THURSDAY, JANUARY 19, 1882

OUR NATIONAL DEFENCES

THE inaugural address of the President of the Institution of Civil Engineers, delivered last week, was of more than usual interest. Selecting as his subject our national defences, Sir William Armstrong was enabled by his great experience and world-wide reputation to give much greater weight to his opinions than any other engineer at the present day. The subject, too, is one to which attention can now be readily directed, as the public mind has of late been somewhat rudely awakened to the fact that our national armaments have not been making the same progress as those of certain foreign powers, and the comfortable belief that we were strong enough to withstand the attack of any possible combination of other nations has given place to a feeling of distrust in our Government establishments. There can be no doubt that the general public was not a little surprised to find that ironclads and heavy guns of a power at least equal to the best in our service were for sale ready made, so to say, in the shop-windows of some of our manufacturers, and had, on the alarm of war with Russia, to be hastily purchased by the Government to prevent their falling into the possession of a hostile power.

Sir William Armstrong first discusses the question of armour. The early ironclads, such as the *Warrior*, were plated throughout nearly their entire length with 4½-inch armour; as guns were produced of greater penetration, the thickness of armour was increased and the protected area diminished until in all the latest ships it has come to be restricted only to the battery, all vital points of the machinery being placed out of harm's way below the water-line. "Everything of importance that projectiles could destroy would be kept below water-level, and so far as artillery-fire was concerned, the ships would be secured against sinking by an under-water deck and ample division into compartments. Armour therefore seems gradually contracting to the vanishing point." Sir William plainly considers that the days of armour-plating are numbered, and he strongly argues in favour of its abandonment at least in many types of ship. As the basis of his argument he takes the comparative cost of an unarmoured and an armoured vessel capable of carrying the same weight and number of guns, and states that three of the former could be constructed for one of the latter; which then, he asks, would be the better investment? In the first place the three unarmoured ships could have higher speed, and if their guns were capable of piercing the plating of the ironclad there can be no doubt that their numerical superiority would enable them to win an easy victory if the three were matched against the one. If the ironclad was impenetrable by the guns of her adversaries they could still, by their greater speed and handiness, be enabled to come to close quarters and attack to the greatest advantage with torpedo and by ramming, unless disabled by their opponent's fire; and this Sir William considers may be provided against without difficulty by means of an underwater deck, and by placing all machinery below the water level. It would still remain for the ironclad to strike a fatal blow, by means of torpedoes, at any one of her adversaries who came to close quarters; but as the chances of this would be equal for either ship the advantage still remains with the larger number. We quite agree with Sir William Armstrong in his conclusion that light unarmoured ships of high speed, with every possible means of protection other than armour-plating, are what the country would most require in case of war, but they must be provided in sufficient numbers.

In estimating from the basis of cost the proportionate number of armoured and unarmoured ships as one to three, we cannot but think that Sir William has overlooked the cost of repairs and of the maintenance and pay of the officers and crews; if this were taken into consideration, as well as the original outlay, the proportion would have to be reduced to something like two to one. In addition to the many advantages so ably pointed out by Sir William in favour of his policy, it should be borne in mind that an unarmoured vessel could always be brought up to date by the substitution of new engines and boilers and guns of an improved type, until fairly worn out, while an ironclad cannot be prevented from becoming obsolete a few years after completion.

"It might perhaps be rash entirely to abandon armour so long as other nations continued to use it, because nothing but the experience of an actual war would remove all question as to its possible utility; but, considering the indisputable value of a numerous fleet of swift and powerfully armed ships built with a view of obtaining the maximum amount of unarmoured defence, and considering that such ships, unlike armour-clads, could never grow much out of date, it did seem expedient that the chief expenditure of this country should be upon ships of that description."

Sir William Armstrong then deals with the question of our mercantile marine being able to furnish a supply of vessels fit for conversion into cruisers, and says, "Where are there to be found amongst trading or passenger steamers, vessels possessing a speed of sixteen knots with engines and boilers below water-level, and having an under-water deck to save them from sinking when penetrated at or below the water-line? From his own experience he knew how difficult it was to adapt mercantile vessels to the purposes of war, and how unsatisfactory they were when the best had been made of them."

But if these vessels cannot be adapted for war purposes in case of need, why, it may be asked, should not specially designed and constructed cruisers be employed for mercantile purposes?

If a number were built by private firms, certain preferences and advantages could be given to their employment in commerce; for example, as giving mail contracts and the contracts for the conveyance of troops and Government materials in time of peace, only to those shipowners who kept in a serviceable condition in their carrying business a certain proportion of cruisers. A vessel of the cruiser type would of course labour under some disadvantages in competition with a ship built entirely for passenger and cargo purposes, but this would be compensated by the advantages given to her owners; and to use for mercantile purposes a number of vessels specially built for the protection of commerce in case of war must assuredly be more economical than to keep the same number laid up in port or cruising about the world for the sake of employing their crews. In connection with this system we might also have a naval reserve, to be employed chiefly on board the mercantile cruisers and liable to service for a short period every year or two on board a commissioned ship of similar type.

Referring to harbour defence, Sir William pointed out that many of our ironclad forts had already become obsolete, and gave the place of first importance to gunboats, in combination with torpedo launches and submarine mines, all of which he suggested might be managed by a well-trained corps of volunteer engineers resident on the spot. Here again it is evident that Sir William does not think, great though our present expenditure is, that enough is done for the efficient protection of the country, and rather than advise an increased outlay he judiciously seeks, by the improvement of the system, to obtain better results for the same money.

Sir William then referred briefly to the progress made in the manufacture of guns since the introduction of rifling, but made no special allusion to the improved breech-loaders constructed by his own firm for foreign powers, and which have long been known to be much superior to anything in our own service; in fact, while guns of this type are now beginning to receive the serious consideration of our Government departments, their original designers have for some time turned their attention to something newer still and far more powerful. Sir William shortly described the latest system upon which experiments are being made at Elswick. In this system the coils surrounding the central tube consist of steel ribbon wound on spirally at a certain tension. It is apparent that no longitudinal strength is obtained in the coils by this method; and to supply this deficiency, longitudinal layers of ribbon steel are interposed at every fourth circular layer.

The advantages of the system are that steel, in the form of wire or drawn ribbon, possesses far greater tenacity than in any other form, and that the initial tension at each point in the coils of the gun can be accurately adjusted. The first gun of this type was a 6-inch breechloader, tried in the beginning of 1880, and so satisfactory were the results, that a 10-inch gun of 21 tons weight has since been constructed, and is now under trial.

The importance of working heavy guns on board ship by engine-power was pointed out as lessening the number of men exposed, and the objection that the machinery was liable to be disabled by an enemy's fire, was shown to apply equally to the mechanism required for hand-power.

In concluding Sir William adverted to a subject of grave importance. "Our navy was at present armed with guns which could not be expected to contend successfully with the best modern guns that could be brought against them." "Our service guns had simply been overtaken in that rapid progress of artillery which had been going on for the last eight or ten years."

"In the mean time no expense should be spared in judicious experiments, seeing that the expense of experiments was trifling in comparison with that of mistakes. Above all, the Government should pursue such a course as would bring into full play the abundant engineering resources of this highly mechanical country, for increasing the efficacy of our national defences."

On this last and most important point we have before laid stress in these columns. We have before pointed out that the keen commercial competition for foreign orders amongst private firms fosters a vitality and vigorous growth in the direction of any improvement or new development which is invisible, and would probably be felt inconvenient in our Government factory. It would surely then be to the advantage of this country to avail ourselves of the energy and enterprise of our private firms instead of allowing them chiefly to benefit our foreign competitors.

THE SUN

The Sun. By C. A. Young, Ph.D., LL.D. International Scientific Series. (Appleton, New York.)

SINCE the method of artificial eclipses was introduced in 1868 Prof. Young, the author of the book under notice, has from time to time done good work in utilising the capital climate of his native country and his relatively superior optical means to confirm in many essential points and to add a little shading here and there, to the bold outlines of the new science, for which we are indebted to his predecessors.

The book, which deals with the sun in the most general manner, will be read with interest, as its style, though not brilliant, is popular, and such questions as the sun's distance and the various instrumental means now at the disposal of astronomers for increasing our present knowledge are very clearly referred to, while those whose acquaintance with spectrum analysis is not very intimate, will be able to gather from the volume much interesting information conveyed in an agreeable form.

To those who have followed with some keenness the recent progress of solar physics that part of Prof. Young's book which refers to the hypothesis of the dissociation of the elementary bodies at the temperature of the sun will possess much interest, the more so as the author has been freely quoted as objecting to the hypothesis *in toto*.

