employed, was to compress once for all a quantity of air, measure the volume to which it was compressed and the corresponding indications of the gauges, and then by the help of Amagat's tables compute the pressure actually attained. The apparatus I employed for this purpose is figured in section in the diagram below.

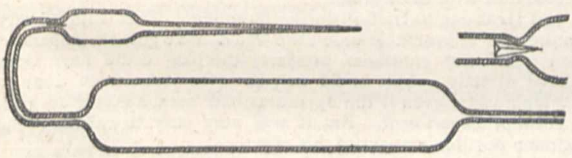


FIG. 4.—Air-gauge giving pressure (after Amagat).

This apparatus, filled with dry air, was allowed to come exactly to the temperature of the water inside the compression apparatus; then, the open lower end of it being dipped into a large vessel of mercury, it was let down full of air into the compression cylinder and pressure was applied. The effect was of course to compress the air, force up the mercury until it gradually filled the vessel and forced the air entirely into the smaller bulb. After a few trials we found roughly what amount of pressure was necessary in order just to commence the forcing of mercury into the small bulb. The mercury forced in was weighed; then the capacity of the small bulb was determined by weighing its contents in mercury. The difference of these weights is the weight of mercury, which would occupy the same volume as did the air when compressed. Finally, the original volume of the air was found by weighing the whole apparatus, first empty then filled with water; and, most important in view of Amagat's results, the barometer and thermometer were carefully observed at the instant when the apparatus had its lower end placed in the vessel of mercury. Mr. Kemp, who made these instruments for me, suggested and carried out the great improvement of inserting a small triangular pyramid of glass into the choked part of the bore (as shown in the small sketch). The effect is to break the mercury (which must be very clean) into exceedingly small drops. In this way the actual compression of the air was determined with a limit of error, represented at the utmost by the ratio of the volume of one of the small drops of mercury formed at the obstruction to the whole capacity of the small bulb. By working simultaneously with three instruments of this kind, even this very small error could be in great part eliminated:—and, practically, the compressions were measured far more accurately than was at all necessary for the purpose in hand. For greater accuracy a larger apparatus would be required. This, however, was quite unnecessary. And the requisite limit of accuracy in the experiment rendered it unnecessary to correct for the alteration of volume of the smaller bulb consequent on the pressure to which it was subjected.

In my later experiments a long carefully-gauged tube of 1·5 mm. in bore was substituted for the small bulb. This tube was coated internally with an excessively thin film of metallic silver thrown down by sugar of milk. The process was arrested the moment the film became visible by reflection. This film is at once dissolved by the mercury up to the point which it reaches at the greatest pressure, and leaves a perfectly sharp and nearly opaque edge from which to measure. This device has proved so very successful that I have now substituted it for the indices in all the pressure gauges (shortly to be described) which are employed for very accurate measures. And I am at present engaged in measuring, by comparison of a glass gauge and an air-gauge both filled in this manner, the compression of various gases at pressures up to fourfold those applied by Amagat.

XII. *Internal Pressure Gauges.*—The next step was to find some plan of construction for an instrument which, having its scale determined once for all by comparison with the air-gauge, should ever afterwards serve instead of it, thus affording a ready measure of pressure. Liquids are obviously better fitted for this purpose than solids, if only on account of their absolute homogeneity and their greater compressibility. But, unfortunately, *two* liquids must be employed, since a record must be kept:—the apparatus being surrounded on all sides by nine inches of iron:—and all my trials with two liquids were more or less unsatisfactory. The very fact that I was dealing with thermometers whose bulbs were protected from pressure, at once suggested an unprotected thermometer as something perfectly well suited to the purpose so long as the glass might be trusted to follow Hooke's law. [I have since found that the invention of such an instrument, to be used as an *élatéromètre*, is due to Parrot.[1] His investigation of the effects of pressure is wholly incorrect, as it takes no account of distortion; but the device, and the recognition of the fact that its indications are proportional to the pressure, are wholly his.]

These instruments, which, like the thermometers, are fitted with a needle-index with hairs attached, have only one defect, which is that they act like thermometers as well as pressure-gauges. That defect I managed to remove almost completely by the simple device of inclosing in the bulb a closed glass tube which *all but* fills it. The liquid then occupies only a small space between the interior tube of glass and the exterior tube forming the bulb, and is as ready as ever to give indications of pressure, while it is not in sufficient volume to be more than slightly disturbed even by a serious change of temperature.

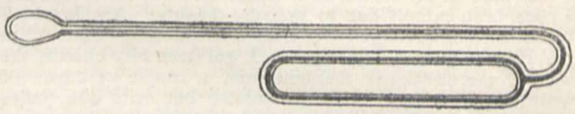


FIG. 5.—Internal gauge, plugged.

It is quite easy, by comparing two instruments of this kind in which the ratios of the internal to the external radius of the cylindrical bulb are different, to find by trial through what range its indications are strictly proportional to the pressure. Thus all the requisites of a perfect gauge, so far as the experiments required, were met by this simple apparatus. That I have obtained a sufficient accuracy in the graduation of these instruments is proved by the close agreement between my results for the volumes of air at different pressures as measured by means of them, with the volumes corresponding to these pressures in Amagat's table. If Boyle's law had been even approximately true for these high pressures, this mode of verification would have been fallacious. It would, however, be easy to make an independent verification, by sinking some of these instruments, each thoroughly imbedded in a mass of lard (as a protection

[1] By Prof. Tait. Abridged by the Author from a forthcoming volume of the Reports of the Voyage of H.M.S. *Challenger*, by permission of the Lords Commissioners of H.M. Treasury. Continued from p. 93.

[2] "Mémoire sur la Compressibilité des Gaz à des pressions élevées," par M. E.-H. Amagat (*Ann. de Chimie et de Physique*, 1880).

[1] "Expériences de forte compression sur divers corps, par M. Parrot" (*Mémoires de l'Académie Impériale des Sciences de St. Petersbourg*, 6me. série, tome ii., 1833). The pages are headed "Parrot et Lenz," and it was by mere accident (seeking in the Royal Society's "Catalogue of Scientific Memoirs" for a reference to Lenz's thermo-electric writings) that I lit on the paper. I was much surprised at some of the statements it contains, till I found at the very end a footnote by Lenz, in which he disclaims all responsibility for the writing of the paper, and for the conclusions drawn in it.

from shocks) to a measured depth in the sea. This idea is worthy of consideration, especially if the gauge be made to register by means of a silvered tube. The only probable cause of error in such a case would be the breaking of the mercury column by a jerk, and to this all other forms are at least equally liable.

XIII. *External Pressure Gauge.*—But it was necessary not merely to measure accurately the pressure applied, but also, for the sake of the thermometers, to provide that the pressure should not be carried too far; and for that purpose it was indispensable to have an exterior indicator of pressure. This was furnished by a thin cylindrical steel tube inclosed in a cavity bored in a large block of iron, the interior of the steel tube being full of mercury and the narrow space between it and the large iron block also full of mercury. This exterior space was connected with the pressure apparatus. The pressure then throughout the whole of the space exterior to the steel cylinder was the pressure in the pump. The steel cylinder was therefore compressed from the outside. In the neck of the steel cylinder, which was screwed into the surface of the block, there was luted a vertical glass tube. It was exposed to no pressure, but the mercury in it rose, by the compression of the steel cylinder, and the height to which it rose could be easily measured. Comparative experiments were made several times by putting one of the glass gauges, whose scale had been carefully ascertained, inside the apparatus, while this newly-described gauge was also connected with it. In this way the external gauge was accurately calibrated. But, lest an accident should happen to one of the gauges, or to its index (as sometimes was the case) no experiment was made without the presence of at least three gauges. The way in which these worked together during the whole course of the experiments is the best possible proof of their value. This form of gauge, also, is greatly improved by inserting a glass tube closed at both ends into the bulb; for the temperature changes produced by pressure in mercury are greater than those in water at ordinary temperatures.

XIV. *Results of the Experiments. The True Correction for Pressure is very small.*—As soon as I applied pressure to the *Challenger* thermometers I found I reproduced pretty nearly the results obtained by Capt. Davis. I had already seen one proof that at least a large part of the result was in all probability not due directly to pressure. The experiment with the long thermometer tube showed that my theoretical calculations had been correct. The question thus became:—Is this a pressure effect of any kind; and, if so, how does it originate? and if it is not a direct pressure effect, to what is it due? There are many ways of answering such questions. One answer was furnished by one of the thermometers (A 3), whose degrees (especially on the maximum side) are very short. The whole effect (in degrees) on this thermometer was not very markedly greater for a given pressure than on the others, as it would certainly have been had the effect been entirely due to pressure directly. Another is, if it be not a direct pressure effect it must be a heating effect. With Sir Wyville Thomson's permission I got from Mr. Casella, the maker of the *Challenger* thermometers, a couple of others of exactly the same form and dimensions, but with the bulbs plugged after the manner of the gauges already described, so as to diminish their susceptibility to changes of temperature. When I put one of these into the pressure apparatus along with one of the *Challenger* thermometers, I found the effects on the new form very much smaller than on the old. Thus it was at once proved that the effect could not be due to wry-neckedness produced by the fitting on of the protecting bulb; which would have been an effect due to pressure directly; but that it must be an effect due to heat. That is to say, it was now completely established that the large results obtained by Capt. Davis are due in the main to causes which can produce no effect when the thermometers are let down gradually into the deep sea; they are due to causes connected with the thermometers, and perhaps also with the pump, but solely under the circumstances of a laboratory experiment.

XV. *Sources of the large Effect obtained in the Press.*—Now comes the question (no longer important to the *Challenger* work, but of great scientific interest), What are these various sources, and how much of the effect is due to each? First of all we have seen that the water in the press is heated when pressure is applied. Using Sir William Thomson's formula I found the amount of that heating should be about 0°·05 F. at 43° F., 0°·16 at 50°, and only 0°·3 at 59°, for one ton of pressure. [These numbers are rather too small. We do not yet know to what extent the temperature of the maximum density point of water is lowered by pressure.] These cannot be expected to be fully shown under the circumstances of the experiments, and even if they were fully shown the greatest of them represents only about one-half of the whole of Capt. Davis' result; there must therefore be some other cause. [Prof. Tait then gives details of the various experiments by which he traced the sources of the large effect obtained.]

Thus it appears that there are no less than five different causes which contribute each its share to Capt. Davis' result. Of these, one is independent of the others, and would produce its full effect even if they were not present. The other four give effects which are not cumulative, and it would be very troublesome to try to assign to each its exact share of the result when two or more act together. Fortunately, it will be seen that we do not require to attempt to solve this problem.

(1.) First is the direct effect of the external pressure upon the exposed part of the thermometer tubes. This, in general, will be found very small, except in tubes where there are large aneurisms. The whole effect of 3 tons pressure on a *Challenger* thermometer without aneurisms, at temperatures near freezing point, so far as the minimum index is concerned, would be only about 3 one-thousandths of 30 degrees or so, that is 90 thousandths or at most 0·1 of a degree for 3 tons pressure. That is an amount which, in consequence of the necessary errors of reading the thermometers, may be entirely neglected, and, unless there are large aneurisms, there will be little need for pressure corrections even in six miles of sea.

The other parts of the observed effect were

(2.) Heating of water. This I observed to follow very nearly, according to Thomson's formula, the original temperature of the water. By comparing the pressure effects on the same thermometers during summer, and during winter (for which latter the late continued frost was of particular service, and enabled me to work for many days at the temperature of the maximum density of water), I found the results to vary in accordance with calculation.

(3.) Heat due to friction during pumping. This from its very nature was unavoidable unless we could have got an apparatus into which (by enormous pressure) the plug could have been forced directly. This could not, however, have been done in my laboratory, even if the apparatus had been adapted to such a form of experiment. But it was very easy to calculate the extreme possible amount of this effect.

(4.) The peculiar heating effect due to the vulcanite mounting. I verified this effect of vulcanite by taking a thermometer which had no vulcanite about it and measuring the effect produced upon it by a definite pressure, and then putting loosely round the bulb (in a test-tube, which had itself been previously experimented on) a small quantity of vulcanite in thin plates. I found that so little as 8 grammes of vulcanite round the protecting bulb raised the effect produced by a pressure of 3·2 tons weight from 0°·5 F. to 1°·1 F. The vulcanite was in thin strips about a millimetre and a half in thickness. The effect of the vulcanite on the *Challenger* thermometers (in the hydrostatic press) must, from the mode of their construction and mounting, in all cases be considerably greater than this.

Under these circumstances, we might without farther inquiry fairly attribute the whole outstanding effects to the massive vulcanite slabs on which these thermometers are framed. But there still remains

(5.) The most difficult question of all, the temperature effect produced by pressure upon the protecting bulb, which is under different circumstances altogether from the vulcanite; for the vulcanite is simply compressed, while the glass sheath is under pressure on one side and not on another, and is therefore subject to shear as well. In its interior the glass is extended in a radial and compressed in a tangential direction. Nobody has yet made any approximation to an answer to the question what effect in the way of heating or cooling will be produced by deformation which consists partly of compression and partly of change of form. We know that in indiarubber a cooling effect is produced by traction, and it may happen that a similar change of form in glass also produces a reduction of temperature. This is a question, however, which is not capable of answer by the help of my present apparatus;—though it will probably be answered by experiment before theory is able to touch it. The results of my experiments on the thermometers with plugged bulbs show that, on the whole, a heating effect results from the combined compression and shear in a bulb exposed to external pressure only. This has been verified by cutting down a thermometer, an exact counterpart of the *Challenger* thermometers but without aneurisms, taking out the greater part of the mercury and inserting a second (now a maximum) index in the minimum side of the tube. When this instrument was stripped of its vulcanite, the effect of pressure at 40° Fahr. was considerably greater than that due to compression of the tube.

But it does not require to be taken into account so far as the *Challenger* thermometers are concerned.

XVI. *Final Conclusion from the Investigation.*—The final conclusion is that only one of these five causes, which are active in the laboratory experiment, can affect the *Challenger* thermometers when let down into the sea, namely, pressure. There is there no heating of water by compression; there is no heating by pumping; there is no heating of vulcanite, because the thermometers are let down so quickly in comparison with the rate of increase of pressure that each little rise of temperature is at once done away with as the thermometer passes through a few additional yards of water; and the effect on the protecting glass also, for the same reason, which is a heating effect on the whole, is all but done away with step by step as it is produced. All these four causes, therefore, which made Capt. Davis' correction so much too large, are valid only for experiments in a laboratory press, and not for experiments in the deep sea. Therefore, as a final conclusion, I assert that, if the *Challenger* thermometers had had no aneurisms, the amount of correction to be applied to the minimum index would have been somewhat less than 0°·05 F. for every ton of pressure, *i.e.* for every mile of depth. All the thermometers which have large aneurisms have had special calculations made for them, but in no case does the correction to be applied to the minimum index exceed 0°·14 or about one-seventh of a degree per mile of depth.