On this account we do not think it inappropriate to give in Prof. Young's own words his views on this point. It is the more important to do this because very few beyond the number of those who have been more or less engaged in the inquiry have any conception of the remarkable character of the facts which have been accumulated during the last thirteen years, or of the way in which they refuse to be included in the previous hypothesis according to which we were really in presence of terrestrial elements in the sun and stars, the old hypothesis being based upon the asserted identity of the solar and stellar spectra with those seen in various terrestrial light sources.

The extracts run as follows:—

"When we recollect that the non-apparent elements constitute a great portion of the earth's crust, the question at once forces itself: What is the meaning of their seeming absence? Do they really not exist on the sun, or do they simply fail to show themselves; and, if so, why? The answer to the question is not easy, and astronomers are not agreed upon it. Mr. Lockyer has, however, proposed a theory which, if established, would remove most if not all of the spectroscopic difficulties. He thinks that our elements are not really elementary, but built of molecules themselves composite and capable of dissociation by the action of heat. Thus, a mass of chlorine, for instance may at a certain temperature break up into constituents, and so it may easily be the case that at solar temperatures certain of our terrestrial elements cannot exist, or, if they exist at all, can do so only in certain very restricted regions of the solar atmosphere.

"One strong argument in favour of this view is found in the fact, now we think beyond dispute, that the same substance may, under different circumstances, give widely different spectra. . . ."

"There seem to be at least three possible explanations of these facts. One is, to suppose that the luminous substance, without any change in its own constitution, vibrates differently and emits different rays under varying circumstances, just as a metal plate emits various notes according to the manner in which it is held and struck. The second assumes that the substance, without losing its chemical identity, undergoes changes of molecular structure (assumes allotropic forms) under the varying circumstances which produce the change in its spectrum. According to either of these views, although we can safely infer from the presence of the known lines of an element in the solar spectrum, its presence in the solar atmosphere, we cannot legitimately draw any negative conclusion; the substance may be present, but in such a state under the solar conditions as to give a spectrum different from any with which we are acquainted.

"The other and simplest explanation is to suppose, with Mr. Lockyer, that the changes in the spectrum of a body are indications of its decomposition, the spectrum of the original substance being replaced by the superposed spectra of its constituents."

"Another point which favours Mr. Lockyer's view is this: Certain substances have numerous lines apparently common. Thus, if one runs over Ångström's map of the solar spectrum, he will find about twenty-five lines marked as belonging both to iron and calcium. The same thing is true of iron and titanium to a still greater extent, and to a considerable degree of several other pairs of substances. This fact might be explained in several ways. The common lines may be due, first, to impurities in the materials worked with; or, second, to some common constituent in the substances (which is Mr. Lockyer's view); or, third, to some similarity of molecular mass or structure which determines an identical vibration-period for the two substances; or, finally, it may be that the supposed coincidence of the lines is only apparent and approximate—not real and exact—in which case a spectroscope of sufficient dispersive power would show the want of coincidence."

"Now, Mr. Lockyer, by a series of most laborious researches, has proved that many of the coincidences shown on the map are merely due to impurities. . . . . But when all is done, we find that certain of the common lines persist, becoming more and more conspicuous with every added precaution taken to insure purity of materials.

"Moreover, when one of the substances, say the calcium, is subjected to continually increasing temperatures, its spectrum is continually modified, and these basic lines, as Mr. Lockyer calls them, are the ones which become increasingly conspicuous, while others disappear. This is just what ought to happen if they are due to some element common to both iron and calcium—an element liberated in increasing abundance with every rise of temperature" (pp. 89-92).

"A given element often has several entirely different spectra. Changes, such as have been mentioned, go on up to a certain point, and then, suddenly, an entirely new spectrum appears, not having apparently the slightest connection with the one which preceded it any more than if it came from an entirely different element or mixture of elements; as, in fact, according to Mr. Lockyer's view, is probably the case.

"Now, in the solar spectrum, the dark lines characteristic of an element are all coincident with the bright lines of its gaseous spectrum; but it is not often the case that the relative width and intensity of the solar lines match those of the bright lines in the spectrum obtained by artificial means" (pp. 96-97).

"In the motion-distortions of lines Lockyer finds strong confirmation of his ideas. It not unfrequently happens that in the neighbourhood of a spot certain of the lines which we recognise as belonging to the spectrum of iron give evidence of violent motion, while close to them other lines, equally characteristic of the laboratory spectrum of iron, show no disturbance at all. If we admit that what we call the spectrum of iron is really formed in our experiments by the superposition of two or more spectra belonging to its constituents, and that on the sun these constituents are for the most part restricted to different regions of widely varying pressure, temperature, and elevation, it becomes easy to see how one set of the lines may be affected without the other" (p. 100-101).

It will be gathered then from these extracts that in Prof. Young's opinion, whatever that opinion may be worth, and we for our part attach great value to it, the new hypothesis does get rid of a good many of the difficulties of the old one, and surely this is the best justification any worker in science can have for suggesting an hypothesis. It is to be noted also that several of the various converging lines of evidence, especially those depending on the changes in spectra, are referred to. It is imagined by some that the new hypothesis breaks down if a line apparently coincident in the spectra of two substances at small dispersion should turn out to be non-coincident when a higher power is employed, while the fact is that the assumption that there should be such coincident lines, if *we can reach a particular temperature*, is based upon one manner of behaviour of compound bodies to the exclusion of another, and on such points as these we are as yet in profound darkness.

The chapter on the sun's light and heat, and the appendix on Prof. Langley's recent work will well repay perusal.

THUDICUM'S ANNALS OF CHEMICAL MEDICINE

Annals of Chemical Medicine. Vols. I. and II. By J. L. W. Thudicum, M.D. (London: Longmans, Green and Co., 1879.)

THOSE who open this work expecting to find it adequately fulfilling the promise of its title will be disappointed. Had they read the initial preface they would have been prepared for this, for it indicates very clearly the intention of the promised series, of which the first two volumes are now published.

Dr. Thudicum is well known as the author of numerous researches in Animal Chemistry, which are chiefly remarkable for the large number of new bodies described in them, and the somewhat fantastic names he has assigned to these bodies. Somehow or other the results of these researches have not met with that general acceptance which their author desires; indeed they have in many cases been either to a great extent passed over or else their value called into question by those who have repeated his experiments or worked at the same parts of the subject. This is clearly recognised by the author in the preface to the first volume, and has accordingly led him, on the assumption that one cause, among others, of this neglect is the scattered nature of his publications, to commence republishing his researches in a "consolidated" form with the addition of new work. Whether this will in future prevent the neglect under which the author feels he has laboured remains to be seen; that he himself so far is satisfied with the results following the appearance of the first volume is evident from the preface to the second.

The only original matter in these volumes other than that of the author consists of one short note by the author's son, so that there has apparently been no response to the invitation to contribute to these "Annals" which was issued with the first volume.

The larger part of each volume is made up of a series of summaries of work which has been done in various branches of Physiological Chemistry; these contain a good deal of information of a fragmentary kind, but can scarcely be regarded as adequately presenting to the reader the present state of opinion on the subjects of which they treat. This is especially the case in the summaries contained in the second volume. "Visual-purple" receives very rough treatment in Article III.; the account of researches on the source of urea in the body is anything but complete, and the same may be said of Article XVIII., on fibrin and its precursors. It is, however, only fair to say that many of the summaries are much less open to objection.

The preface to the first volume contains a charge of malevolent and ignorant opposition to the author's work, which reaches its full development in his concluding remarks to Article XIX., on the existence of Protagon; in these he accuses those whose work is opposed to his own, not only of incompetence, but of what is best known as "cooking"; he speaks of them as obtaining "extracts of uniform composition" "by the aid of processes nearly akin to trimming." The reference is obvious. Similarly in the second volume, Article XVI., "Modern Text-Books as Impediments to the Progress of Animal Chemistry," consists of a review of Prof. Gamgee's "Text-Book of Physiological Chemistry," in which this work is characterised as "humiliating to scientific literature." Comment on this article may safely be left to the individual judgment of those who take the trouble to read it. It may, however, not be out of place to suggest here that a continuance of this tone in future volumes towards those whose work is at variance with the author's, will undoubtedly do much to alienate from him any sympathy with the "Annals" which physiologists might otherwise have been inclined to extend to them.

OUR BOOK SHELF

Kufra. Reise von Tripolis nach der Oase Kufra. By Gerhard Rohlfs. With Eleven Drawings and Three Maps. (Leipzig: F. A. Brockhaus, 1881.)

THIS new volume of travels by Dr. Gerhard Rohlfs is a valuable contribution to a knowledge of the southern parts of the Vilayet of Tripolis and of the Lybian Desert. In December 1878, Herr Rohlfs, accompanied by Dr. Stecker, started from Tripoli, and soon reached the interesting oasis of Djofra, or Sokna, already known from the travels of many Europeans. Thence he proceeded east-south-east to Aujila, crossing the formerly quite unknown tracts of the sandy and stony deserts situated at the north-eastern foot of the Black Mountains. He reached the green and pretty oasis of Sella, which is one of the richest of the Eastern Sahara, and has no less than 100,000 palm-trees, and large flocks of camels. Going further east to Abu-Naim, Herr Rohlfs did not follow the usual route, but, avoiding encounters with robbers, he made a great bend towards the south, having thus the opportunity of visiting the hilly tracts of the spurs of the Harauj-assod Mountains, watered during the rainy season by numerous Wadi. On March 24, 1879, he reached the small but wealthy Abu-Naim, whose numerous fossils, as well as foraminifera scattered in its sands, will probably attract the attention of future explorers, Herr Rohlfs' collection having been plundered by robbers. A few days later he was in Aujila, which he already had visited in 1869. But his further advance being checked by the fanaticism of the inhabitants, he was compelled to send Dr. Stecker, and one month later to go himself to Bengasi, on the Mediterranean coast, to obtain there some protection for his journey to Kufra. It was only in July that he was enabled to return to Aujila, and to start for Kufra, 350 kilometres distant due south of Aujila. The oasis, situated between 26° and 24° N. lat., and 21° to 24° E. long., is elevated 250 to 400 metres above the sea-level, and is far larger than it was expected, as it covers 17,818 square kilometres. It must have been once a great salt lake, and even now it is covered with brackish marshes, and has a small lake; but sweet water is found everywhere in this oasis at a small depth, and throughout its length and breadth it is covered with vegetation. From Kufra Herr Rohlfs returned to Bengasi, after his caravan had been plundered by the inhabitants.

The work contains interesting observations on the sinking of the North African coast, and gives a good description of the physico-geographical conditions of the Eastern Sahara. There are illustrations and a map of the region visited, and more detailed maps of Djofra and Kufra. In the second part of the book we find a list of new routes in Tripolitania; a list of temperatures of wells, observed by Dr. Stecker; a paper on altitudes and on meteorological observations by Dr. Hann; papers on the Amphibia and Arthropoda collected by the Expedition, by Dr. Karsch; and an elaborate paper, by Dr. Ascherson, on the plants collected during the last seventy years in Central Africa—the catalogue of Dr. Ascherson mentions 437 plants from Tripolitania, 200 from Fezzan, 48 from the Aujila oases, and 493 from Cyrenaica.

Tables of Qualitative Analysis. By H. G. Madan. (Clarendon Press, Oxford, 1881.)

IT is surely high time that students of chemistry were taught qualitative analysis by some other method than by following a very complicated table of analysis. That very important stage of chemical learning, qualitative analysis, would be much more thoroughly mastered if the student were well exercised in the reactions of the elementary substances, and then led to construct methods of separation himself. He would by this means become independent of tables and books in the laboratory. Students who are accustomed to work with, or follow, a table, often lose much time in finding where they are working on the table, and get on the "left side" of the group when they should be on the other. The tables before us would doubtless be useful to an advanced student, but appear certainly very complicated to be put into the hands of a beginner. No notice is taken of the so-called rare elements, but a good table of solubilities is supplied—a part of an analysis book that students might benefit by consulting a little oftener than is usually the case. Although produced in the usual good style of the Clarendon Press, a somewhat smaller form would perhaps be more convenient for use on the laboratory benches.

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.*]

Tidal Evolution and Geology

IT appears to me that the difference of opinion between Mr. George Darwin and his interpreter, Dr. Ball, is very small. Dr. Ball is careful to confine his large tides to the Eozoic rocks, and has not asserted their efficacy in Carboniferous times.

The Laurentian rocks form nearly 19 per cent. of the total known thickness of strata of all ages, and occur at the bottom of all; but we must ascend through nearly 66 per cent. of the total thickness before we reach the lowest bed of the Carboniferous period; and it is plain that Mr. Darwin's large tides may have existed (as Dr. Ball suggests) in the Eozoic period, and have become much smaller before the Carboniferous period began.

The real importance, in my opinion, of a large tide considered as a geological agent, depends upon its rise and fall, and not upon its ebb and flow. The waves of the sea, agitated by the wind, make the ocean surface a vast planing-machine, acting upon the coast-lines; and a great range of tide applies this planing-engine either twice or four times a day to every part of the coast laid bare by the rise and fall of tide. The effects must have been very serious when the day was six or eight hours long.

The claim for priority made on behalf of Kant, by the metaphysicians, must be set aside, as Kant's statement was not based on sound dynamical principles. SAMUEL HAUGHTON

Trinity College, Dublin, January 17

I WAS much interested in reading Prof. Ball's lecture in NATURE, vol. xxv. p. 79, but failed to understand the following passage on p. 81:—"*The reaction of the earth tends to increase that distance*, and to force the moon to revolve in an orbit which is continually getting larger and larger." In what sense does the reaction of the earth tend to "drive away" the moon? Will the Royal Astronomer of Ireland, or some other friend of science, be so kind as to add a few words of explanation? J. R. B.

The Remarkable White Spot on Jupiter

EARLY in the present month this singular object became obscured, so that on January 1 I could scarcely distinguish it at all, and on the 3rd, 5th, and 6th it was noted as extremely faint. The origin of the spot's disappearance was obvious. A dark mass on the north border of the great south belt (and therefore in the same latitude as the white spot) appeared on December 14; it followed the white spot 1h. 4m., according to observations by Mr. A. S. Williams at Brighton. The dark spot moved with more rapidity than the latter, and soon overtook it, so that as the former swept over it, its disappearance was complete. On January 6 the white spot was seen struggling through the south-east limits of the dark patch. On January 7 it had further freed itself, and I saw it much plainer, though it still continued somewhat faint. On January 9 it was bright, and evidently on the point of regaining its normal brilliancy. The dark patch referred to is obviously of the same character as the train of black spots visible on one of the northern belts last winter; they move with even greater velocity than the white spot, and are somewhat evanescent as regards duration. They appear to be excrescences from the surface of Jupiter, and as they near the outer envelopes, are dispersed into longitudinal bands; in fact, it is these dark spots which sustain the decided tone of the belts, for the latter show a disposition to become fainter, until reinforced by the commingling of these dark eruptions.

As to the brilliant white spot, it is an object of notable permanency; and though it failed to come generally under notice until October, 1880, it had probably been a conspicuous marking on Jupiter during the few preceding years. Certainly in 1879 it was very bright, and several times observed by Dr. F. Terby at Louvain, and Mr. J. Gledhill of Mr. Crossley's observatory, Halifax. I computed back the dates of its conjunctions with the red spot, and found the following nights in 1879-80 when it might have been well observed:—

1879, September 1	1879, November 29
,, October 16	1880, January 13

The date of November 29 is amply confirmed both by Dr. Terby and Mr. Gledhill as follows:—

1879, November 27, 5h. 40m., a brilliant white spot ("Tache brilliante et blanche") slightly east of the *f.* end of the red spot. —Terby.

1879, November 29, 6h. 30m., a bright gap into north border of the great south belt. It is situated about a quarter the distance from the middle to the *p.* end of red spot.—Gledhill.

In two days the white spot traverses an extent of longitude equivalent to half the length of the red spot, so that the above observations are quite consistent, and there can be no doubt that they relate to the curious object at present visible. Mr. Gledhill's drawing of November 29 shows the spot to be some twelve hours past conjunction with the red, so that the phenomenon probably occurred on the *morning* of November 29, which is not far from the computed time. The ensuing conjunction on January 13, 1880, is confirmed by Dr. Terby. On January 11, 6h. 16s., he saw a brilliant white spot occupying the same longitude as the *f* end of the red, which is exactly the computed place, and there can be little doubt that these white spots are identical with each other and with the white spot of to-day.

Mr. Gledhill's drawings supply other interesting facts. Thus at 6h. 45m. both on November 13 and December 8, 1879, there was a brilliant white spot or gap (in the north side of the great southern belt) about ½h. past the central meridian. These observations again conform to the positions of the present spot, which in the interval between the two dates mentioned had performed sixty-one rotations. It is curious that at periods of twenty-five days (equal November 13 – December 8 as above) the transits of the white spot recur at very nearly similar times. Mr. Gledhill's observed conjunction of November 29, 1879, compared with my own similar observations on December 24 last year proves that the white spot had completed seventeen revolutions of Jupiter in the 756 days!