[From the *Appendices* to Prof. Tait's Report, which contain numerous formulæ with detailed descriptions of apparatus and modes of experimenting, we make the few following extracts.]

The diminution per unit volume of the interior of a cylinder with closed ends, of internal radius a_0, and external radius a_1, when exposed to an external pressure Π, is

$$\Pi \frac{a_1^2}{a_1^2 - a_0^2}\left(\frac{1}{n} + \frac{1}{k}\right).$$

Here n is the rigidity, and $\frac{1}{k}$ the compressibility, of the walls of the cylinder.

When Π is a ton-weight per square inch, the value of the quantity

$$\Pi\left(\frac{1}{n} + \frac{1}{k}\right),$$

is, according to the best determinations, somewhere about $\frac{1}{1000}$ for ordinary specimens of flint glass, and about $\frac{1}{4000}$ for steel. This expression is very simple, and enables us at once to calculate the requisite length of bulb, when its internal and external radii are known, which shall have any assigned sensitiveness when fitted with a fine tube of a given bore. To obtain great sensitiveness, increasing the diameter of the bulb is preferable to diminishing its thickness, as we thus preserve its strength; and we have seen how to avoid the complication of temperature corrections.

As a verification of this formula, in addition to the simple one described in the text above, I had an apparatus constructed of ordinary lead glass of the following dimensions:—Length of cylindrical bulb, 745 mm. Ratio $a_0 : a_1 = 8{\cdot}7 : 21{\cdot}9$. The weight of mercury filling 424 mm. of this bulb was 167 grm. To the bulb was attached a smaller tube of which the mercury filling 68 mm. weighed 1·43 grm.

Hence we have

$$\frac{a_1^2}{a_1^2 - a_0^2} = 1{\cdot}187.$$

Also the content of the whole bulb in mercury is $\frac{745}{424}167$ grm. = 293·4 grm. Hence a pressure of one ton-weight should force into the narrow tube $\left(\frac{1{\cdot}187}{1000}\,293{\cdot}4 = \right)$ 0·348 grm. of mercury.

This ought to displace the index through $\left(\frac{0{\cdot}348}{1{\cdot}43}68 = \right)$ 16mm.·55.

Comparing this with the result of experiment, we had the following remarkably satisfactory numbers:—

Tons.		Calculated.		Observed.
0·9	...	14·9	...	14·6
1·4	...	23·1	...	21·2
3·1	...	51·3	...	48·9

There was no glass tube in the interior of the bulb, so that the slight discrepancies between the ratios of calculated to observed effects are mainly due to effects of temperature.

In the *Proc.* R.S., June, 1857, Sir William Thomson gives for the rise of temperature of a fluid, the pressure on which is suddenly raised from p to $p + \omega$, the general expression

$$\frac{te}{\text{JK}}\omega.$$

Here t is the absolute temperature of the fluid; e its coefficient of expansion, and K its average capacity for heat, under constant pressure, between p and $p + \omega$. J is Joule's equivalent.

The value of e, as given by Kopp's experiments, is nearly

$$\frac{t - 278}{72{,}000},$$

for temperatures within 20° C. of the maximum density point. The mean of the experimental determinations of Matthiessen, Pierre, and Hagen, makes it about 5 or 6 per cent. greater.

For the Centigrade scale the value of J is 1390 foot-lbs. An atmosphere of pressure is nearly 2117 lbs. weight per square foot; and K is about 63·45 (the number of pounds of water in a cubic foot).

Hence it follows that, for one additional atmosphere of pressure, the temperature of water is raised (in degrees Centigrade) by about

$$\frac{t(t - 278)}{2{,}850{,}000}.$$

Now 56° F. is 13°·3 C., for which $t = 287{\cdot}3$, and the rise of temperature produced by a ton-weight per square inch is

0°·14 C. or 0°·25 F.

This is the statement in the text.

From the above formula we find the heating effect of one ton pressure on water at 50° F. to be nearly

0°·16 F.;

and for each degree above or below 50° F. this number must be increased or diminished by about one-tenth of its amount.

This expression is very easy to recollect, and it gives the results with ample accuracy throughout the whole range of temperatures (40°–60° F.) within which my experiments were conducted.

It is to be observed that Thomson's formula is strictly true for small pressures only. No account has been taken of a possible lowering of the temperature of maximum density, or of a change of expansibility, under pressure. Nor is it known how a considerable increase of pressure affects the thermal capacity.

On the first occasion on which one of the thermometers gave way, we were much surprised at the loudness and musical quality of the sound produced. The whole mass of iron and steel vibrated like a bell in consequence of the (comparatively slight) sudden relaxation of pressure. On another occasion, just as a pressure of three and a half tons had been reached, the whole apparatus gave a strong, protracted musical sound, which continued until the screw-tap was opened. This was probably due to a species of hydraulic-ram behaviour on the part of one of the valves of the pump. These are little conical pieces of steel, with the points much elongated, which are ground accurately into conical beds, and fall back into their places by gravity. It was not observed that this powerful vibration had in the least degree altered the position of the indices in the thermometers or gauges which were in the pressure chamber. Their indications agreed perfectly with those of the preceding and succeeding day.

I made a number of experiments with the view of determining the amount of distortion at which glass gives way, with the view of finding the limit of strength of a glass tube, and also the ratio of external to internal diameter to secure it against any assigned lower pressure. I allude to them now in consequence of a curious fact observed, which gives the explanation of a singular occurrence noticed on board the *Challenger*. The walls of the tubes, when they gave way, were crushed into fine powder, which gave a milky appearance to the water in the compression apparatus. But the fragments of the ends were larger, and gave much annoyance by preventing the valves of the apparatus from closing. To remedy this inconvenience, I inclosed the glass tube in a tube of stout brass, closed at the bottom only, but was surprised to find that it was crushed almost flat on the first trial. This was evidently due to the fact that water is compressible, and therefore the relaxation of pressure (produced by the breaking of the glass tube) takes time to travel from the inside to the outside of the brass tube; so that for about 1-1000th of a second that tube was exposed to a pressure of four or five tons weight per square inch on its outer surface, and no pressure on the inner. The impulsive pressure on the bottom of the tube projected it upwards, so that it stuck in the tallow which fills the hollow of the steel-plug. Even a piece of gun-barrel, which I substituted for the brass tube, was cracked, and an iron disk, tightly screwed into the bottom of it to close it, was blown in. I have since used a portion of a thicker gun-barrel, and have had the end welded in. But I feel sure that an impulsive pressure of ten or twelve tons weight would seriously damage even this. These remarks seem to be of some interest on several grounds, for they not only explain the crushing of the open copper cases of those of the *Challenger* thermometers which gave way at the bottom of the sea, but they also give a hint explanatory of the very remarkable effects of dynamite and other explosives when fired in the open air.

To show how possible is a serious mistake in the measurement of pressure, I append a comparison of the indications of the very elaborate gauge attached to the old *Challenger* apparatus with those of my steel external gauge already described. The scale of the *Challenger* gauge is divided to cwts. on the square inch. My gauge gives very nearly 20 mm. per ton; so that, for a rough comparison, we may take 1 mm. as equivalent to 1 cwt. The two instruments were simultaneously attached to the pump, and the pressure was therefore the same in both at each reading. There can be no doubt whatever, from repeated comparisons with glass gauges of all sizes and shapes, that my gauge follows Hooke's law with great accuracy. The only possibility of serious error is in the actual value of the unit. This important determination has, however, been very carefully repeated by the aid of Amagat's numbers and the indications of the silvered gauge already described; and the result is as above stated.

Steel Gauge. Millimetres.	*Challenger* Gauge. Cwts. per sq. in.	Ratio.
0	0	...
5	0	0·0
9	1·2	0·13
15	8·7	0·58
20	13·9	0·69
30	23·6	0·78
40	35·0	0·87
50	47·0	0·94
60	58·7	0·98
70	71·7	1·02

The comparison was repeated several times with almost exactly the same results.

It is quite clear that the *Challenger* gauge does not follow Hooke's law. It lags behind the steel gauge at first (does not give any indication, in fact, till the pressure is nearly 50 atmospheres), then gradually gains on it; and, at pressures greater than 3½ tons, appears to leave it rapidly behind. The instrument is, however, graduated up to 4 tons only. My very first experiments with this *Challenger* instrument, in which I used a simple form of manometer, showed that it was not trustworthy, and led me to make various trials for the purpose of getting a proper mode of measuring high pressures.

Finally, it may be interesting to mention that a fairly approximate determination of the compressibility of water was made by counting the number of strokes of the pump required to produce a measured pressure in the interior of the large apparatus.

[Then follows a table of the experimental data for each of a large series of the *Challenger* thermometers. These are of no general interest. Their importance is confined to the reduction of the actual observations made on board the *Challenger*].

THE GRASS BARRIERS OF THE NILE

THIS interesting phenomenon, which so largely contributes to produce changes in the bed of the Nile and to accumulate river formations of great geological importance, has been recently investigated by M. Ernest Marno, who has just published an elaborate paper on the subject, in the last number of *Petermann's Mittheilungen*. It is accompanied by a map, on the scale of 1 to 500,000, of the Bahr-el-Gebel and of the Bahr-el-Abiad, from Geseir Abbas to Sohat, and of the Bahr-el-Serat from its mouth to 7° 30′ N. lat. After having made its way among the hilly region, through several great lakes, formerly forming a series of terraces and connected together by short rivers, the Nile, or the Bahr-el-Gebel—the River of the Mountains—enters an extensive flat land, which it crosses over six degrees of latitude to the next rocky barrier, which it cuts through at Khartum. Over this stretch it runs with numerous windings, first north to its confluence with the Bahr-el-Ghazal, and then to the east, under the name of Bahr-el-Abiad, and, although the direct distance between its issue from the hilly tract to Khartum is only 600 miles, the total length of the river with its windings is no less than 1100 miles. The whole of this region is a wide marsh, and the river has no proper banks, its water being mixed with that of marshes which cover the whole of this tract. It is even a rare occurrence to see dry banks, as the country is more like an extensive marsh, through the midst of which a somewhat deeper channel has been dug by the current of the river. Numerous smaller rivers connected together and with the main channel and its numerous ramifications circulate amidst these marshes, and during the rainy season the *maije*, or lateral ponds and lakes, increase yet more, covering wide tracts of land, whilst during the dry season some stretches of banks re-appear, and the lakes which were navigated by steamers some months before become simple marshes. Vegetation plays an important part in the modifications which are going on in this region. The country is covered with rich grasses, mostly consisting of such species (*Saccharum spontaneum, S. irschæmum, Vossia*) as grow perfectly well even in water; this grass can be lifted with its roots by water, and grow floating on the surface, so as to render it most difficult to draw a line of demarcation between land and water. Thick and high papyrus palms grow sometimes on the very banks of the main channels of circulation of the water, and strengthen these by their complicated roots, but they do not cover all the banks, and the outlines of the river are mostly indefinite. Some few tree-like *Herminiera elaphrosylon* grow as isolated individuals on the banks of the rivers, and of the *maije*, whilst the smaller marshy and aquatic flora (*Pistiæ, Nymphææ, Vallisneriæ*) nearly disappears in comparison with the rich vegetation of the above-named species. The fauna of this region closely depends upon the season. Mammals and birds leave it during the rainy period and wander to the hilly tracts, but during the dry season the banks of the *maije* and of the rivers are peopled with elephants, buffaloes, giraffes, antelopes, and by many kinds of birds. Besides this region has also its special forms, namely the *Balæniceps Rex*, the *Protopterus æthiopicus*, and the ganoid fish, *Polypterus*, all being remains from earlier geological periods. The people who inhabit this region, the Dinka, the Shilluk, and the Nuehr, all belong to a very low level of civilisation, living mostly on their herds of cattle; they change their abodes in accordance with the season, but they cannot be considered as true nomades, as the land occupied by each tribe is strictly limited by other tribes, and every encroachment on another's land is punished by war.

It is obvious that in this region the fall of the rivers is very small and that the regular outflow of water may be checked by winds and other occasional circumstances; whilst the great quantities of water poured down into the basin during the rainy season cannot find an easy way through the flat channels; extensive inundations occur therefore every year, and when the rains are especially heavy, great masses of floating grass are brought from the *maije* into the main river, and accumulate in its windings. New floating islands of grass are brought by and by to these barriers, being pressed upon or beneath them, and soon the whole of the river throughout its width and depth is obstructed by these barriers, which the inhabitants call *setts*. The grass does not decay in the *setts*, it continues to grow on their surface, and if the vegetation, which rises two or three metres above the water, is burnt, it soon reappears again, reaching a height of one metre and more after eight or ten days. The thread-like roots of the grass form a kind of rough felt, in which palms are sometimes inclosed, whilst masses of ooze fill up the interstices between the roots, and form thus true dams across the river. When the barrier has not yet reached a great size, it might be occasionally destroyed by the pressure of water accumulated above it; but, as several barriers are formed at the same time at various places, the upper one being destroyed, its *débris* is brought to the lower one, and accumulates above it, or presses beneath it. The elasticity and tenacity of these dams is so great that a steamer attempting to enter it is soon repelled by the elasticity of the grass, while men and even cattle can easily stay on the floating grass without danger. The river is thus soon transformed into a marsh covered with a mighty grass vegetation, and the water expands to the neighbouring *maije*, seeking its way through many new channels. It is obvious that those parts of the river where its bed is more definite are especially liable to be obstructed by grass islands which are formed in those parts of it where there is no definite frontier between running water and marsh. As to the appearance of *setts*, M. Marno is of opinion that they have become more frequent during these last years; he sees in their frequency a proof of the gradual levelling of the whole region by fluviatile deposits and of the general transformation of the whole of the region into marshes. The high floods of 1878 have largely contributed to the formation of numerous floating grass islands and to the formation of several large barriers across the river. Of course any hydrographical works for preventing the formation of grass obstructions would be very difficult now, owing to the scarcity of population; but the planting of papyrus palms along the banks of the chief channel would be most useful, as it would prevent the floating grass islands formed in the *maije* from entering into the main channel of the Nile.

THE WEATHER OF NOVEMBER, 1881

THE weather of November last has been in many respects so unusual as to call for a brief record of its chief characteristics. For thirteen months previously the immense majority of the depression-centres, or centres of the storms which swept across North-Western Europe, passed to the southward of the northern half of the British Islands, and many of them wholly to the south of these islands, with the inevitable result of unseasonably cold weather to the north of these storm tracts. But early in November an important change set in, and up to the time of going to press the change has been an enduring one, viz. the storms of North-Western Europe have swept eastward along tracts wholly to the westward and northward of the British Islands, with the necessary result of a temperature very greatly in excess of the average of the month.