If possible it is important to trace still further back the apparitions of the white spot. The special brilliancy of this object and its unique position indenting the north side of the southern belt, could hardly escape notice unless indeed the spot was temporarily obscured, as it sometimes is, when the dark patches sweep over it. This brilliant spot should have been nearly in the same longitude as the red spot on the following dates in the last half of 1878:—

July 29	October 26
September 11	December 10

Can observers furnish any additional links in the previous history of this wonderful object? W. F. DENNING

Ashley down Bristol, January 10

Fossil Insects of the Dakota Group

THERE are till now, as far as I know, no fossil insects out of the Dakota group published. Among a large number of fossils belonging to this group, and collected by Mr. Chas. H. Sternberg, some of the leaves show insect galls and mines, the latter mostly of a decided Tineid and Tortricid character. Perhaps a list of those plants may be of interest. The determination of the plants is by Mr. L. Lesquereux[1]:—*Aspidiophyllum trilobatum*, 6 specimens; *Sassafras cretaceum*, 1; *Araliopsis grossedentata*, 4; *A. cretaceum*, 2; *A. mirabile*, 4; *A. acutiloba*, 1; *A. Haskenanum*, 1; *Ficus primordialis*, 1. Mr. Sternberg informs me that this is only a partial list of his fossil plants, which were all collected in Central Kansas. Among the plants figured in the Cretaceous flora by Mr. L. Lesquereux (Hayden's "Survey," vol. vi.), I find on the following plants insect mines or galls:—*Menispermites obtusiloba*, *Greviopsis Heydenii*, *Protophyllum Sternbergii*, *Platanus recurvata* and *Heerii*, *Liquidambar integrifolium*. All from Kansas or Nebraska. Mr. F. B. Meek ("Cretaceous Invertebrata" in Hayden's Rep., vol. ix. p. xliv.) says: "The evidence respecting the exact part of the European Cretaceous series to which the Dakota group belongs

[1] I am informnd by Mr. Lesquereux that a large number of Magnolia leaves from the Tertiary of Alaska show serpentine trails not larger than a thread running all over the leaves, apparently under the epithelium.

is not entirely satisfactory. . . . The modern affinities of the numerous leaves of the higher types of dicotyledonous trees found in it, present a strong objection to the adoption of the conclusion that it may belong to a lower horizon than the Upper Greensand of British geologists; while its position directly below beds almost beyond doubt representing the Lower or Gray Chalk, precludes its reference to any higher stratigraphical position. Consequently, we have long regarded it as most probably representing in part, if not the whole, the Upper Greensand. . . ." As the fossils above mentioned belong to the Museum of Comparative Zoology, I hope to be able to give more detailed information upon these galls and mines.

Cambridge, Mass., January 3 H. A. HAGEN

On Combining Colour-Disks

THE paper of Lord Rayleigh in NATURE (vol. xxv. p. 64) describing experiments on colour, gives near the close a method of observing the image of colour-disks seen through an inverting prism in rapid rotation, while the disks were at rest. This recalls to mind a method somewhat similar that I have tried, that will sometimes be found convenient as well as simple: Here the image of the stationary disks is formed in a plane mirror slightly inclined to the axis around which it rotates; by properly proportioning the angle of inclination, the distances from the mirror to the eye and disks, and the sizes of the mirror and disk, it is obvious that a good combination of the colours may be effected, while the adjustment of colours is easily effected without stopping the rotation. If, as with my instrument, the clockwork is not heavy enough to give easily the desired speed when the disks are mounted on it, a much higher speed can be obtained with the light mirror: indeed, the mirror might be attached to the end of a wire resting on two supports, and rotated by unwinding a string, and thus colour combinations could be simply effected, and with cheap apparatus. Of course here, as with the inverting prism, the line of vision is inconveniently limited; but with both methods the uncertainty arising from unequal illumination of different parts of the disk may be detected by giving to the disk a slow rotation on its own plane.

CHARLES K. WEAD

University of Michigan, Ann Arbor, U.S.A., December 31, 1881

Sound-Producing Ants

WITH reference to the question whether ants produce sounds which are of such a pitch as to be inaudible to the human ear, I should like to make a suggestion which occurs to me, but which I have no means of carrying out practically. It is a well-known acoustical fact that two notes of high pitch sounding together produce a third whose vibrational number is the difference of the vibrational numbers of the two primary notes. If now we suppose a vibration at the rate of (say) 60,000 per second, another at the rate of 38,000 per second would give a difference note of 22,000 per second, which would be well within the range of audibility. If then we send up a note beyond the extreme limit of audibility, we shall be able to detect the presence of vibrations which exceed that of the note sent up by the highest number of vibrations of audible sound. It would be interesting to know if this has been attempted, and if the microphone can be applied to assist in the investigations.

Hirwain, Aberdare, January 10 D. M. LEWIS

Nepotism?

PLEASE, Mr. Editor, is a pet baboon (NATURE, vol. xxv. p. 217) more interesting than either a pet sparrow or a pet canary bird? Don't give rise to the suspicion that there is any nepotism in the affair!

JOHN H. VAN LENNEP

Zeist, January 10

INDIAN FOSSILS.—Mr. J. W. Oliver informs us that at the Birmingham and Midland Institute there is a small collection of Siwalik fossils which, he understands, were sent some years ago from the British Museum. Prof. Prestwich writes that there is a very large and fine collection in the Oxford University Museum, presented by Dr. Falconer and Sir Proby Cantling. Prof. Prestwich will be happy to give Mr. Lydekker every facility for the examination of the specimens.

COMPRESSED AIR UPON TRAMWAYS

FEW persons unconnected with the practical working of the companies are aware of the great amount of time, labour, and money which have been devoted to the substitution of mechanical for horse-power upon tramways both in this country and abroad. The principal incentive to this exertion has been the large margin of saving which has presented itself in the light of a premium to inventors and capitalists. Motives of humanity towards the horses have also had considerable influence, especially with Parliament, and have contributed in no small degree to the legislative sanctions which have been obtained not only by particular companies, but by the tramway interest in general. In no case however that the writer is aware of, have the tramway companies themselves made any material contributions towards the solution of the problems involved. When the story of the subject comes to be written it will be found full of arguments in favour of the principle that the monopoly granted to inventors by the patent laws is nothing more than a clumsy method of spurring them to exertion, and of providing a remuneration for success which never covers the aggregate losses of failure by which the whole community have been indirectly benefited.

The fact of the horse-tramway companies having refused to assist inventors with money is fully accounted for and rendered excusable not only because they have no funds placed at their disposal by their articles of association for such a purpose, but also because the investment would have been far too speculative to have been sanctioned by the shareholders. Where the companies appear to the writer to have been at fault is that while the margin of saving as between a successful invention and horse-traction is admitted to be enormous, because the invention could hardly be said to be successful unless the margin was a large one, they have never admitted either individually or collectively that some substantial share of the saving should be the reward of the successful inventor. The writer has no hesitation in saying that if the leading companies had put the issue clearly before the inventive capacity of the engineering profession in the shape of an offer of say 30 per cent. of the actual saving in the shape of royalty to the inventor that the problem would have been solved at least six years ago. The far-stretching results of such a revolution, even within the comparatively confined area of the tramway interest, would be incalculable. Not to speak of the emancipation of the horses, the employment of capital in channels so consistent with the spirit of the age and the genius of the country as the manufacture of machinery would have economic results affecting the welfare of whole classes of the community, and the impetus given to the intramural locomotion of our large cities would go far to overcome the pressure of difficulties affecting the housing of the poor, which contribute more to the unrest of the people and the propagation of socialistic ideas than the wealthier classes are aware of. The policy of the tramway companies, however, appears to have assumed the character of a fixed determination to give nothing in return for the advantages which would accrue to them from the adoption of a successful mechanical substitute for horses. So long as they maintain this attitude the problem is likely to remain unsolved. Licensees of inventors have followed their example, and at least one case is known to the writer in which a gross breach of agreement has debarred the adoption of an invention which is notoriously efficient. Time no doubt will expose the guilty parties, and their names, instead of being honourably associated with the advance and improvement of mechanical science, will be handed down to posterity with the contempt which they deserve.

A description and illustration have already been given in these pages of a system of tramway traction by means of electricity, and this is no doubt safe in the hands of the distinguished specialists who have taken it up. In the paper which the writer read recently before the Institute of Mechanical Engineers at Manchester, and which has already been reproduced in the engineering journals (see *Engineering*, vol. xxxii., No. 829), a sufficient explanation of his views was given upon the merits of the use of steam locomotives upon tramways compared with compressed air. The objections to steam were based principally upon its failure to comply with the necessary conditions of street traction in the matter of freedom from smell and dirt, and also on account of the excessive cost incurred by the maintenance of small high-pressure boilers and machinery. No such objections can be urged against the use of compressed air, as compared with electricity, because in both cases there is nothing to give trouble or annoyance from the residual products. In the one case the air escapes in its original purity to the atmosphere from whence it was derived, and in the other a still more subtle transference of force occurs, in which the conversion of one form of energy into another is all that takes place in order to effect the object aimed at. The overhead wire, in the Siemens system, which is the stage at which the invention at present stands, is a disadvantage as compared with a self-moving car in which no such obstruction is necessary to its working. Overlooking this objection to the rival system which may possibly be overcome by the use of accumulation of electric force in the vehicle itself, the point upon which the success of both must ultimately turn is that of their comparative economy. At present there are no figures to hand that can satisfactorily decide the question. In both cases a stationary engine is a necessary adjunct in order to supply a source of energy, and the future of both hinges (1) upon the comparative cost of the plant, and (2) upon the percentage of useful work which can be obtained from the use of compressed air and electricity respectively. These questions can only be answered by the trial of both upon a commercial scale, but it may safely be said in the meantime that there is nothing to lead to the conclusion that compressed air will appear to a disadvantage either as regards the necessary outlay in machinery or in the percentage of useful work to be obtained from it as compared with electricity.