From Buchan's isobars for the month we see that the mean increase of atmospheric pressure from the Butt of Lewis to Valentia, in the south-west of Ireland, is about 0·100 inch; but in November last the increase amounted to 0·348 inch, the means of these places being respectively 29·391 inches and 29·739 inches. The increase from the Butt of Lewes to Dover was still greater, amounting to no less than 0·605 inch, instead of 0·150 inch, the normal difference. It is premature to state the locus of the centre of this extraordinary barometric depression till fuller observations have been received; in the meantime, however, a position in the Atlantic, a little to westward of the Hebrides, may be provisionally assumed as the centre with but a small limit of error.

The most important result of this abnormal diminution of atmospheric pressure in the north-west, and rapid increase southward, has been a prevalence of winds from the Atlantic, characterised by a force and a persistency quite unprecedented during the last quarter of a century, with a distribution of temperature and rainfall over the British Islands very remarkable and in some respects strikingly abnormal. As these winds from the Atlantic swept across and reached the east of Scotland, their direction took a more southerly, and in the north a more south-easterly course.

Everywhere the temperature was abnormally in excess --the smallest excess, about 3°·5, being on the coast in the north; and the largest excess being in the interior, as happens with high temperatures at this time of the year, since in such circumstances the cooling through terrestrial radiation is relatively much less than usual in strictly inland situations. The greatest excess would appear to have occurred in the higher parts of the valleys of the Thames and Trent in England, and of the Clyde and Tweed in Scotland, where it reached, or closely approached to, 6°·5 above the means of November for the respective districts. In London and Edinburgh the excess was 6°·0.

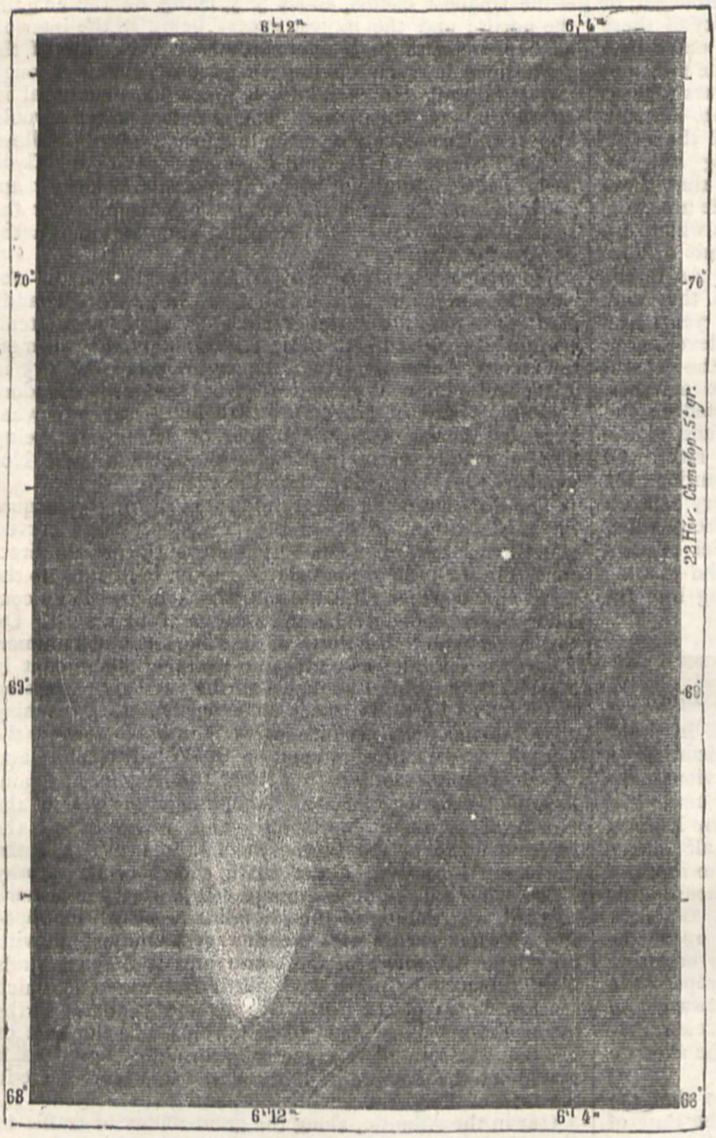
On comparing this excess for Edinburgh with the observations made in that division of the British Islands during the past 118 years, or since 1764, the mean temperature of November, 1881, is absolutely the warmest on record, the nearest to it being an excess of 5°·5 in 1818, and 5°·2 in 1792 and 1847. As regards London, the temperature of November 1818 and 1852 somewhat exceeded that of 1881, the former of these years being also unusually warm in Edinburgh, whereas there November, 1852, was colder than the average.

The distribution of the rainfall was strikingly unequal in North Britain, or where the prevailing winds curved round more towards a southerly and south-easterly direction. On the high ground sloping up on both sides to the Lead and Lowther Hills the rainfall at many places considerably exceeded double the average of the month. On the other hand to the north of the Cheviots and Lammermoors the rainfall was under the average, the amount in East Lothian being less than half the average. Crossing the Firth of Forth, we meet an extensive tract reaching as far as the high grounds of the Grampians, where the rainfall was excessive, amounting in West Perthshire and Upper Dee to more than double the average. Again, beyond the Grampians, and including the whole of the North of Scotland, northward and westward to the extreme north of the Lewis, the fall was less than the average, the amount on the south shores of the Moray Firth being only half the average. It is worthy of remark that this distribution of the rainfall is precisely the opposite of what occurs with weather very similar, but with the single difference of the south and south-east winds being replaced by north and north-east winds, in which the foreshores of the Forth, Moray, and Pentland Firths facing the north are deluged with rains. In the east of England the rainfall was, generally speaking, light, but it was above the average in Ireland, and in a less degree in the west of England.

Out in the Atlantic, along the great routes of traffic to New York, the month would appear to have been characterised by an almost unbroken succession of storms, several of which, if judged by their destructive effects on even well-appointed sailing-vessels and steamers, were memorably great storms. The storm which reached the west on the 21st will be long remembered for the furious winds and extraordinarily high and destructive tides which accompanied it; and the storm of Sunday, the 27th, for its most disastrous effects, particularly in the south, and for the unprecedentedly low readings of the barometer in the north-west and north of Scotland, where, over a wide area and for a considerable time, atmospheric pressure was under 28·000 inches, the lowest being 27·865 inches at the Butt of Lewis, at which low point the barometer stood from 4.30 to 7 a.m. of the 27th.

PHOTOGRAPH OF COMET B, 1881

PHOTOGRAPHY has already proved of great service to astronomy, and its value in reproducing with unfailing accuracy and permanently preserving an observation is evident. It is long since the art has been utilised in the observation of eclipses; with De La Rue's photographs of the moon we are all familiar, while those of sun-spots have recently attained a rare degree of perfection. And now at last photography has been successfully applied to comets by Dr. Janssen at the Meudon Observatory, Paris. The woodcut we give to-day of Comet B is from our French contemporary *La Nature*, and has been revised by Dr. Janssen himself, so that it may be accepted as a faithful reproduction of his photograph. Dr. Janssen also gives some interesting details as to the circumstances under which the photograph of the comet was taken. It was obtained on July 1, 1881, at 0h. 37m. under the following conditions:—The operators used a telescope of half a metre aperture and 1·60m. focal length. The plates of gelatino-bromide of silver, extra sensitive, were manipulated and developed in darkness. The time of exposure was thirty minutes. Arrangements were made to counteract the proper movement of the comet in addition to the diurnal movement. The impression of the tail extends to more than 2½ degrees; and the head of the comet assumed very great dimensions; but the details of the tail show that the movement of the instrument has kept pace with that of the object. The rectilineal rays are a revelation of the photograph, which moreover shows some very small stars not seen in any celestial atlas.



Facsimile of a photograph of the Great Comet B 1881, taken at the Observatory of Meudon, July 1, 1881.

ON ARTIFICIAL DEFORMATION OF THE HUMAN SKULL IN THE MALAY ARCHIPELAGO

MR. CROCKER mentioned, in the *Proceedings* of the Royal Geographical Society of London in the beginning of this year, that the Milanows, a coast tribe in North-West Borneo, between Bruni and Tandjong Agri, Sarawak, flatten their heads by means of pressure in infancy, but not to the extent of disfigurement, a custom, Mr. Crocker adds, which is peculiar to this tribe, and occurs nowhere else in the Archipelago.

This last statement induces me to show that, on the contrary, the custom is spread through the whole vast area from Sumatra to Timorlaut, and north to the Philippines; I even believe that it is not going too far to say that almost no large island within this region can be found, where the custom of artificial deformation of the skull is not, or has not been in use. Having treated of the geographical distribution of the custom all over the globe in a paper "Ueber künstlich-deformirte Schädel von Borneo und Mindanao im königl. anthropologischen Museum zu Dresden, nebst Bemerkungen über die Verbreitung der Sitte der künstlichen Schädel-Deformation," I shall restrict myself here to the Malay Archipelago.

To begin with Borneo: I procured last year a skull from Sarawak, over which a basket of ratan was so closely twisted, that it could but with difficulty be freed. When taken out I immediately perceived that it must have been artificially deformed; the whole occiput was flattened in a way which could not have been due to other causes. This skull (Fig. 1) must have hung a long time in the basket over a fireplace, for it was blackened and dusty all over. The direction of the pressure in youth had been, besides perpendicularly from behind, from the right side and below, for the right basal portion is totally distorted.

Wishing to know something positive as to the custom in Borneo, I wrote to the well-known naturalist and collector, Mr. Everett, who is now living in Papan, North Borneo, and who sojourned a long time in Sarawak before. Mr. Everett had the kindness to answer, in a letter dated August 25, 1880: "With regard to the custom of flattening the skull, I have heard that it is practised by the Kanowits and Malanau tribes in Sarawak." In consequence of this information I asked Mr. C. C. de Crespigny of Sarawak, a gentleman who has already (in 1876) published some account of the Malanaus in the *Journal* of the Anthropological Institute of Great Britain, to forward, if possible, the instrument with

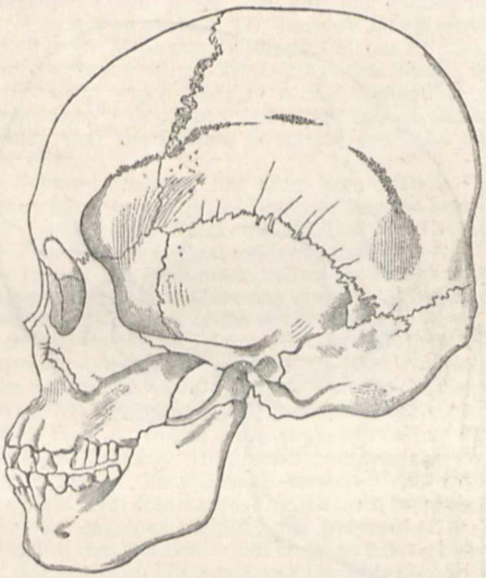


FIG. 1.—Artificially deformed skull from Sarawak, Borneo.

which the artificial deformation is effected; and Mr. de Crespigny was so obliging as to fulfil my wish and to write on April 8, 1881: "I am sending by this post the little instrument you desired me to procure for you, used by the Malanau women in flattening the heads of their female children, in order that their appearance may correspond with their parents' idea of beauty."

The instrument (Fig. 2) is by no means roughly made, but so well adapted to the purpose that one must regard it as the result of the exertions of many generations. I am sorry that Mr. de Crespigny, to whom I am so much indebted, did not add a note as to the way in which the apparatus is applied to the child's head. I suppose that this is wrapped up in cushions and laid with the occiput on the square wooden part of the apparatus *a;* the bandage *b*, made of blue cotton, then being tied round the forehead, the bandage *c* over the whole head from the forehead to the occiput, and the threads, fastened at the end of *c*, drawn through the holes in *a*, and finally through the square hole of a Chinese coin, behind which they are knotted together with some glass beads. Two sets of holes in the longitudinal part of the wooden instrument allow the degree of pressure to be regulated. The apparatus is very accurately cut and polished. The length is 325 millimetres, length and breadth of the square middle part 90 and 60 mm. respectively, the length of the frontal band 315, of the sagittal band 190 mm.

In the mean time Prof. Flower, in his interesting essay ("Nature Series"), "Fashion in Deformity, as illustrated in the Customs of Barbarous and Civilised Races," mentioned, on the authority of Mr. H. B. Low, that in the neighbourhood of Sarawak the deformations are made purposely; and I therefore do not doubt that the custom is a common one in that country. Perhaps a very asymmetrical skull in the Vrolik collection of Amsterdam, from Banjermassin in South-Eastern Borneo, may be artificially deformed. I have not yet succeeded in finding another trustworthy report of the same custom in Borneo from other tribes, but am sure that we shall soon hear from other quarters of the same, attention once being directed to the question.

Proceeding from Borneo to the Philippine Islands in the north, we have ample materials from that group of islands. I procured, in the year 1872, in the island of

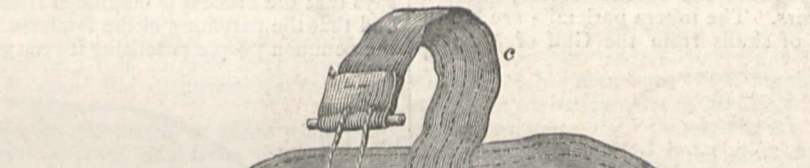


FIG. 2.—Instrument for deforming the heads of infants, used by the Malanaus on Borneo.

Luzon, in the province of Bataan in Zambales, from graves in the forest, twelve skulls of Negritos, nearly all of which are more or less artificially deformed. Prof. Virchow is of opinion that the flattening of the occiput and the broadening of the hinder parts of some of the skulls is so strong as to make them in a high degree similar to certain deformed skulls from Peru. The flattening of the occiput is very obvious in some of the portraits of Negritos which I sketched on the spot, three of which are represented in Figs. 3–5.

It has been known since the seventeenth century that the custom is in vogue on the Philippine Islands. M. Thévenot in his valuable work, "Relations de divers Voyages curieux" (1664), in the part, "Relation des isles Philippines faite par un Religieux qui y a demeuré 18 ans," says in his old French: "Ils auoient accoustumé dans quelques-vnes de ces Isles, de mettre entre-deux ais la teste de leurs enfans, quand ils venoient au monde, et la pressoient ainsi, afin qu'elle ne demeura pas ronde, mais qu'elle s'estendit en long; ils luys aplatissoient aussi le front, croyant que c'estoit vn trait de beauté le a'auoir ainsi." Artificially deformed skulls have further been procured by Doctors Schetelig and Jagor, about the year 1860, from caves on the islands of Samar, Leyte, and Luzon, and from Bicol and Cimarron graves (Cimarrons being hybrids between Negritos and Bicols) in Albay on Luzon. An Igorrotes skull from West Luzon, which I brought home, is, according to Prof. Virchow, so small as to suggest that it has not its natural form. From the south-west of the large island of Mindanao Professors de Quatrefages and Hamy have described two deformed Hilloonas (Negrito?) skulls, and the Dresden Museum possesses two enormously deformed skulls from a cave

FIG. 3. FIG. 4.

FIG. 3.—Negrito, man, Luzon. FIG. 4.—Negrito, young woman, Luzon.

near Lianga in South-East Mindanao, procured by Prof. Semper.

One of these (Fig. 6) has been pressed from the front to the occiput for the special purpose, at the same time, of flattening the whole head. The hinder parts of the parietals slope down nearly perpendicularly at the tubera, and the occiput has no prominence at all. The other (Fig. 7) has been acted upon from below and behind and from the front, and, at the same time, by a broad bandage across the parietals behind the coronal suture, where a deep depression occurs. The tubera parietalia are blown up similar to those of skulls from the Gulf of Mexico,

FIG. 5.—Negrito, man, Luzon.

which Dr. Gosse called "têtes trilobées." Therefore it cannot be doubted that the custom has been, and is in use nearly everywhere on the Philippine Islands.

Not less so in the island of Celebes, which is nearly united to the Mindanao by some smaller groups of islands, which may be considered as stepping-stones. Mr. Riedel of Gorontalo informed us in the year 1871 that the inhabitants of Buol, Kaidipan, and Bolang-itam in North Celebes wind round the heads of their children the smoothed bark of the Lahendong tree, and afterwards press it between two wooden planks, which are fastened in front and occiput. The heads are broadened by this process, which is considered a peculiar attraction; the child is treated in this way from four to five months. Mr. Riedel even forwarded a model of a cradle, as used in Buol for deforming the heads of noblemen's children; the instrument remains fastened for six to eight weeks, and the children are only freed every second day to be bathed. Mr. Wilken recorded the same custom from

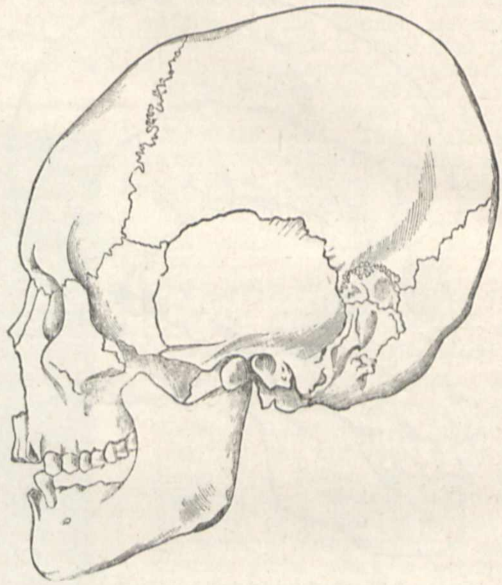


FIG. 6.—Artificially deformed skull from a cave near Lianga, Mindanao.

Passan and Rataban in the Minahassa, in North Celebes, the last-named spot being quite near Panghu, a place where Mr. Wallace made one of his celebrated collections ("Malay Archipelago," vol. i. p. 408). Mr. Wilken says that the process is continued from fifty to sixty days, and that the flattening of the forehead is called "taleran," the common people practising it very generally now. The

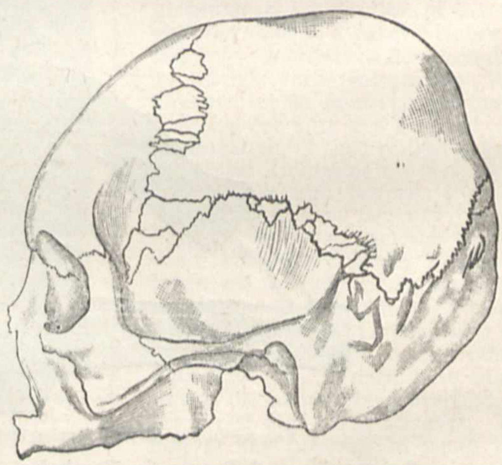


FIG. 7.—Artificially deformed skull from a cave near Lianga, Mindanao.

same custom is in use still with other tribes of the Minahassa and the surrounding countries. Finally, Mr. Riedel could prove it among peoples called Toragi, Tondai, Torau, and Tomori in Central Celebes, where the heads of the boys are pressed laterally and from behind, "that they may become good warriors," and the foreheads of the girls broadened "to increase the beauty of the women"; the process is continued from four to five months.

Besides this direct information there is an artificially deformed skull of an "Alifuru," from Celebes in the Hildesheim Museum; and of a Bugis from South Celebes, in the Vrolik Collection of Amsterdam, the descriptive catalogue saying: "Plus que tout autre ce crâne fait l'effet d'avoir été comprimé à son jeune âge par une grande force agissant d'arrière en avant." Dr. Barnard Davis remarks on a skull from Makassar, in South Celebes: "Has an extensive parieto-occipital flattening; the result is a brachycephalism which scarcely seems compatible with undesignedness." No doubt this is proof enough to justify the opinion that the custom is spread over the whole island of Celebes.

As to Sumatra Marsden has often been quoted, "that the women have the custom of compressing the heads of children newly born, whilst the skull is cartilaginous, which increases their natural tendency to that shape."

From Java it has been made known by Professors van der Hoeven, Swaving, Halbertsma, and Zuckerkandl, that a considerable proportion of the skulls from that island are asymmetrical, viz. 60 per cent., and that of three awry skulls two are flattened on the left side. Prof. Halbertsma supposes that this asymmetry comes from the child's position on its left side while sleeping; Prof. Zuckerkandl is of opinion that it comes from pressure during birth; whereas Prof. Rolleston, whose premature death we deeply deplore, expressed the following view:—"The wish to keep the right arm free causes the left arm to be usually employed for carrying a child; the pressure of a sling used in aid of the left arm would come to bear mainly on the left side of the child's head, and the observed flattening would thus be accounted for." However this may be, the asymmetry does not appear to occur as a result of designed deformation; but Dr. Swaving concedes that the midwives try to change the form of the head in the newly-born child by pressure; Dr. Gosse saw a Javanese skull with occipito-nasal deformation, and perhaps this question must be more thoroughly studied on the spot to get a better insight.

Dr. Davis says of a skull from the island of Bali:—"Approaches closely to the American crania deformed by occipito-frontal pressure; it is so great as to render it very difficult to look upon the distortion as unintentional."

The Dresden Museum possesses a skull from the island of Ceram, and another one from Boano, near Ceram, which appear to be artificially deformed; further, two skulls of the same kind from the island of Flores among ten specimens. Of a skull from the island of Timor, Dr. Davis says: "Of extraordinary form and proportions, being extremely brachycephalic, and exhibiting a large parieto-occipital flattening." Finally, the Dresden Museum recently got from the Timorlaut Island group two skulls which undoubtedly are artificially deformed.

I will not proceed further on to New Guinea, because this would lead me into the Papuan or Melanesian region, where, as well as on many islands of the South Sea, the custom prevails; but I only proposed to show its being far spread through the Malay Archipelago. I do not doubt that more information will come from this region, if only the attention of residents and explorers in future is directed to the question, and if more skulls are forwarded to scientific men and institutions.

A. B. MEYER

NOTES

EVERYTHING in connection with the Crystal Palace Electrical Exhibition appears to be progressing most satisfactorily. All the available space has been allotted to exhibitors, and many applications for room have had to be refused. The best positions have been given to the first applicants, and from appearances there is little doubt but that this exhibition will be a success. As an Electric Light Exhibition it will surpass that in Paris, because the peculiarities of the building permit direct comparisons being made, and allow of each different system having a portion of the building allotted to itself. Thus the whole of the nave will be divided off, each part to a different system, while all the different courts, the Alhambra Court, the Pompeian Court, and others, will have a separate and distinct system applied to its illumination. There does not appear to be in the world a building more suited for the display of the electric light than the Crystal Palace with the far-famed courts referred to. There is little hope of any show being made before the commencement of the ensuing year, but there is strong reason to believe that some portion of the building will be illuminated by the electric light at Christmas time. Not only has the Postmaster-General consented to make an extensive show, but the War Department have now agreed to exhibit, and there is every probability that this display will be most interesting. Had our War Department made an exhibition in Paris it would have undoubtedly outshone the displays of other governments in this section. A great feature of the exhibition will be the external exhibits. A tramway is about to be constructed along the whole terrace, on which a coach will run by the aid of Faure batteries. An electric railway, which was such an attraction at Paris, will continue to whirl passengers about by the energy produced by Siemens' currents. Although the exhibition will contain a great display of apparatus relating to all the applications of electricity, it will be an Electric Ligh Exhibition, and the numerous lamps and machines for the production of the light will be the great attraction to the public.

MR. LIVINGSTONE, Master of the Public Schools, Fort William, having kindly offered to the Scottish Meteorological Society to climb Ben Nevis once a month, whenever practicable, to read the thermometers left on the top of the Ben, made his first ascent on Saturday last. He left Fort William at 8.15 a.m., and returned at 4.5 p.m. The ascent to 2200 feet was easily accomplished, the real difficulties being encountered above this height, owing to the snow which covered the higher parts of the Ben. A shower of rain fell at the lake on the way up. At this point, as had been done by Mr. Wragge, observations were taken, and the temperature of the air found to be 37°·0, and that of the water 38°·3. On reaching the spring, which is 3363 feet high, the temperature of the air was 30°·0, and that of the spring 35°·6, or a degree higher than in the middle of June. The summit was reached at 1 p.m., the wind being north-west the temperature of the air 26°·5, and the plateau covered with snow to a depth of 2 feet. The protecting cage for the thermometers and other instruments was found all right. The maximum thermometer read 44°·0, and the minimum 14°·1—these being the extremes of temperature since Mr. Wragge made his last observation in the end of October.

IN a few days the Russian expedition to the mouth of the Lena to establish a magnetical and meteorological observatory on Weyprecht's plan is to start from St. Petersburg. The route is by rail to Nishni-Novgorod, thence by sleigh to Perm, by rail to Yekaterineburg, by sleigh to Irkutsk, where they are expected to arrive in January, and stay till May to complete their outfit, secure the services of five soldiers, and train them to meteorological observation. Meanwhile a barge is to be built or bought at Katschug, on the Lena, where the navigation of this river begins. The party, on descending the river, will stop for some time at Irkutsk, to make further preparations. The length of the route, and especially the difficulty of transportation by land without railways, make the Russian expedition the most difficult of the Arctic expeditions on Weyprecht's plan. Petroleum is wanted to give a good, clear light, and 2¼ tons of it will have to be bought at Nishni-Novgorod, as this light is yet little used in Siberia. Besides the building of the houses, the food of the expedition, &c., all will be more difficult to obtain than the same articles wanted by an expedition sailing in ships. The sum of 42,000 roubles has been granted by the Russian Government. The idea of establishing a second station had to be abandoned, the money being barely sufficient for one station. If the Russian Government should give another sum for observations in high latitudes, a station will probably be established at Möller Bay, on the west coast of Novaya Zemlya. This station would be less expensive, there being always a possibility of reaching the place by ship. The expedition starting now takes two sets of meteorological instruments for establishing additional stations at Irkutsk and some point north of it. The chief of the expedition is Lieut. Jurgens, I.R.N.; he is well qualified to fulfil the arduous duties assigned to him. He will be accompanied by Dr. Bruge, medical assistant, and a meteorological assistant.

WE direct the attention of our readers to the letter of the Rev. A. E. Eaton in to-day's NATURE, which has so important a bearing on the probable condition of Mr. Leigh Smith's expedition in the *Eira*. From Mr. Eaton's letter it is evident that Mr. Smith deliberately intended to winter at Franz-Josef Land; and to those who know him it is not surprising that he said little about it to his friends. This is also essentially the drift of a short notice on the subject in yesterday's *Times*, where, however, the very inconsequent conclusion is drawn "that a relief vessel should be sent out in the course of next summer by either Mr. Leigh Smith's relatives or the Government." There can be no objection to the relatives sending out an expedition, but so far as present evidence goes, a Government expedition does not seem to be called for.

THE news lately received from the Behring Strait whalers discloses a very remarkable condition of things in the Arctic Sea this season. Capt. Williams, of the *Frances Palmer*, reports clear water in N. lat. 73° 30′ to the east of Herald Shoal, and the U.S. Relief-ship *Rodgers* got as far north as 73° 44′ on the west side of Wrangel Land. Other whaling captains assert that this year they went fully two degrees further north than their charts extended, and every one agrees that both the early and latter parts of the season have been open to a degree unparalleled in Arctic records. The Arctic basin has been found to be comparatively shallow, the depth being about twenty-three fathoms. The gales which prevailed when the *Thomas Corwin* left the Arctic Sea in the early part of September broke up the ice further north, and the prevalence of northern winds no doubt accumulated it about the north coast of Wrangel Land, and prevented the boats of the *Rodgers* from actually circumnavigating the island. This year's exploring cruise of the U.S. steamer *Thomas Corwin* has been a very remarkable one. The most important event was the landing on, and partial exploration of, Wrangel Land, which Capt. Hooper renamed New Columbia. He discovered there a tolerably large river, which he named the Clarke River, and the course of which a party who landed at its mouth assert that they were able to trace for some forty miles into the interior. The *Thomas Corwin* appears to have had no difficulty in moving to and fro in the Arctic Sea, except early in September, when a second attempt was made to reach Wrangel Land, but failed through fogs and strong gales. Capt. Hooper visited Point Barrow, on the northern coast of Alaska, and found the ice some twenty miles off the shore.

MR. W. H. DALL, of the U.S. Coast Survey, contributes to the *American Naturalist* for November a paper on the Chukchi and Namollo people of Eastern Siberia, which seems to have been called forth by some criticisms on the part of Lieut. Nordquist in a communication to the St. Petersburg Geographical Society, afterwards reproduced in our Geographical Society's *Proceedings*. If Mr. Dall replies to all his critics, he will next have to take up the subject of the currents of Behring Strait, for the American whaling captains assert that what he has written on this point is incorrect. Capt. Fisher, of the *Legal Tender*, indeed, says that Mr. Dall's observations extended only over a few days, and were made in an eddy current under the lee of the Diomede Islands.

NEWS has been received by the Bremen Geographical Society that two walrus hunters have returned to Tromsö from Spitzbergen, who report that early in September they were fifteen miles north of the Seven Islands (north of Spitzbergen), and that they found the sea quite free from ice in a northerly direction.

ON Monday next Mr. Clements R. Markham, C.B., will read a paper before the Geographical Society on the Arctic work of the present year.