The conditions which effect the useful effort exerted by a steam-engine through the intervening medium of a permanent elastic fluid such as air, employed as the ultimate vehicle of the original force upon a piece of mechanism, are first the loss from friction of the compressing apparatus; second, the loss represented by the difference between the temperature of the air as freshly compressed without radiation, and the temperature of the air as used in the second engine. These may be spoken of as the primary losses of energy. The secondary losses are: first, the friction of the secondary engine; and secondly, the losses arising from its inability to utilise the whole of the force contained in the air as compressed and cooled. Now the theoretical losses arising from these various causes are all easily determined, with the exception of that arising from the defects of the secondary engine, and this, which amounts to more than all the rest put together, not only varies in each separate case, but may be fairly looked upon as being capable of indefinite reduction by discoveries and improvements in the apparatus itself.

With regard to the fixed losses: the one which occurs from the loss of heat due to compression and subsequent cooling is one that can be restored under circumstances of peculiar economy, as there is perhaps no condition in the whole range of physics which lends itself so readily to the economical conversion of heat into work as raising the temperature of an elastic fluid under compression and making use of it at a corresponding pressure. It must be remembered, however, that what we are dealing with in practice is not so much the saving of every heat unit of the original supply for the purpose of producing a theoretical result and a beautiful experiment, as bringing the gross expense of the fuel used in the original steam-boiler to a point that leaves a sufficient margin as compared with horse traction, and in such a manner as not to interfere with the convenience of passengers. The writer has already in actual practice brought this gross sum per mile for fuel to $\frac{1}{2}$*d.* when coal is used costing 10*s.* a ton, a common enough price in districts where tramways are in use. Now in attempting to reduce the cost of fuel to a smaller fraction of a penny than $\frac{1}{2}$*d.* per mile run, it occurred to him that the effort should be made first in the direction in which the greatest loss occurred. This is certainly to be found in the defects of the secondary engine if an ordinary reciprocating steam-engine is employed, and an explanation of the writer's work in adapting it to the use of compressed air will be found in the paper already referred to. The result of his experience has gone to show that it is hopeless to obtain an economical result from reciprocating engines as at present arranged for the use of steam, without some special appliances such as he has adopted for making use of the ever-varying rates of expansion necessary in the case of a self-moving car. By reason of the additional apparatus required for re-heating the air resulting in grave inconvenience, and effecting an economy of perhaps not more than one-fifteenth of a penny per mile in fuel, he has not as yet included a heating appliance in the arrangements, and strong arguments would require to be brought to bear upon him before he determined upon doing so. The importance of introducing a heating apparatus would turn more upon what might by gained by adding to the capacity of a self-moving air-car with the view of making it capable of overtaking a particular journey for which the cold air was insufficient, than upon a mere question of economy, but even in this case he believes it would be more convenient and economical to add to the quantity and pressure of the air in the receivers than to make use of a separate heating appliance to obtain the same result.

Compressed air as a locomotive power is represented by three different systems, known respectively by the names of their inventors. All of them are more or less protected by patents, and taking the dates of the patent specifications as the standard of priority, the writer's stands first upon the list. The other two are known as Mékarski's and Beaumont's. The writer is the only one of the three who has made public in this country, otherwise than by patent specifications, the scientific work which he has overtaken, and the exact principles upon which his engines have been constructed. Before Col. Beaumont took out a patent at all he had driven in the writer's car and examined it, but as he has departed from his original specification the writer has had no means of comparing the efficiency of the engines, as recently constructed, with his own. On the occasion of his reading the paper at Manchester already referred to, a letter from Col. Beaumont was read by M. Bergeron, in which it was stated that the engine now running at Stratford used 10 cubic feet of air per mile at 1000 lbs. pressure per square inch, or 666 cubic feet at atmospheric pressure. This efficiency is more than 50 per cent. less than the writer's car, without allowing for the loss of power arising from the use of a heating apparatus, and the higher initial pressure of 66 as compared with 26 atmospheres to begin with. If this statement is correct the writer's views with regard to a moderate pressure and avoiding the use of a heating apparatus, except when absolutely necessary, are fully confirmed.

A heating apparatus, and reducing the initial pressure of the air by means of what is known as a reducing valve, are essential elements of the Mékarski system, but the engine would require to be considerably modified before it could comply with the requirements of the Board of Trade in this country.

The experiments which are now being made by the

Beaumont Compressed Air Engine Company at Stratford with a separate engine, hauling an ordinary passenger car behind it are likely to bring the question prominently before the notice of tramway companies, and the hopeful remarks made before the last meeting of the British Association by Sir Frederick Bramwell, with regard to the use of compressed air, must have contributed towards the same result. The experience of the writer, who has been longer at work on the subject than either of the representatives of the systems referred to is, however, so much opposed to their proposals, that he does not feel himself to be an altogether unbiased critic of their proceedings. It is sincerely to be hoped, for the sake of suffering horseflesh, and in order to promote the expansion of intramural locomotion throughout the country, that a fair trial may soon be given to the rival systems, including electricity. This, however, is but a remote contingency if tramway companies continue to adhere to the principle, or rather no principle, that they have to get everything, and the men who add to their dividends nothing, for their pains. The writer's car, which can be seen at work by any one interested, is entirely self-contained, and offers absolutely no obstructions to the convenience of passengers, and it carries forty of them a distance of more then seven miles with a low and safe pressure of air in the receivers, and without replenishing the supply. The distance it would travel with the pressure used in Col. Beaumont's engine is over twenty miles with one charge of air. The weight complete, including the fittings for passengers, is less than that of any compressed air tramway engine which the writer knows of, hauling a tramway car behind it.

W. D. SCOTT MONCRIEFF

SEA FROTH

I HAVE just read with interest Dr. Gladstone's article in NATURE (vol. xxv. p. 33) on "Sea Froth." I venture to inclose, as an illustration of his nephew's observations, portion of a description of such froth as witnessed by myself during a Mauritius hurricane, extracted from a book I am now publishing. It will be noticed how that close observer of nature, Bernardin de St. Pierre, depicted the same a century since in the same locality.

"This remnant of wreck had been washed bodily out of the deep water to within the outer barrier of reef on to a ledge, and was wholly out of the water, which position thus saved it from entire destruction, as only a portion of the enormous waves, which broke along the entire reef for miles, actually struck the remaining moiety, for the vessel had broken in two, and the stern-half had entirely been destroyed by the prodigious force of the breakers, the sound of which oceanic passion rose high above the din of the nearer dashing waves. Without the reef, sea and sky, ocean and air, were commingled, indistinguishable, 'a complete annihilation of the limit between sea and air.' Within the reef, the shallower sea presented a most wonderful sight, such as few can describe; it was what Bernardin de St. Pierre, nearly a century since, termed [1] '*Une vaste nappe d'écumes blanches creusés de vagues noires et profondes*'; and what Victor Hugo, in his 'Travailleurs de la Mer,' has aptly described in European waters as '*d'eau de savon*,' [2] a sea of soapsuds and lather, the lather flying in snowy flakes like thistle-down.

"[Both the above authors, incomparable in their respective lines, have, it will be observed, used somewhat similar imagery, which is sufficient proof of its fidelity to realistic facts. I have only seen one painter's drawing which has at all even faintly attempted to copy these soapsuds of the sea, '*L'énorme écume échevelait toutes les roches*,' and that only on a small scale, viz. Mr. Frank Miles' study of a curling wave before it breaks on 'An Ocean Coast: Llangravieg, Cardiganshire' (No. 342), in Gallery No. IV. of last year's Academy.[1] The rendering of the blotches of foam,[2] which curdle on the hollow curved side and translucent crest of the breaking wave, are praiseworthy in their transcription, although their perspective has been blamed by some critics. ('*L'écume ressemblait à la salive d'un léviathan.*' Mr. Miles ought to have given to his drawing the lines from Keats, quoted by Ruskin as the *perfect* expression of the peculiar action with which foam rolls down a long wave:

> "'Down whose green back the short-lived foam, all hoar,
> Bursts gradual with a wayward indolence.'