ZOOLOGISTS are indebted to Dr. R. W. Shufeldt, First Lieutenant, Medical Department, U.S. Army, for a highly valuable contribution to the study of the osteology of birds. He has written two essays in the United States Geological and Geographical Survey *Bulletin* of September, 1881—one on the "Osteology of the North American *Tetraonidæ*" (pp. 309–350), and the other entitled "Osteology of *Lanius ludovicianus excubitorides* (pp. 351–359), both illustrated by several plates; and we can only wish that every monographic essay which treats of the anatomical structure of a limited group of birds were written in such a careful and exhaustive manner. There is scarcely a bone which is not correctly figured, most of them life-size, although some might be a trifle more plastic. All of them are treated of separately, and an exact description is given of the general *Tetraonine* feature of the bones, and in instances where the representatives of the genera under notice are aberrant due attention is drawn to the fact. The author frequently refers to allied families, such as the Partridges and others, and throughout the whole paper we see that the work of previous anatomical writers is carefully taken into consideration; and as Dr. Shufeldt had a large series of specimens before him he was enabled to exclude any peculiarities which might have been attributable to malformation of the bones. So far so good; but descriptive anatomy is one thing, and comparative anatomy another. Whenever the author discusses some of the difficult questions of comparative anatomy, as he does more than once, being well aware of the points where there is still a problem to be solved, we are afraid we cannot follow his deductions. One of the figures in the first plate in the paper on the *Tetraonidæ*, and part of the letterpress, is devoted to a demonstration of the "four cranial vertebræ" with all their appendages and derivatives; but although the disarticulated segments are nicely grouped together on the plate, the conclusions he arrives at certainly contain some obvious mistakes. At p. 328, to the ribs generally known as "sterno-costal" the term "hæmal" ribs is applied. Again we are glad to find that the author admits the theory which considers the limbs with their girdles to be transformed and translocated gill-branch elements, but he goes too far. He seems to believe that the scapular arch originally belonged to and constituted the hæmal arches of the occipital vertebræ. Further on we are informed that we may consider the bones of the pelvic girdle to be the pleur- and hæmapophyses of some of the sacral vertebræ—*verbum sat*. We therefore regret that this essay on the *Tetraonidæ*, valuable as it is as a contribution to ornithotomy, should be handicapped by speculations so wild and so dangerous to the credit of comparative anatomy.

IN his "Zur Aetiologie der Infectionskrankheiten," A. Weil states the cause of the decay of teeth, whether external or internal, to be the Schizomycete *Leptothrix buccalis*, the mode of entry and propagation and the life-history of which he follows out in detail. The acids which occur in the mouth, especially lactic acid, while they may greatly promote the decay, cannot give rise to it. The Leptothrix can be readily recognised by its iodine reaction. The author considers further that in many cases diseases of various parts of the body can be distinctly traced to excretions from the mouth and teeth. Other observers had already traced a connection between decayed teeth and septic abscesses, in which was found a fungus similar to that which occurs in decayed teeth.

THE balance has been applied by Herr v. Jolly, at Munich, to the problem of gravitation thus (*Wied. Ann.* No. 10): The instrument was placed in the upper part of a tower, and from each of the scales depended a wire (through a zinc tube) having a second scale at the lower end, 21·005 m. below. These lower scales were 1·02 m. from the ground, so that a lead ball one metre in diameter might be brought under one of them. A body brought from an upper scale into a lower one has an increase of weight corresponding to its degree of approach to the earth's centre and to the increase of acceleration. When the lead ball is brought under the same lower scale its pull is added. The difference of the increments of weight, with and without the lead ball, indicates the amount of pull of the latter, and the quotient of this pull and that of the earth alone furnishes a means (with the law of gravitation) of comparing the density of the earth with that of the lead, and, the latter being known, of determining the mean density of the earth. Referring to the original for details, we merely state that the author finds the mean density 5·692 (probable error not more than ± 0·068). This agrees more or less with other determinations; from the mean of those with the torsion balance it diverges about 2 per cent.

THE death is announced, at the age of eighty-nine years, of Jean Alfred Gautier, the *doyen* of science in Geneva, and one of the most active citizens of that city. M. Gautier belonged to a very old Genevese family, and displayed an early taste for science. In Paris he counted among his teachers such men as Laplace, Lagrange, Legendre, and Poisson, and in England he formed a life-long friendship with Sir John Herschel. When he settled down in Geneva from his travels, he carried on the work of the little observatory then existing at Geneva, and it was through his exertions that a much better one was built, though defective vision did not enable him personally to superintend it. M. Gautier was one of the earliest to discover a relation between sun-spots and terrestrial magnetism, and in many ways he laboured successfully to advance science in his native city.

WE learn also of the death of Dr. Chr. G. A. Giebel, Professor in the Philosophical Faculty at Halle University, an eminent zoologist and geologist. He died at Halle on November 14. The death is also announced, on November 11, of Prof. Engelhardt, a well-known Danish antiquarian, and secretary of the Society of Antiquaries at Copenhagen; and of Prof. Paul Günther Lorentz, a well-known German authority on mosses; he died at Concepcion del Uruguay at the early age of forty-six years.

THE earthquake of November 18 was noticed in Switzerland, shocks being reported from Ragatz and St. Gall. A great area, comprising Westphalia, Hessen-Nassau, and Belgium, was also visited by this phenomenon; it was noticed at Münster, Marburg, Brussels, Tournai, and Liège and Metz. On November 24 at 11 p.m. a shock was observed at Dedenborn, near Montjoie (Rhenish Prussia), and two shocks at Pergine (Southern Tyrol) early on November 20.

IN February next a private scientific exploring tour to Persia will be undertaken by a Viennese medical man, Dr. Polak. He will lead the expedition himself, and will be accompanied by a geologist and a botanist. All expenses will be defrayed by Dr. Polak.

MOST of the members of the Royal Commission on Technical Instruction have returned to England; they have, we understand, accumulated a mass of valuable information in the course of their preliminary tour, which has included the principal centres of industry in France.

THE dinner in commemoration of the Brewster Centenary will take place in Edinburgh to-morrow.

PROF. J. G. MCKENDRICK has been appointed Fullerian Professor of Physiology for three years at the Royal Institution.

THE Vienna Geographical Society will celebrate the twenty-fifth anniversary of its foundation on December 12 and 13 next.

WE have received from the Parkes Museum a copy of the artistic certificate of awards in connection with the International Medical and Sanitary Exhibition, lithographed from the original design by Mr. Cave Thomas. The certificates are now being distributed. The following facts are of interest:—Exhibitors from different parts of the United Kingdom, 414; exhibitors from abroad, 88; making a total of 502 exhibitors, of whom 258 received either awards of the first class, or awards of merit.

A SURVEY party, under Col. Branfil, has left Calcutta for the purpose of verifying and completing the survey of the Megin Archipelago. The work, including the measurement of the base line, is expected to occupy about six months. Dr. Anderson, Superintendent of the Indian Museum, has accompanied the party and will take the opportunity of instituting a thorough investigation of the local fauna.

THE German Government contemplates sending out two expeditions for observing the transit of Venus in 1882: one to the mouth of the La Plata River, the other to Magelhaen's Straits or the Falkland Isles. The expedition of 1874 cost the Government 600,000 marks (30,000*l*.), the one of next year is estimated to cost only 195,000 marks (9750*l*.).

M. MOUCHEZ, director of the Paris Observatory, is making arrangements for taking meteorological observations at an elevation of 2300 metres by means of a captive balloon. The balloon will be charged with ordinary coal-gas. These observations are intended to facilitate the calculation of atmospheric refractions.

DURING November, twenty-two earthquake shocks have been observed in various parts of Switzerland. They seem to have been most numerous in the neighbourhood of Schaffhausen.

A FINE monument has been erected at Bonn on the tomb of the eminent geologist, Prof. Jakob Nöggerath, who died on September 13, 1877. The sculptor is Herr Albert Küpper.

THE preliminary earthworks for the erection of the monument in memory of Justus von Liebig have been begun on the Maximiliansplatz at Munich.

M. TISSANDIER has organised a private company to prosecute his experiments with an electric directing balloon.

SOME of our readers may be glad to know that King's College, London, has a Science Society which meets on Wednesdays at 8 p.m. during term, for the purpose of reading papers on, and for the discussion of, scientific subjects. The papers, we are glad to learn, are generally experimentally illustrated.

DR. TAYLOR, curator of the Ipswich Museum, was on Saturday afternoon presented with a purse of 660*l*., accompanied with a handsome clock and gold watch for Mrs. Taylor, in recognition of his labours in connection with the museum, and of his annual course of scientific lectures, which for a number of years he has delivered in Ipswich without any emolument. Sir Richard

Wallace presided on the occasion, accompanied by Lady Wallace, and there was a large company present.

A TRAIN of Pullman carriages lighted by electricity has begun to run between London and Brighton.

THE Risikopf, on which the landslip occurred that recently overwhelmed the village of Elm in Switzerland, is being bombarded by heavy artillery in order that all the loose portions may be detached and thus prevent any future catastrophe.

EISENACH is to have an electric railway from the station to the Wartburg Castle, if the Royal permission can be obtained.

THE *British Almanac and Companion* for 1882 contains a summary of Science for 1881 by Mr. J. F. Iselin. It is necessarily meagre, but Mr. Iselin has selected some of the leading points; the geography is pretty full.

THE additions to the Zoological Society's Gardens during the past week include a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, presented by Mrs. George Willins; a Tawny Eagle (*Aquila nævioides*) from South Africa, presented by the Hon. — Southey; a Grey-breasted Parrakeet (*Bolborhynchus monachus*) from the Argentine Republic, a Black-headed Conure (*Conurus nanday*) from Paraguay, presented by Mr. J. Lloyd; two Talpacoti Ground Doves (*Chamæpelia talpacoti*) from Para, a Plumbeous Snake (*Oxyrrhopus plumbeus*), two Taraguira Lizards (*Taraguira smithi*), a —— Tree Frog (*Hyla*, sp. inc.) from Brazil, presented by Dr. A. Stradling, C.M.Z.S.; a Red-faced Spider Monkey (*Ateles paniscus*) from Guiana, three Red-billed Tree Ducks (*Dendrocygna autumnalis*) from South America, a Vinaceous Amazon (*Chrysotis vinacea*) from Brazil, a Redshank (*Totanus calidris*), two Dunlins (*Tringa cinclus*), two Razorbills (*Alca torda*), a Grey Plover (*Squatarola helvetica*), a Curlew (*Numenius arquatus*), British, purchased; a Geoffroy's Dove (*Peristera geoffroii*), bred in the Gardens.

THE ROYAL SOCIETY—ADDRESS OF THE PRESIDENT

II.

AFTER the Congress one of the most remarkable events during the present year has undoubtedly been the Electrical Exhibition in Paris. I do not of course purpose to describe it, as many of our Fellows visited it; and full descriptions have reached us through various channels. One point, however, must have struck those who examined any considerable number of the objects; and this I mention, not as in any way disparaging them, but rather as illustrating the stage to which electrical science has attained; namely, that while the assemblage of instruments and appliances was in every way remarkable, and while very great ingenuity and skill had been expended on their contrivance and construction, yet the amount of novelty in the principles involved was comparatively small. Of new combinations, improved methods, and adaptations in detail there was abundance. Some of them even removed former inventions from the category of curiosities to that of instruments for practical employment; or enlarged their sphere of utility from that of the laboratory to that of every-day use. But such is the mass of fruitful matter which science has furnished to the mechanician and constructor, that we might almost wish, from the point of view of the latter, that they may have time to work out more fully than has yet been done, the results of science, before they are called upon to elaborate any fresh materials.

It is now proposed to repeat as far as may be this Exhibition at the Crystal Palace; and the energy with which the proposal has been taken up, and the response with which it has met in many quarters, appear to justify sanguine expectations of its success, at all events from a practical and popular point of view. From the side of science it would doubtless have been far more interesting to look forward to a fresh exhibition, either here or elsewhere, of the progress of electricity after an interval of two or three years. But there is nothing in the present undertaking to interfere with the more advanced project, if, after some such period as that indicated, circumstances should prove favourable. In the mean time it must be remembered that there are very many persons to whom the Paris Exhibition would have proved both interesting and instructive, but who, from one cause or another, were prevented visiting it. Besides this, there are not a few commercial, and even municipal, bodies desirous of adopting some of the modern applications of electricity, but who would be more ready to avail themselves of them after a personal inspection of the instruments and of their mode of action. From this point of view the exhibition may fairly be expected to give considerable impulse to the adoption of electrical appliances in fresh quarters.

But even over and above this practical aspect of the undertaking there may still have been, at the epoch of the Paris Exhibition, some results on the eve of achievement, some remedies for defects, sufficient to transform a doubtful into a certain issue, or even a failure into a success; some steps which may open out new questions, or serve as a departure for new investigations in the subject of electricity. If such should be the case, even science may derive substantial benefit from the proposed undertaking.

But the present year has been rendered generally remarkable, amongst other things, by the multiplicity of its congresses. Apart from those which are concerned with subjects not coming under the head of "Natural Knowledge," there have been held the annual meetings of the British Association, and of the Iron and Steel Institute; the International Medical Congress, in London; the special Congresses on Electricity and on the Transit of Venus, in Paris (mentioned above); that on Geography in Venice; that on Geology in Bologna, and others.

Among all these the International Medical Congress, which this year met in London, stands conspicuous. The work of that meeting showed that the study of medicine by the real workers is, in every part, even the most practical, pursued in a thoroughly scientific spirit; that facts are industriously collected, and patiently grouped and compared; and that conclusions are, if sometimes hastily drawn, yet very cautiously accepted. And there was ample evidence that help, whether in apparatus or in knowledge, is eagerly accepted from all the other sciences, whether their range be far from, or near to, the biological. In short, in the opinion of those best qualified to form a judgment, it is not too much to say that the whole tone of the proceedings of the Congress, though chiefly concerned with practical questions, was, in the best sense, even in the sense which the Royal Society would give to the term, scientific.

Several of the societies meeting annually, or at longer periods, have organisations which, during the intervals between two successive meetings, do useful work. But in all cases the meetings form the most prominent, if not the most important, feature of their life; and, speaking particularly of the meetings themselves, the question has more than once been raised whether they continue to justify the efforts necessary to bring them about. It has been argued that, so many are the scientific periodicals in every civilised country, that all the papers of importance communicated to the meetings would under any circumstances be published in some place or other. Again, it has been urged that, so numerous are the centres of science, so many the means of communication both between places and between persons, that the necessity for these gatherings has, in the natural course of events, become superseded. The time which such meetings and the preparation for them involve, and the trouble which they entail on men already burdened with much work, have also been pleaded on the same side, and objections have been taken on the ground of the useless and irrelevant matter which is too apt to crop up on these occasions. These arguments are certainly not without weight; but there is still another side to the question. It is indeed quite probable that all the more important papers would be published even if the meetings never took place at all. But at these meetings there are usually a number of communications, many, but not all, of local origin, the production of which has been stimulated by the meeting itself; and a fair number of these may be reckoned on the side of gain. Again, it is true that the original idea of a parade or march-past of science, valuable enough when the provinces heard or saw little of science, has become less important now that provincial centres are to be found in almost every large town in the country. Nevertheless, the mere presence of some of the leading men stimulates dormant powers and encourages rising aspirations; and this perhaps all the more the

[1] Address of William Spottiswoode, D.C.L., LL.D., the president, delivered at the anniversary meeting of the Royal Society on Wednesday, November 30, 1881. Continued from p. 119.

case for the very reason that science and scientific names are no longer unknown. That most of the leading men have opportunities of meeting from time to time, and for scientific purposes, is certainly true; but that they should meet also on occasions when science is not too formal, is a thing which has its uses. And a concurrence of minds more numerous and more diversified than usual is sure to be fruitful of results. The whole advantage of these meetings, however, depends ultimately and fundamentally on the presence of a strong scientific element, which, from its own mere dignity and character, will repress all that is unworthy and will leaven the whole lump. Acting on this principle as a scientific duty, many good men have attended these meetings; and although they may have approached them with some degree of reluctance, few who during their attendance have taken their fair share in the proceedings, have come away without having derived a more favourable impression than that with which they entered.

Of such gatherings, the late meeting of the British Association at York was, if I may be permitted to express an opinion, a pattern and exemplar. And although it cannot be expected that in every year there will be so strong a muster as on the occasion of the fiftieth anniversary, yet all well-wishers of the Association must feel that it has entered upon its second half century with vigour and with dignity, and that it now remains only for its future supporters to maintain the high standard with which it has been handed down by those who have gone before.

It may be a matter of regret, although doubtless inevitable, that the same causes which have affected the social, the intellectual, the industrial, and the political life of our generation, and have made them other than what they were, should affect also our scientific life; but, as a matter of fact, if science is pursued more generally and more ardently than in former times, its pursuit is attended with more haste, more bustle, and more display than was wont to be the case. Apart from other reasons, the difficulty, already great and always rapidly increasing, of ascertaining what is new in natural science; the liability at any moment of being anticipated by others, constantly present to the minds of those to whom priority is of serious importance; the desire to achieve something striking, either in principle or in mere illustration; all tend to disturb the even flow of scientific research. And it is perhaps not too much to say that an eagerness to outstrip others rather than to advance knowledge, and a struggle for relative rather than for absolute progress, are among the dangerous tendencies peculiar to the period in which we live. I do not, of course, for one moment mean to imply that this tendency universally prevails, for in Science, as well as in other pursuits, I believe that the best of the present would well stand comparison with the best of the past, and that there are nowadays men in the mid-stream of life who are as little affected by the eddies and back-waters with which they are surrounded as were the giants of former days. Nevertheless the danger is a real one, and is to be met with at every turn.

But the part of Cassandra is neither agreeable to the player nor welcome to the audience; nor is it indeed necessary that I should play it; for, even although what I have said be true, it is still, I trust, not the whole truth. I have already spoken of noble exceptions; but although noble exceptions may go far to redeem the character of a nation or of a period, and example may have influences of which we hardly dream, yet for a general remedy I am more inclined to look to the natural course of events, and to what is often loosely spoken of as "things curing themselves." Such a cure may perhaps come about somehow on this wise. So multitudinous are the workers in every science, so numerous are the channels through which their discoveries are chronicled, that it is becoming every year more difficult for even the learned and the well-read to say what is and what is not new, or what has not been published before. Claims for novelty must, therefore, as time goes on, be put forward with greater and greater diffidence. The only originality that can be safely claimed will be originality on the part of the investigator; and the question of absolute priority must be left to the verdict of time and of that sifting process by which ultimately all discoveries will find their proper places in the Temple of Science.

When this stage is reached, and we are even now approaching it, the fever of to-day may in a great measure subside and give place to a more tempered, although still fervent glow of aspiration. The eagerness and haste to which we have become almost accustomed may be chastened by the reflection that questions of priority are not to be settled by a mere stroke of the pen, and that in the comparison of rival claims the question of the quality of work will undoubtedly arise and become interwoven with that of priority. And so in the end it may come to pass that a half understood experiment or a hastily drawn conclusion may avail less than ever for establishing a reputation, and that, even for the purpose of winning the race, it may be worth while to spend sufficient time in laying sure foundations and in building a superstructure commensurate with that on which it stands and well-proportioned in all its parts.

The transference of the Natural History Collections of the British Museum to the new building at South Kensington is still in progress. It is hoped that the building for the specimens preserved in spirits, as well as the fittings for the zoological department, will be so far completed as to allow of the moving of that department during the autumn of 1882. The lighting of the reading-room by Siemens' lamps is so far satisfactory, that it has been decided to keep that room open in future until 8 p.m., instead of 7 p.m. This change, it is hoped, will prove to be of substantial service to a large class of readers.

The Institution founded in 1851, under the title of the Government School of Mines and Metropolitan School of Science applied to Mining and the Arts, for the instruction of students in those branches of science which are indispensable to the Miner, the Metallurgist, the Geologist, and the Industrial Chemist, has this year been organised afresh, and, under its new title of the Normal School of Science and Royal School of Mines, adds to its former functions the training of teachers for the Elementary Science Classes under the Science and Art Department, the multiplication of which, in recent years, is a significant indication of the rapid spread of scientific instruction throughout the country.

The accommodation requisite for practical teaching being inadequate in all cases and totally wanting in respect of many of the classes, in the Museum of Practical Geology in Jermyn Street, and in the Royal College of Chemistry in Oxford Street, all the instruction, except that in Mining, has been transferred to the Science Schools at South Kensington. The staff of professors and lecturers has been increased, and provision has been made for the teaching of various important subjects, such as Mathematics, Drawing, Botany, and the Principles of Agriculture, which were either omitted, or insufficiently represented, in the original programme of the school.

Under its new organisation the Normal School of Science and Royal School of Mines will not merely supply from among its associates persons highly qualified to apply the principles of science to the Mining, Metallurgical, Chemical, and Agricultural industries of the country, and properly trained science teachers; but, through the exhibitions attached to the yearly examinations of the Science and Art Department, it will place within reach of promising young students in all parts of the country, whose means do not enable them to obtain the benefits of a University education, such a training as will enable them to turn their natural abilities to account for the advancement of science and the improvement of its applications to industry. Under the latter point of view, the instruction given in the Normal School of Science will lead up to the special technical training of the Central Institute of the Guilds of the City of London.

Under the auspices of the City and Guilds of London Institute, further progress has been made during the past year in the promotion of Technical Education. It will be remembered that the work at present undertaken by the Institute embraces the establishment of a Technical Science School in Finsbury, a Technical Art School in Kennington, a Central Institution or Higher Technical College in Kensington, the subsidising of existing institutions, affording facilities for Technical Instruction and the encouragement of existing classes in the manufacturing centres by the grants paid to teachers on the results of the Technological Examinations.

In May last the foundation stone of the Finsbury College was laid by H.R.H. Prince Leopold, and the new building, which will afford accommodation for the teaching of applied Chemistry, Physics, and Mechanics, will be finished early in next year. Notwithstanding the inadequacy of the present temporary accommodation, large numbers of students have availed themselves of the instruction afforded. The principles of Electric Lighting, and Transmission of Power, the making of Electrical Instruments, Coal Tar, and Spirit Distilling have been the subjects that have been chiefly studied during the past session.

Since October the classes that were previously conducted by the Artisans' Institute have been transferred to the Finsbury College.

The Institute has under its consideration the establishment of a School for Applied Art in connection with the Finsbury College. Acting on the general principle that every Technical School of this kind ought to provide, in addition to the general course of instruction, as applicable to different industries, special courses applicable to the staple industry of the district, the Council of the Institute are contemplating the establishment of classes in the Finsbury College adapted to the educational requirements of those engaged in Cabinet-making. With this object it will be necessary to attach a School of Design to the College.

The influx of pupils to the studios in Kennington have induced the Council to vote a sum of money for the extension of the building in which the Art School of this district is conducted. These new buildings are nearly completed, and will afford accommodation for Classes in Modelling, Design, and Wood Engraving,

The building of the central institution, which is to be in the first place a school for the training of technical teachers, has been commenced. The first stone was set in July last by H.R.H. the Prince of Wales, who is now the President of the Institute. The plans of this building show accommodation for the teaching of the different branches of Physics in their application to various industries, of Chemistry as applied to trade purposes, and of Mathematics and Mechanics in their application to Engineering. A good engineering school, containing workshops, well supplied with machinery and collections of mechanical instruments and models, such as exist in numerous Continental cities, seems likely to be obtained for London on the completion of this building.

This Institute has done much towards the encouragement of technical instruction in provincial towns, where it is most needed, by its system of annual examinations. In the examination held in May last, 1563 candidates presented themselves, in twenty-eight subjects, from 115 centres, and of these 895 passed. A close connection is being established between the several technical schools which are being now opened in Lancashire and Yorkshire, and the City and Guilds of London Institute. The demands made upon the Institute by Chambers of Commerce in different parts of England satisfactorily indicate the usefulness of this part of the Institute's work.

The programme of Technological Examinations for 1881–82, just issued, shows thirty-two subjects in which examinations may be held, some of which are divided into four or five branches, so that they may be better adapted to individual industries. Whilst attention has in this way been given to the details of different trades, the attempt has been made to secure from candidates passing the Institute's examinations a general knowledge of the principles of their subject and of the relation of closely connected industries with one another.

In order to secure in future efficient teachers, the Council of the Institute have determined after March next not to register as teachers any persons except those who have passed the Institute's Honours Examination, or such as already possess special or distinct qualifications.

The interest which the subject of technical education is beginning to arouse has led to the appointment by the Crown of a Commission to inquire into the education of the industrial classes in England and in other countries; and the City and Guilds of London Institute is represented on this Commission by Prof. Roscoe, who, as President of the Chemical Society, occupies a seat on the Executive Committee, and also by Mr. Philip Magnus, its director and secretary. The Commissioners are at present engaged in making a tour of inspection in France, a section of them having already visited some of the principal technical schools and factories in the north of Italy.

In Meteorological Science the present year has been marked by the publication of an important work ("Die Temperatur Verhältnisse des russischen Reichs," St. Petersburg, 1880), by Prof. Wild of St. Petersburg, on the Temperature of the Russian Empire, embodying, in charts and tables, a great amount of information, hitherto either inaccessible or existing only in scattered memoirs, relating to the meteorology of the vast tracts of Northern Asia. As an interesting particular result it may be mentioned that Prof. Wild has transferred the "Siberian pole of cold in winter" from the neighbourhood of Jakutsk to a point somewhat further north, lying on the Arctic Circle in (about) E. longitude 125°. At this centre of maximum cold, round which the isotherms lie in fairly regular ovals, the mean temperature in January sinks as low as −54° F., the mean temperature at Jakutsk being 11° higher. In close relation to the phenomena exhibited by these charts, Prof. Wild, in St. Petersburg, has been led to study the connection between areas of permanent high or low mean pressure on the one hand, and areas of permanent high or low mean temperature on the other; and he has found this connection to be of the same kind as that known to exist in the case of the shifting areas of high or low pressure, and high or low temperature, which determine the changes of weather. M. Léon Teisserenc de Bort, in Paris, has also investigated the same subject.

The Meteorological Office has completed during the year two works of some interest, which are now ready for immediate publication. The first consists of tables of the Rainfall of the British Isles, prepared at the request of the Council of the Office by Mr. G. J. Symons, F.R.S. These tables include the monthly results recorded at 367 stations in the United Kingdom, being all those for which it was possible to obtain series of observations maintained continuously during the last fifteen years. The second is a volume of charts (with an introduction and explanations) illustrating the meteorology of an ocean district specially important to seamen—that adjacent to the Cape of Good Hope. Some points of novelty are presented by the charts. For example, a new form of "wind-rose," invented by Mr. F. Galton, F.R.S., has been employed, which offers some theoretical advantages over those previously in use, being intended to represent, with geometrical precision, the probability (deduced from the observations) that, in a particular place and at a particular season, a wind blowing between any two given points of the compass will be experienced. Again, for the first time in marine meteorology, the wind observations have been "weighted" with the view of neutralising the tendency to over-estimate the frequency of adverse winds, which has been found to affect meteorological charts injuriously. The work brings into clear relief the most interesting physical feature of the district—one indeed already well known—the intermingling of hot and cold water, brought by the Agulhas and the South Polar currents respectively, and supplies strong evidence for the belief that this intermingling has a large share in producing the atmospheric disturbances so common in the region in which it occurs.

In my Address to the Society in 1879, I stated that an International Conference of a semi-official character had been held, with the view of establishing for one complete year a circle of meteorological observations round the Arctic regions of the globe. Notwithstanding the lamented death of Lieut. Weyprecht, the gallant young discoverer of Franz-Josef Land, by whom the proposal had been originated, it would seem that the efforts of the Conference are likely to be crowned with success. The following stations have already been undertaken by different Governments:—Point Barrow and Lady Franklin's Bay in Smith's Sound, by the United States; West Greenland, by Denmark; Jan Mayen, by Austria; Mossel Bay and Spitzbergen, by Sweden; Bossekop, by Norway; Nova Zembla, by Holland; the Mouths of the Lena, by Russia. The Conference has also been led to hope that the Canadian Government may reinstitute observations at Fort Simpson, and that the Government of France may organise a simultaneous meteorological expedition to Terra del Fuego. It is arranged that the observations should begin as soon as possible after August 1, 1881, and should continue to September 1, 1883.

In astronomy Mr. Gill has completed his discussion of the extensive series of heliometer measures of the parallax of Mars, which he made at Ascension in 1877, and has deduced the value 8″·78 for the solar parallax, corresponding to a mean distance of 93,080,000 miles from the earth to the sun. A value of the solar parallax has also been derived by Mr. D. P. Todd, from the American photographs of the transit of Venus, 1874. The result for the parallax is 8″·883, corresponding to a mean distance of 92,028,000 miles.

A valuable contribution towards the determination of the moon's physical libration has been made by Dr. Hartwig. From a series of forty-two measures made with the Strassburg heliometer he derives values for the physical libration and for the inclination of the moon's axis, substantially confirming the results found by Wichmann, and recently by Prof. Pritchard.

An addition to the small list of stars which have been found to have a measurable parallax has been made by Dr. Ball. He finds that the star Groombridge 1618, which is remarkable for its large proper motion, has a parallax of about one-third of a second, so that it is to be considered one of the sun's nearest neighbours. Dr. Ball has also re-determined the parallax of the double star 61 Cygni, his result being 0"·468, which agrees more nearly with Struve's value than with Bessel's.