I cannot forbear giving Ruskin's imagery, as bearing out the above similes:—"The water from its prolonged agitation is beaten not into mere creaming foam, but into masses of accumulated yeast, which hang in ropes and wreaths from wave to wave, and where one curls over to break, form a festoon like a drapery from its edge; these are taken up by the wind, not in dissipating dust, but boldly in writhing, hanging, coiling masses, which make the air white and thick as with snow, only the flakes are a foot or two long each: the surges themselves are full of foam in their very bodies, underneath, making them white all through, as the water is under a great cataract; and their masses, being thus half water and half air, are torn to pieces by the wind whenever they rise, and carried away in roaring smoke, which chokes and strangles like actual water.' See 'Of Truth of Water' ('Modern Painters,' vol. i. part 2, sec. v. Chap. III. p. 375."

S. P. OLIVER

[1] The description given by Bernardin de St. Pierre of the view from the seashore on the north-east side of Mauritius is so true, and so evidently sketched from nature, that it will ever bear repetition. "Chaque lame qui venait se briser sur la côte s'avançait en mugissant jusqu'au fond des anses, et y jetait des galets à plus de cinquante pieds dans les terres; puis venant à se retirer, elle découvrait une grande partie du lit du rivage, dont elle roulait des cailloux avec un bruit rauque et affreux. La mer, soulevée par le vent grossissait à chaque instant, et tout le canal compris entre cette île et l'île Ambre n'était qu'une vaste nappe d'écumes blanches creusées de vagues noires et profondes. Ces écumes s'amassaient dans le fond des anses, à plus de six pieds de hauteur, et le vent qui en balayait la surface les portait par-dessus l'escarpement du rivage à plus d'une demi-lieue dans les terres. A leurs flocons blancs et innombrables qui étaient chassés horizontalement jusqu'au pied des montagnes, on eût dit d'une neige qui sortait de la mer."—"Paul et Virginie" (Ed. 1879, Hachette).

[2] "La mer à perte de vue était blanche; dix lieues d'eau de savon emplissaient l'horizon."

[1] An exhibition of paintings and drawings of "The Sea" is announced this winter, as to be held in the Gallery of the Fine Art Society, 148, New Bond Street.

[2] "Les flocons d'écume, volant de toutes partes, ressemblaient à de la laine."

ON THE HEIGHTS OF THE RIVERS NILE AND THAMES

COLONEL DONNELLY has put into my hands information from which the following results have been obtained:—

The information regarding the Nile has been derived from General Stone (Pacha), who has forwarded to the Science and Art Department a graphical representation exhibiting the height of the River Nile above the zero of the Cairo Nilometer for every five days, or six for each month from the beginning of 1849 to the end of 1878.

The information regarding the Thames has been derived from Sir F. W. E. Nicolson, who has forwarded a daily record of the levels on the lower sill of Teddington Lock when the tidal water has all drained off. This record extends from the beginning of 1860 to the end of 1880.

At present it is impossible to deduce from these records the volume of water which passes in unit of time across a section of these rivers: nevertheless the results give us a good deal of information, for we may be sure that an increase in depth denotes an increase in the volume of the water carried by the river and a decrease in depth a diminution of the same.

The results deduced I have embodied in a series of tables. In Table I. the yearly sum represents the whole area above the zero of the Cairo Nilometer of the graphical curve for the year in small squares whose base represents five days, and height one decimetre.

In Table II. we have the dates of maximum height of the Nile, reckoned from the beginning of September as a zero date and the sums of the numbers for two years taken.

In Table III. the numbers record sums for two years of monthly means of the water level at Teddington. reckoned in feet and decimals of a foot; that is to say each number must be divided by 24 in order to get the *mean* of the two years.

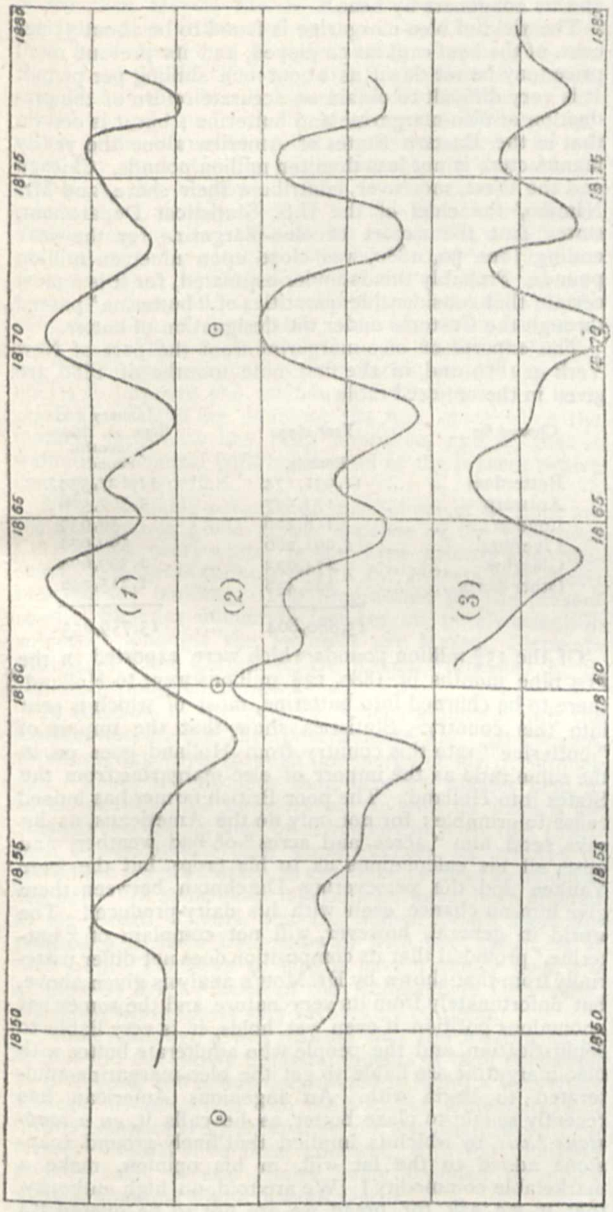


TABLE I.—*Recording the Yearly Heights of the River Nile in the manner already described*

Year.	Height.		Year.	Height.		Year.	Height.
1849	2130	...	1859	1766	...	1869	2284
1850	2080	...	1860	2098	...	1870	2701
1851	2077	...	1861	2368	...	1871	2718
1852	2078	...	1862	2574	...	1872	2404
1853	2434	...	1863	2765	...	1873	2142
1854	2425	...	1864	2475	...	1874	2317
1855	2173	...	1865	2229	...	1875	2463
1856	2141	...	1866	2432	...	1876	2541
1857	2016	...	1867	2208	...	1877	1981
1858	1736	...	1868	2003	...	1878	2290

TABLE II.—*Recording the Dates of Maximum Height of the River Nile in the manner already described*

Year.	Date of max.		Year.	Date of max.		Year.	Date of max.
1849-50	64	...	1859-60	116	...	1869-70	96
1850-51	54	...	1860-61	80	...	1870-71	100
1851-52	63	...	1861-62	84	...	1871-72	79
1852-53	60	...	1862-63	89	...	1872-73	22
1853-54	68	...	1863-64	41	...	1873-74	33
1854-55	48	...	1864-65	33	...	1874-75	88
1855-56	43	...	1865-66	57	...	1875-76	82
1856-57	37	...	1866-67	38	...	1876-77	31
1857-58	10	...	1867-68	11	...	1877-78	40
1858-59	71	...	1868-69	52			

TABLE III.—*Recording the Water Level at Teddington in the manner already described*

Year.	Heights.		Year.	Heights.		Year.	Heights.
1860-61	315·77	...	1867-68	299·58	...	1874-75	292·91
1861-62	306·52	...	1868-69	297·21	...	1875-76	304·68
1862-63	299·83	...	1869-70	292·29	...	1876-77	299·41
1863-64	288·27	...	1870 71	278·77	...	1877-78	288·81
1864-65	294·63	...	1871-72	294·90	...	1878-79	296·32
1865-66	308·67	...	1872-73	306·10	...	1879-80	300·62
1866-67	312·11	...	1873-74	286·82			

A diagram likewise accompanies this, in which the results are graphically represented, curve (1) denoting the results of Table I., curve (2) those of Table II., and curve (3) those of Table III. In this diagram the dates of sunspot maxima are likewise indicated. From an inspection of this diagram we may perhaps deduce the following conclusions:—

1. The curve representing the heights of the River Nile and that representing the dates of maximum height are very like each other, a maximum height corresponding generally to a late date of maximum rise.