The Cape catalogue of upwards of 12,000 stars is the outcome of Mr. Stone's labours during nine years, as Her Majesty's Astronomer at the Cape, and is the most important catalogue of stars which has yet been formed in the southern hemisphere. Another important contribution to stellar astronomy has been made by Prof. Newcomb, who has recently prepared a catalogue of the places of nearly 1100 standard stars compiled from the best authorities.

In connection with his photometric researches Prof. Pickering has discussed the causes of the variability of stars of short period. Taking the various hypotheses which have been proposed, he finds that for Algol and stars of that type the hypothesis of an eclipsing satellite or cloud of meteors revolving round the star is the only one which satisfies the observed phenomena. In the case of β Lyræ and similar variables the fluctuations of light would be explained as due to rotation round the axis, the two hemispheres being of unequal brightness and the form more or less elongated. Prof. Pickering has very carefully investigated the conditions in each individual case, and has brought together the most important facts bearing on the subject. It may be mentioned that on Prof. Pickering's initiative a committee of American astronomers has been formed to co-operate with European astronomers in selecting a series of stars to serve as standards of stellar magnitude.

The present year has been remarkable for the appearance of two bright comets simultaneously visible to the naked eye. The first comet was first seen in the southern hemisphere before its perihelion passage, and burst upon our view in its full splendour soon after perihelion. The most important point in connection with this comet was that photographs of its spectrum were obtained by several physicists, and in particular by Dr. Huggins, who found on his photographs two strong bright lines in the ultra-violet corresponding to a group in the spectra of compounds of carbon, and also a group of lines between G and *h* agreeing in position with another carbon-band. The photographs also showed a continuous spectrum extending from F to some distance beyond H, on which the dark Fraunhofer lines were seen—an indication that part of the light from comets is reflected solar light.

In the visible portion the continuous spectrum was so bright when the comet was first seen after perihelion that it almost obliterated the ordinary cometary bands. These, however, became afterwards very conspicuous, and five bands were noted which were found to coincide sensibly with the carbon band as given by the flame of the Bunsen burner. On the brightest band, three bright lines corresponding to three lines in the carbon band were seen by several observers at Princeton, U.S. These observations show conclusively that the spectrum of this comet is identical with the first spectrum of carbon, and not with the second.

In the telescope this comet showed striking changes from day to day, and even, according to some observers, from hour to hour, and the head was remarkable for its unsymmetrical appearance. Another point of interest is that the orbit presents a remarkable resemblance to that of the great comet of 1807. As, however, the period of this latter was found by Bessel to be 1540 years, the question arises again, as in the case of the comets of 1843 and 1880, whether there are not two comets travelling along the same path.

The second bright comet was first discovered with the telescope, and gradually increased in brightness till it became visible to the naked eye, though by no means so interesting an object as the preceding comet. Besides these two bright comets, several telescopic comets have been discovered, raising the total for this year to eight. The last but one of these has proved to be a periodic comet, revolving in the short period of about eight years. It was discovered by an Englishman, Mr. Denning, being the first instance of such a discovery in this country for many years.

The Copley Medal has been awarded to Prof. Karl Adolph Wurtz, For. Mem. R.S. Prof. Wurtz has, for many years past, been one of the most distinguished leaders of the progress of chemistry, and is now the most eminent of active French chemists. The younger generation of French chemists were, for the most part, his pupils. His writings have been the medium by which most of the knowledge of the more modern theories of chemistry has been disseminated in France. His discoveries have been fruitful of the greatest results, not merely in the way of enriching the science with a knowledge of many previously unknown compounds and classes of compounds, but more especially in extending and improving our knowledge of the laws of chemical combination.

It was he who first discovered compound ammonias containing alcohol-radicals in the place of hydrogen—a family of compounds which has since acquired enormous development. It was he who first made those remarkable alcohols called glycols, and thus gave the key to the explanation of glycerine, erythrite, mannite, and the sugars. Many other discoveries of his might be quoted; but those who know the influence which these two have exercised on the progress of chemistry can feel no doubt that the author of them is deserving of the highest scientific honour.

One Royal Medal has been awarded to Mr. Francis Maitland Balfour, F.R.S. Mr. F. M. Balfour's investigations in embryology and comparative anatomy have placed him, thus early in life, in the front rank of original workers in these branches of science. His "Monograph upon the Development of Elasmobranch Fishes," published in 1878, embodies the results of several years' labour, by which quite a new light has been thrown upon the development of several important organs in the Vertebrata, and notably of the genito-urinary and nervous systems. More recently Mr. Balfour has published a most important work on "Comparative Embryology" in two large and fully illustrated volumes, which stands alone in biological literature, not only as an admirable and exhaustive summary of the present state of knowledge respecting the development of animals in general, but by reason of the vast amount and the varied character of the original researches which are incorporated in its pages.

A second Royal Medal has been awarded to the Rev. John Hewitt Jellett, F.R.S., Provost of Trinity College, Dublin. Dr. Jellett is the author of various papers on pure and applied mathematics; but the award is more directly connected with his invention of the analyser known by his name, and for the elaborate optico-chemical researches which he has made with it.

This analyser was introduced by its inventor into the instrument by which he has carried on his researches on the state of combination of mixed solutions, as evidenced by the changes in their power of rotating the plane of polarisation consequent upon a change in the proportion of the active ingredients which enter into the solution. This is a problem towards the solution of which ordinary chemical methods can contribute but little. A single instance will suffice to give an idea of the nature of the results. It is known that quinine forms with many acids two series of salts, one having twice the quantity of acid of the other for the same quantity of base, while with other acids only the less acid salt has been obtained; so that the ordinary chemical methods fail to give evidence of the existence of the more acid salt. Now, by examining the rotatory power of a solution of a given quantity of base with different doses of acid, Dr. Jellett was able to obtain evidence of the existence of two, and but two, salts of the base, no matter whether the acid were or were not one which yields two crystallisable salts. A slight deviation in the amount of rotation when the more acid salt began to be formed in tolerable quantity, from what it ought to have been, on the supposition that the whole of the acid introduced was combined with the quinine, was naturally attributed to a slight partition of the acid between the base and the solvent, regarded as a feeble base; but the smallness of the deviation indicated that a solution of the more acid salt mainly existed as such, and that it was not, as some had supposed, decomposed into free acid and the less acid salt.

The Davy Medal has been awarded to Prof. Adolf Baeyer. Prof. Baeyer was already known as the author of many masterly researches in organic chemistry, among which those on uric acid and on metallic acid deserve special mention, before his latest and most remarkable discovery. The process for the artificial formation and manufacture of indigo is the result of long-continued efforts, directed by singularly clear and accurate views of the order and mode of combination of its constituent elements, and of the conditions requisite for obtaining reactions indicated by theory.

The work of the Royal Commission on Accidents in Mines during the past year has been of such great interest, both from a scientific and from a practical point of view, that I venture to note at length some notes upon it, furnished to me by our Fellow, Mr. Warington Smyth, the Chairman.

A preliminary report was presented before the end of the

Session 1881, drawing attention, under the chief heads of the subject, to the facts and opinions elicited from the examination of a large number of competent witnesses.

Experimental inquiries, which will be the subject of a further report, have been instituted for the purposes of testing the various safety-lamps in use, as well as the numerous modifications recently proposed, and of determining the effect of coal-dust in causing or aggravating explosions. From time to time also experiments have been made with a view to substitute, in the breaking down of coal, some other means for the gunpowder shots which have so often, by their flame, caused the ignition of fire-damp.

The presence of a powerful "blower" of natural gas at the Garswood Hall Colliery, near Wigan, with the facilities offered by the proprietors, induced the Commission to erect suitable apparatus for a long series of these trials, and now that it appears desirable to compare the results with what may be obtained in another district and with a differently constituted fire-damp the whole of the apparatus is in course of erection at a colliery in the Rhondda Valley, where a very permanent "blower" offers similar advantages.

In the course of the lamp experiments it came out very clearly, in confirmation of statements before made, that the greatly augmented ventilation in our larger modern collieries has put an end to the fancied security of the simple Davy and Clanny lamps. Their use in fact, unless they be protected by some farther contrivance, is attended with the most imminent risk when the velocity of a current liable to be rendered explosive, exceeds six feet a second. A high degree of importance thus attaches to the comparative trials of lamps in which the flame is sufficiently shielded against the impinging stream of air, and those which have the property when immersed in an explosive mixture, of rapidly quenching both the flame of the wick and of the burning fire-damp.

The terrible disaster which occurred in September, 1880, at the Seaham Colliery, drew more anxious attention than ever to the question of the part played by coal-dust, and a special reference having been made by the Secretary of State for the Home Department to Prof. Abel, C.B., the experiments at Garswood Hall were largely extended. Some of the results were very remarkable; the proportion of fire-damp present with the air may be so small as to elude detection by the ordinary test of the carefully watched flame in the safety-lamp, and yet the presence of dust in suspension will cause rapid ignition, or even explosion, in a degree varying with the proportion of gas and the velocity of the current. Dust was employed from different parts of the works of several collieries where it was suspected that this agent had borne a serious part in intensifying and spreading explosions; and it was found that some of the varieties were far more sensitive than others. Certain kinds of dust, in themselves perfectly non-combustible, were similarly tested, and proved to have an analogous effect in promoting explosion, even when the percentage of gas was exceedingly small.

It is obvious from these facts that under certain conditions it is very important that a satisfactory indicator of minute proportions of fire-damp should be employed; and the further experiments proposed to be carried out by the Commission will include a particular inquiry into this subject.

The question of the feasibility of the introduction of the electric light into the workings of a colliery has been partially solved. The Stanton Coal and Iron Company were induced by the Commission to make a trial of Mr. Swan's lamps in their Pleasley Colliery, near Mansfield. Not only the inset and main road, but some of the "long-wall" faces of work, were brilliantly lighted in this manner. A second experiment of the same kind has been carried out at the Earnoch Colliery, near Hamilton.

The use and abuse of explosives in mining operations have in the last few years formed a subject of much inquiry, especially with reference to the firing of shots in coal-seams liable to be invaded by fire-damp. A return to mere wedging in all cases, as proposed by some officials, would be to ignore the advance of science as well as the necessities caused by competition; and the Commission hopes by further examination, and especially by practical trials, to contribute useful information to the solution of a difficult but important question.

Among the applications of scientific apparatus the employment of the ingenious protected lime-light lamp, and of the portable breathing arrangement of Mr. Fleuss, during the operations for re-opening of parts of the Seaham Colliery, deserves special notice.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Messrs. W. M. Hicks and W. W. R. Ball are appointed Moderators in the Mathematical Tripos for the year beginning next May. The Senior Wranglership will in future be adjudged in June.

The Examiners for the Natural Sciences Tripos in 1882 are Lord Rayleigh, Prof. W. J. Lewis, Prof. Morison Watson (Owens College), Drs. Gaskell, R. D. Roberts, and Vines, Mr. A. G. Vernon Harcourt (Oxford), and Prof. A. M. Marshall (Owens College).

Mr. R. T. Glazebrook, Demonstrator of Experimental Physics, is approved as a Teacher of Physics, and Mr. A. S. Lea, Lecturer at Caius College, is approved as a Teacher of Physiology for the purpose of Medical Studies.

Clare College offers a Natural Science Scholarship, examination March 28; subjects: Chemistry, Chemical Physics, Botany, Geology. Candidates must give notice a fortnight previously to the tutor.

GLASGOW.—The matriculations for the present session number 2316, distributed among the various Faculties as follows, viz.:—In Arts 1327, in Medicine 624, in Law 211, in Theology 100, in Arts and Medicine 25, in Arts and Law 9, in Arts and Theology 20. The total number of matriculations last session was 2304, distributed as follows:—In Arts 1406, in Medicine 563, in Law 189, in Theology 85, in Arts and Medicine 29, in Arts and Law 18, in Arts and Theology, 14.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, October.—Experiments on the strength of wrought iron and steel at high temperatures, by Mr. Roelker.—On the proper method of expansion of steam and regulation of the engine, by Prof. Thurston.—On the last experiment with the Perkins machinery of the anthracite, by Ch. Eng. Isherwood.—Radio-dynamic facts, by Dr. Chase.—Universal energy of light, by the same.

Annalen der Physik und Chemie, No. 10.—Photometric researches on absorption of light in isotropic and anisotropic media, by C. Pulfrich.—On the vapour-tension of mixed liquids (continued), by D. Konowalow.—On the heat of formation of water, by A. Schuller.—On the heat-conductivity of gases and its connection with temperature, by L. Graetz.—Past observations on the expansion of water by heat, by P. Volkmann.—On the theoretical determination of vapour-pressure and volumes of vapour and liquid, by R. Clausius.—On heat-conduction in a system of cylinders, and on the experimental determination of the conductivity of water, by H. Lorberg.—On magnetic reaction, by F. Auerbach.—Application of the balance to the problem of gravitation, by Ph. v. Jolly.—On the spectra of hydrogen and acetylene, by A. Wüllner.—Some remarks on Herr Wesendonck's experiments on spectra of carbon compounds, by the same.—The minimum of deflection of a ray of light in a prism, by K. H. Schellbach.—Contribution to history of natural sciences among the Arabians, by E. Wiedemann.

La Natura, Nos. 21 and 22, November.—The Italian section at the Paris Electrical Exhibition, by R. Ferrini.—Thermal radiation of the sun, &c. (continued), by C. Cattaneo.—On the origin of electricity of storm-clouds and of the air, and on electricity in general, by F. G. Nachs.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 17.—"Researches on Chemical Equivalence." By Edmund J. Mills, D.Sc., F.R.S., and J. H. Bicket. Part IV.: Manganous and Nickelous Sulphates.

The authors have examined the precipitability and precipitation of manganous and nickelous sulphates, alone or commixed, by means of sodic carbonate. The chemical events they describe are represented in a series of four hyperbolas, whose equations are given in the memoir. They sum up their results as follows:—(1) Precipitability is a linear function of mass; (2) when the commixed sulphates are precipitated by sodic carbonate, equal weights of them are equally precipitable, the attraction of one of them for the reagent being the inverse of that of the other; (3) when the sulphates are separately precipitated by the same reagent, they are equally precipitable, and do not exhibit the inverse function; (4) there is some evidence that the precipitabilities of the commixed and separate sulphates are mathematically related in a simple manner; (5) within moderate limits precipitation is not traceably affected by temperature.

"Researches on Chemical Equivalence." By Edmund J. Mills, D.Sc., F.R.S., and Bertram Hunt. Part V.: Nickelous and Cadmic Sulphates.