2. There is also a considerable likeness between the Nile curve and that for the River Thames.

3. There appears to be a maximum in these curves at or somewhat after the date of maximum sun-spots, but they have more than one maximum for one sun-spot cycle.

It would be extremely interesting if this comparison could be still further extended. BALFOUR STEWART

OLEO-MARGARINE

IT is now doubtless known to most people that much of what by courtesy goes by the name of butter is only very distantly related to the dairy produce which has hitherto enjoyed a prescriptive right to that appellation. If any of our readers were ignorant of this fact, the interesting and instructive statement which the Chairman of Committee, in his capacity as a private member, laid before the House during the last Session will have fully enlightened them on that point, as indeed it enlightened, and seemingly astonished, Honourable Members. During the past ten years a new industry has been created. It came into existence very quietly, and under the taint of illegitimacy, and consequently the world in general knew very little about it. Thanks, however, to the operations of Sanitary Boards, Officers of Health, and Food Analysts, it was eventually dragged out into the light of day, when, despite the circumstance that the greater part of its existence had been spent in out-of-the-way places and without the fostering recognition of authority, it stood revealed as an astonishingly well-grown and highly prosperous business. The industry in the outset was set going to manufacture a product from beef-suet to be used in the adulteration of butter, and enormous quantities of this product were made in this country and in America for this purpose. The fraud was, however, so repeatedly exposed, and convictions against grocers and others selling this adulterated butter were so frequently obtained, that the vendors were driven to so far take the public into their confidence as to declare that the product was "a butter-substitute," and hence arose the euphemism of "butterine," by which it became generally known. Now these remarks are in no sense derogatory to the value of this product as an article of food. We quite agree with Dr. Playfair that "butterine" may be, and frequently is, very much better than many qualities of butter; but this fact cannot be held to defend or extenuate the practice of substituting "butterine" for butter without the knowledge and consent of the purchaser. The common-sense of buyers and sellers has practically settled this point. The manufacture of "butterine" has now reached such extraordinary proportions that we are bound to recognise it as a legitimate industry: the substance is now sold openly for what it is and on its merits, and it is perfectly obvious that it supplies a public demand. A recent report by Mr. Bateman to the Board of Trade, on the manufacture of these "butter substitutes" in the United States, throws fresh light on the subject, and the statistics which the report contains are calculated to afford a very precise idea as to the magnitude of the industry. The greater part of the substance is made in the States by the patented method of M. Mége Mouries. The process is as follows:—The beef suet, on arriving at the factory, is thrown into tanks containing tepid water, and after standing a short time it is repeatedly washed in cold water, and disintegrated and separated from fibre by passing through a "meat-hasher" worked by steam, after which it is forced through a fine sieve. It is then melted by surrounding the tanks with water of a temperature of about 120° F.; great care is taken not to exceed this point, otherwise the fat would begin to decompose and acquire a flavour of tallow. After being well stirred, the adipose membrane subsides to the bottom of the tank, and is separated under the name of "scrap," whilst a clear yellow oil is left above, together with a film of white oily substance. This is removed by skimming, and the yellow oil is drawn off and allowed to solidify. The refined fat, as the substance is now termed, is then taken to the press-room, which is kept at a temperature of about 90° F., and is packed in cotton cloths and placed in galvanised iron plates in a press; on being subjected to pressure oil flows away, and cakes of pure white stearine remain: these find their way to the candle-makers. The oil is known as "oleo-margarine": it is packed in barrels for sale or export, or is directly made into "butterine" by adding 10 per cent. of milk to it, and churning the mixture. The product is coloured with annato and rolled with ice to "set" it; salt is then added, and the "butterine" is ready for packing in kegs. The taste of "butterine" is described as being similar to that of second-class butter, but it is rather more salt; owing to the very small quantity of the characteristic fats of natural butter—the so-called "butyrin," "caprin," &c., which it contains, it lacks the flavour of high-class butter. On the other hand, as these fats are specially liable to become rancid, butterine is free from the disgusting smell and taste of the lowest class butters.

The composition of natural butter and of "butterine" may be stated as follows:—

		Butter.	"Butterine."
Water		11·968	11·203
Solids		88·032	88·797
		100·000	100·000
Insoluble Fats	Olein, Palmitin	23·824	24·893
	Stearin, Arachin, Myristin	51·422	56·298
Soluble Fats	Butyrin, Caprin, Caproin, Caprylin	7·432	1·823
Casein		0·192	0·621
Salt		5·162	5·162
Colouring Matter		trace	trace
		88·032	88·797

It will be seen that in the main "butterine" is very similar in chemical composition to butter, and its value as an article of food is probably quite as high. Indeed to some people "butterine" might possibly be more wholesome, owing to its comparative freedom from the readily decomposable fats which are apt in some cases to be specially disagreeable; for cooking purposes it may be safely averred that the artificial butter would be generally preferable, owing to the ready alteration of butyrin and its congeners by heat.

The yield of oleo-margarine is found to be about 35 per cent. of the beef caul fat employed, and its present retail price may be set down as about one shilling per pound. It is very difficult to obtain an accurate return of the production of oleo-margarine and butterine; but it is certain that in the Eastern States of America alone the yearly manufacture is not less than ten million pounds. Chicago and the West, moreover, contribute their share, and Mr. Nimmo, the chief of the U.S. Statistical Department, states that the export of oleo-margarine for the year ending June 30, 1880, was close upon nineteen million pounds. Probably this is under-estimated, for it is almost certain that considerable quantities of "butterine" passed through the Customs under the designation of butter.

The exports of oleo-margarine from the port of New York in 1879 and in the first nine months of 1880 are given in the annexed table:—

Cleared for	Year 1879. Pounds.	January 1 to Sept. 30, 1880—9 months. Pounds.
Rotterdam	11,931,174	11,127,574
Antwerp	173,537	1,367,526
London	188,426	58,639
Liverpool	1,091,266	590,974
Glasgow	274,023	1,399,694
Other ports	222,438	1,215,246
	13,880,864	15,759,653

Of the 15¾ million pounds which were exported in the first nine months of 1880, 12½ millions went to Holland, there to be churned into butterine, most of which is sent into this country. Statistics show that the import of "butterine" into this country from Holland goes on in the same ratio as the import of oleo-margarine from the States into Holland. The poor British farmer has indeed cause to grumble: for not only do the Americans, as he says, send him "acres and acres" of bad weather, and upset all his calculations as to his crops, but the 'cute Yankee and the persevering Dutchman between them give him no chance even with his dairy-produce! The world in general, however, will not complain of "butterine," provided that its composition does not differ materially from that shown by Dr. Mott's analysis given above, but unfortunately from its very nature and the somewhat anomalous position it even yet holds, it is very liable to sophistication, and the people who adulterate butter with oleo-margarine are liable to get the oleo-margarine adulterated to begin with. An ingenious American has recently sought to place butter, as he calls it, *on a soapstone basis*, by which is implied that finely-ground soapstone added to the fat will, in his opinion, make a marketable commodity! We are told, on high authority, that if we ask for bread we are not to be offered "a stone": neither are we when we ask for butter. T.

SCIENTIFIC EDUCATION IN LIVERPOOL

IN the youngest city of the Empire, which on Saturday witnessed the inauguration, by Lord Derby, of its new university, already endowed with more than a hundred thousand pounds, the public recognition of the practical value of scientific education to the community, commenced only in 1860, when Sir William Brown gave to the town the magnificent pile of buildings forming the Free Library and Museum, which at once received from the late Lord

Derby his fine natural history collection, and the Museum of Archæology and Art, formed with so much care and cost, by Mr. Meyer, of Bebington.

Previous to Sir William Brown's princely gift little seems to have been done to advance education in Liverpool since 1647, when it was entered in the records, "Ordered that two dictionaries be provyed for the use of this towne and to be chayned." In 1861 Sir William Brown stated that the Free Library and Museum would not be complete until it had attached to it a School of Science, which scheme was supported by the then Mayor, Mr. S. R. Graves, and the school was opened in October of that year by Lord Granville, then Lord President of the Council, supported by the Right Hon. W. E. Gladstone and Sir William Fairbairn, president of the British Association for that year. The school was affiliated with the Museum and Library Committee of the Corporation, and at present contains no less than 801 students, the largest number in any science school in the kingdom. Last year it obtained three scholarships at the Normal School of Science, South Kensington, and four Whitworth scholarships, whilst 81 per cent. of the students passed the Government Science Examinations, winning four Queen's medals and 233 Queen's prizes, and a Government Grant of 694*l*. In 1865 a period of depression occurred, which ceased in 1868, when Messrs. S. Leigh-Gregson and T. J. Moore, the indefatigable honorary secretaries, made vigorous efforts to improve the attendance, which was most successfully effected by doubling the fees, since when the marked prosperity has been unbroken, and all that is wanted is a central building instead of the present twelve centres of instruction.