This series of experiments had for its object the comparison (as in Part IV.) of nickelous sulphate with a sulphate belonging to another group. The precipitability equations for the commixed salts are given; and it is shown that, according to these, nickelous and cadmic sulphates do not admit of comparison as equally precipitable substances. The authors say, in conclusion, "Our present inference with regard to the precipitability of nickelous-cadmic salt will lead (if confirmed by the action of reagents other than sodic carbonate) to the following important criterion:—*Two elements belong to the same group when*, in saline solutions of identical genus, *they may be equally precipitable*.

"Note on the reversal of the Spectrum of Cyanogen," by Professors Liveing and Dewar.

The authors have frequently noticed dark shaded bands which appeared to be the reversals of bands of oxides or chlorides of sundry metals, but only recently have they obtained photographs showing the reversal of the violet and ultra-violet flutings of cyanogen. The most complete reversal of these flutings were obtained by the use of a Siemens' machine in a crucible of magnesia fed with cyanide of titanium. No other cyanide has been found to produce this effect, but borate of ammonia has produced the reversal of the strongest group near L. In one case the reversal was produced by the bright background given by the expanded lines of magnesium when that metal was introduced. Probably the great stability of titanic cyanide and boron nitride has an influence on the result. The difficulty in reproducing the reversal at will is in securing an absorbing stratum of sufficiently high temperature, and at the same time a sufficiently bright background.

Geological Society, November 16.—R. Etheridge, F.R.S., president, in the chair.—Dr. T. Sterry Hunt, who was present as a guest, gave some account of the pre-Cambrian or Eozoic rocks of Europe as compared with those of North America. He had on several occasions studied them, both on the Continent and in the British Isles, especially with Dr. Hicks in Wales in 1878. In North America the recognised base is a highly granitoid gneiss, without observed limestones, which he has called the Ottawa gneiss, overlain, probably unconformably, by the Grenville series of Logan, consisting chiefly of granitoid gneisses, with crystalline limestones and quartzites. These two divisions make up the Laurentian of Canada, and correspond respectively to the Lewisian and the Dimetian of Hicks. Resting in discordance on the Laurentian, we find areas of the Norian or Labrador series (Upper Laurentian of Logan), chiefly made up of anortholite rocks, granitoid or gneissoid in texture, with some true gneisses. The Huronian is seen to rest unconformably on the Laurentian, fragments of which abound in the Huronian conglomerates. To the lower portion of the Huronian the speaker had formerly referred a great series of petrosilex or hälleflinta rocks, described as inchoate gneisses, passing into petrosilex-porphyries, occasionally interstratified with quartzites. This series, in many places wanting both in Europe and America, he is now satisfied forms an underlying unconformable group—the Arvonian of Hicks. Above the Huronian is the great Montalban series, consisting of grey tender gneisses and quartzose-schists, both abounding in muscovite, occasionally with hornblendic rocks. The Pebidian of Hicks includes both the Huronian and the Montalban, to which latter belong, according to the speaker, certain gneisses and mica-schists both in Scotland and in Ireland, as he had many years since pointed out. In some parts of North America he found the Montalban resting unconformably on Laurentian. Above the Montalban comes the Taconian (Lower Taconic of Emmons), a series of quartzites and soft micaceous schists, with dolomites and marbles. All these various series are older than the Lower Cambrian (Menevian) strata of North America; and it may be added that the Keweenian or great copper-bearing series of Lake Superior there occupies a position between the Montalban and the Cambrian. In the Alps the speaker recognises the Laurentian, Huronian, and Montalban, all of which he has lately seen in the Biellese, at the foot of Mont Viso, in Piedmont. The Huronian is the great *pietre verdi* group of the Italians, and much of what has been called altered Trias in this region is, in his opinion, probably Taconian. The Montalban forms the southern slope of Mont St. Gothard, and is the muscovite gneiss and mica-schist of the Saxon Erzgebirge. Here Dr. Credner and his assistants of the Geological Survey have described abundant conglomerates holding pebbles of Laurentian rocks imbedded in the Upper or Montalban gneiss. The pre-Cambrian age of this has been shown by Credner, who has proved by careful survey that the so-called younger or Palæozoic gneisses of Naumann are really but a continuous part of the older series. Late surveys also show that the crystalline rocks of the Taunus are really Eozoic, and not, as formerly maintained, Devonian in age. The speaker insisted upon the fact that where newer strata are in unconformable contact with older ones, the effect of lateral movements of compression, involving the two series, is generally to cause the newer and more yielding strata to dip towards and even beneath the edges of the older rock, a result due to folds, often with inversion, sometimes passing into faults. This phenomenon throws much light on the supposed recency of many crystalline schists.—The following communications were read:—Additional evidence on the land plants from the Pen-y-glog slate-quarry, near Corwen, by Henry Hicks, M.D., F.G.S.—Notes on *Prototaxites* and *Pachytheca* from the Denbighshire grits of Corwen, North Wales, by Principal Dawson, LL.D., F.R.S., F.G.S.

Zoological Society, November 29.—Dr. A. Günther, F.R.S., vice-president, in the chair.—A letter was read from Dr. A. Frenzel announcing his success in breeding parrots of the genus *Eclectus* in his aviary at Freiberg, in Saxony.—A communication was read from Dr. A. B. Meyer, C.M.Z.S, containing the description of a new species of *Eclectus* received from Timorlaut Island, which he proposed to name *Eclectus riedeli*.—Mr. R. Bowdler Sharpe read a note on the genera *Schœnicola* and *Catriscus*, and pointed out that these genera were identical, but that the South-African *S. apicalis* was specifically distinct from the Indian *S. platyura*.—Mr. G. A. Boulenger gave the description of a new species of *Anolis* from Yucatan, proposed to be called *Anolis beckeri*.—Mr. W. A. Forbes gave an account of the observations he had made on the temperature of the Indian Python (*Python molurus*) during her incubation in the Gardens of the Society in June and July last. The result arrived at was that in the present case there was a difference on the whole average of about 1°·4 Fahr. in favour of the female as compared with the non-incubating male when the temperature was taken on the surface, and of more than double that amount when the temperature was taken between the folds of the body.—Dr. Gwyn Jeffreys, F.R.S., F.Z.S., read the fourth of his series of papers on the Mollusca procured during the expeditions in H.M.SS. *Lightning* and *Porcupine*, 1869 and 1870. This part concluded the Conchifera or Bivalves. Eighteen additional species, chiefly belonging to the genus *Neæra*, which is peculiar to deep water, were described. The geographical, hydrographical, and geological distribution, as well as the synonymy of all the species named in the paper, were treated of.—A communication was read from Dr. G. Hartlaub, describing the birds collected in Socotra and Southern Arabia by Dr. E. Riebeck. Amongst the Socotran birds was an example of a new species of finch of the genus *Rhynchostruthus*, which he proposed to call, after its discoverer, *R. riebecki*.

Royal Microscopical Society, November 9.—J. W. Stephenson, vice-president, in the chair.—The Rev. J. J. Halley, vice-president of the Microscopical Society of Victoria (one of the affiliated societies), attended the meeting, and gave an account of the progress of biology and microscopy in that colony.—Mr. Stephenson exhibited a slide of *Surirella gemma*, mounted in phosphorus, illustrating in a remarkable manner the advantage of mounting in media of high refractive index. Mr. Crisp, Mr. Crossley, and Mr. Watson exhibited various forms of microscopes and apparatus, and Mr. Mayall an Abbe apertometer of dense glass for measuring apertures up to 1·50 N.A., and a plate ruled by Fasoldt of New York, who claims to be able to rule lines up to 1,000,000 in the inch.—The deaths of M. Nachet, sen., of Paris, and Mr. C. A. Spencer of Geneva, N.Y., were announced.—Two papers were read by Dr. B. Wills Richardson on multiple staining of animal and vegetable tissues, and by Dr. L. G. Mills on diatoms from Peruvian guano; and Mr. T. Charters White exhibited and explained Goodwin's growing slide.—Eight new Fellows were elected.

Anthropological Institute, November 22.—Mr. Hyde Clarke, vice-president, in the chair.—The election of C.

Pfoundes was announced.—Mr. E. B. Tylor, F.R.S., read a paper on the Asiatic relations of Polynesian culture. The author called attention to some new evidence relating to the transmission of civilisation from the Indo-Chinese district of Asia through the Indian Archipelago to Melanesia and Polynesia. The drawings of wooden tombs in Borneo by Mr. Carl Bock show architectural design, apparently derived from the roof-projections of pagodas of Cochin China. The flute played with the nostrils may be traced from India (where it is said to have a ceremonial use to prevent defilement through touching a low-caste mouth), through South-east Asia into Borneo, to the Fiji Islands, and down to New Zealand. Among the traces of mythical ideas having spread from Asia into the South Sea Islands, Mr. Tylor mentioned the notion of seven or ten heavens and hells, apparently derived from the planetary spheres of the Pythagoreans. The Scandinavian myth of the fishing up of the Midgard serpent bears, as Prof. Bastian of Berlin has pointed out, a striking resemblance to Maui's fishing up the Island of New Zealand, and the Maori myth of the separation of heaven and earth has one of its best representatives among the Dayaks of Borneo. Leaving the question of race on one side, it is becoming more and more certain that much of the culture of the Polynesians came in some way from civilised nations of Asia.—The following papers were also read:—On Fijian riddles, by the Rev. Lorimer Fison.—On the stature of the inhabitants of Hungary, by Dr. J. Beddoe.—Notes on the affinity of the Melanesian, Malay, and Polynesian Languages, by the Rev. R. H. Codrington.—The discussion on Mr. Codrington's paper was adjourned to the next meeting, on December 13.

Institution of Civil Engineers, November 22.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the "Forces and Strains of Recoil considered with reference to the Elastic Field-Gun Carriage," by Mr. H. J. Butter.

Victoria (Philosophical) Institute, December 5.—The first meeting of the new session was held at the Institute's House, 7, Adelphi Terrace, on Monday evening, when a paper on Mr. Herbert Spencer's "Theory of the Will" was read.

Paris

Academy of Sciences, November 28.—M. Wurtz in the chair.—M. Faye presented the volume of the *Connaissance des Temps* for 1883.—The following papers were read: New method of annulling the astronomical flexure of telescopes, by M. Villarceau. The simultaneous application to a well-made telescope of two weights in equilibrium, causes a variation of the astronomical flexure, proportional to their difference. Two iron rings, of fixed weight, are applied at distances from the axis of rotation, that are determined by formula.—On the isomeric states of haloid salts, by M. Berthelot.—Summary account of a zoological exploration in the Mediterranean with the Government vessel *Le Travailleur*, by M. Milne-Edwards. This expedition, organised by M. Milne-Edwards, left Rochefort on June 9, and returned August 19. Part of June and all July was devoted to the deeper parts of the Mediterranean. *Inter alia*, many Crustaceans, known only in the Atlantic before, were got in those depths; also remarkable species of Mollusca, Bryozoa, Cœlenterata, &c. The presence of the magnificent sea-star Brisinga was quite unexpected; several specimens were dredged between 550 and 2660 m. No Infusoria, Bacteria, or Microbes were found at great depths; Rhizopods were rare; at 2660 m. some small Actinophrys were obtained. In general the Mediterranean is not to be thought a distinct geological province; its inhabitants have probably come from the ocean, and their development and reproduction have been more active than in their place of origin. Some have been slightly modified. The more we get to know of oceanic productions off the coasts of Portugal, Spain, Morocco, and Senegal, the more do differences from Mediterranean animals disappear.—Fossil man of Lagoa Santa (Brazil), and his present descendants, by M. de Quatrefages. Several human crania were long ago found in a cavern near Lagoa Santa, by Dr. Lund, a Danish *savant*. His letter about them (1844) seems to have been forgotten. Most were sent to Copenhagen, but have not been described. One remaining in Brazil has been studied by Drs. Lacerda and Peixoto, who find the skull to have strong points of similarity to skulls of Botocudos of the present. This M. de Quatrefages confirms, and he further finds the type quite distinct from European fossil man, chiefly in the combinations of dolichocephaly and hypsistenocephaly. This Brazilian fossil man lived in the reindeer epoch. The type (with added ethnic elements not yet determined) is now met with in Ando-Peruvian populations, as well as in Brazil.—Admiral Paris presented a second series of his "Souvenirs de Marine Conservés," plates of old or disappearing types of vessels, comprising Danish ships previous to the siege of Copenhagen, Arab vessels, French fishing-boats, Turkish boats, &c.—Researches on a new property of the nervous system, by M. Brown-Séquard. Various parts of the nervous system may act suddenly, or very rapidly, in a purely dynamic way and without intervention of nutrition, on other parts of this system, so as to increase the power of action of those parts. Thus, *e.g.* by irritation of the skin the excitability of the phrenic nerve of the same side may be at once so increased that the minimum faradic current then required to set the nerve in action may be only one-sixth of that for the same nerve in a similar animal whose cutaneous nerves have not been irritated.—Observation of the new comet (*g* 1881) at Paris Observatory, by M. Bigourdan.—On algebraic equations of the form

$$\frac{A_0}{x-a_0} + \frac{A_1}{x-a_1} + \ldots + \frac{A_n}{x-a_n} = 0,$$

by M. Laguerre.—Distribution of energy by electricity, by M. Deprez.—Decomposition of vapour of water by electric *effluves*, by MM. Deherain and Maquenne. They show that certain electric discharges without sparks, and at a comparatively weak tension, will decompose water. They used sometimes MM. Thenard and Berthelot's well-known apparatus with double glass envelope, sometimes a tube traversed by a play tinum wire, and having some tinfoil outside.—Contribution to the pathological anatomy of the spinal cord in poisoning with phosphorus, by M. Danillo. With phosphorus inflammator-irritation may be produced either in the grey substances alone, or both in that and in the white.—Reply to a note of M. Isambert on carbamate of ammonium, by MM. Engel and Moitessier.—On the post-embryonal development of Diptera, by M. Künckel.—On an electrolytic dosometer for measuring the intensity of the current during medical application of electricity, by M. Pulvermacher. The gases produced by decomposition of water are admitted into a chamber where they act on coloured water, forcing it up a tube to which a graduated scale is attached.—Mr. Axon communicated some facts about articulation by deaf mutes, confirming M. Hémént's observations.—M. Bousset reported a curious case of double parturition by a cow.

Vienna

Imperial Institute of Geology, Nov. 22.—The following papers were read:—R. Hoernes, contributions to the knowledge of mid-Meiocene Trionyx species in Styria.—Standfest, on the Devonian formation in the environs of Gratz.—F. Kreutz, contributions to the explanation of the ozokerite and naphtha occurrence in Gallicia.—T. Woldrich, contributions to the knowledge of the fauna of Moravian caves.—E. Reyer, on the eruptive rocks of Toscana and Elba.

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