A very valuable outcome of this School of Science are the free lectures, given at the expense of the Liverpool Corporation every winter in the Free Library and Museum, on subjects connected with the objects and specimens in the building. The programme for the present session includes numerous lectures on purely scientific subjects; amongst the lecturers are Messrs. Clements Markham, Lant Carpenter, De Rance, Professors R. S. Ball and Campbell Brown.

In addition to the Science School affiliated with the Corporation are the Liverpool Science and Art Classes, established in 1870, through the energy of Mr. J. Samuelson. There are no less than fifty-one classes held in seven centres; the numbers of students in science are steadily increasing, and by arrangement with the Liverpool School Board their pupil-teachers are allowed to attend the science classes, so as to qualify them for science-teachers. In some cases laboratories have been erected at the Board schools, and the School Board have appointed a Science Demonstrator with two assistants of their own. The boys so taught have recently been examined by Prof. Forbes, of the Andersonian University, Glasgow, who reports very favourably of them.

Three years ago it was realised that the existing institutions did not satisfy the requirements of high education in Liverpool, and it was determined to found a University College, in connection with the Victoria University, and in this comparatively short time no less than seven Professors' Chairs have been endowed, with ten thousand pounds each, several chairs being founded by single donors, amongst whom is Lord Derby.

The Council of the College having no large funds to expend in the erection of imposing buildings, have been fortunate to receive from the City Council a large building standing in its own grounds at Brownlow Hill, a site on the brow of the hill 200 feet above the sea, overlooking the public buildings of Liverpool and the broad channel of the Mersey; in the city, yet removed from its traffic and turmoil. The building was originally erected at a cost of 20,000*l*.; it contains a rectangular centre with two wings; the solidity with which it was built has enabled Mr. Waterhouse to throw down the compartment walls of the wings, and to convert them into two lecture theatres, holding 150 students each, while the body of the buildings form council, professors' and class rooms, whilst other rooms have been fitted up as libraries, natural history, and physical laboratories, and engineering and drawing rooms. There are at present no chemical laboratories, but those of the adjacent medical school being available they are hardly required. The scientific chairs at present filled are those of Physics, Biology and Geology, and Chemistry, held by Professors Lodge, D.Sc., Herdman, D.Sc., F.L.S., and Campbell Brown, F.C.S. respectively. It is to be hoped ere long the wide range of knowledge covered by such sciences as biology, botany, and geology will be separated into at least two chairs, especially as the proximity of the Lancashire and Welsh coalfields render it important that Practical Geology and Mining should find a place amongst the College Chairs.

At the inaugural ceremony on Saturday Lord Derby presided, and showed from the sums that were still coming in that there is likely to be no lack of funds. Among other things he said: "We live in changing times, but democracy appreciates education, and especially appreciates science, and I think the scientific foundation is pretty safe not to be disendowed whatever happens. Let me add only this. Over and above its special educational work our college will do two things. It will be the centre of local patriotism, the means by which local public spirit may freely display itself, and it will give fresh evidence, if evidence is needed, that commerce and culture, so far from being antagonistic, are natural allies. They were so in Athens, they were so in Alexandria, they were so in the Italian Republics of the Middle Ages, and I do not think that a probably busier existence and a certainly smokier atmosphere constitute any reason why they should not be so here likewise."

Prof. Rendall, M.A., in delivering the inaugural address, said:—"The effort inaugurated that day was but one of many, each one wearing, indeed, its distinctive features, but all alike. What meant the simultaneous stir in Birmingham, in Bristol, in Leeds, in Nottingham, in Sheffield? What meant a host of cognate efforts in country towns and in the metropolis, too numerous to recapitulate? What meant the sudden expansion in want of a college whose fate and trial it was to wait long and work obscurely, sustained rather by belief in its mission than by reassurances of success? It was easy to say that the forwardness of founders was out of proportion to the zeal of students. As a matter of fact, founders' munificence has met with quick response, and five times out of six it is lack of funds, not lack of classes, that has hindered progress or even entailed defeat; and for predicting a like conclusion there were ample grounds. For primary education in England efficient provision had been made; of secondary and higher education the supply was sparse and capricious; while academic training remained the monopoly of the privileged and the wealthy. Unless the middle classes looked to it they would shortly find their children starting the race of life less well equipped for the inevitable struggle than those who in wealth and social standing have occupied a lower place."

Certainly the Liverpool College has made a most promising start; and considering the wealth of the city, there is no reason why, in a very short time, it should not be in perfect working order.

BJERKNES' HYDRODYNAMIC EXPERIMENTS

IN NATURE, vol. xxiv. p. 360, were described in general terms the very interesting experimental researches of Prof. Bjerknes, of Christiania, which excited so much attention at the late Electrical Exhibition at Paris. Our readers will remember that the main point in those researches was the imitation of the phenomena of magnetic and electrical attraction and repulsion by analogous attractions and repulsions produced between pulsating or vibrating bodies immersed in liquid. The extreme importance of such experiments in hydrodynamical theory was so well pointed out by Prof. George Forbes in the former article, that nothing need be said here in that respect. The present article is confined to a concise description of the apparatus of M. Bjerknes, and of the results obtained by its means.

Fig. 1 depicts the fundamental piece of apparatus for showing the action between two pulsating drums or tambours, A and B. These tambours consist of metal cups covered with an elastic membrane. Each tambour communicates by a tube with an apparatus by means of which

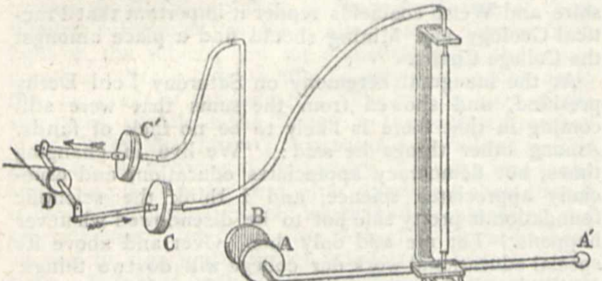


FIG. 1.

the elastic membrane is set in regular pulsation. A pulley, D, driven by a band from a multiplying wheel, works two small cranks whose rotations are converted into rectilinear movements by connecting-rods attached to two other tambours, C and C'; the latter serving as pumps to alternately compress and rarefy the air in the tubes which communicate with A and B. Fig. 2 shows the construction of a single pulsating tambour. When air is compressed into it the membrane is forced outwards as at C, when the pressure is withdrawn the membrane is drawn in as at D. Returning to the particular apparatus of Fig. 1 the result of setting the adjacent tambours in synchronous vibration when the whole apparatus is immersed in water, is as follows. If the tambours are arranged so that the movements are in similar phases

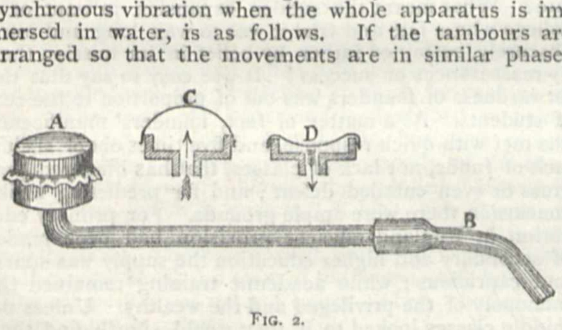


FIG. 2.

they *attract* one another; if in opposite phases they *repel*. This is exactly the inverse of what occurs for magnetic poles or electric charges, where similars repel one another and dissimilars attract one another. The tambour A is mounted upon a lever capable of turning upon a pivot at P, and balanced by a counterpoise at A'. The connection with the pump C is made through a vertical tube of india-rubber which permits of limited rotation about a vertical axis. The tambour B is held in the hand at a convenient distance, just as one may hold in the hand a magnet to show its action upon a balanced compass needle.

A second fundamental piece of apparatus is the oscillating sphere shown in Fig. 3. To a pulsating tambour is fixed a small plate of metal, C, bearing a stiff wire terminated by a small ball, A, and supported by a metal guide. The oscillations executed by such a ball when pulsations of air are directed into the tube D, are of course rectilinear displacements to and fro. Such an oscillating sphere presents at opposite sides opposite phases of displacement. Accordingly if the tube D be connected with the pumping apparatus, and a tambour, such as that just described, communicating with the other pump, be held near the sphere A, it is found that the effects are of two opposite kinds, according to the position of the tambour. The oscillating sphere resembles then a magnet in having two poles of opposite properties. These figures are from sketches furnished some months ago by M. Bjerknes. His apparatus, as shown in the Paris Exhibition, included a more powerful means of producing the pulsations. In Fig. 4, which shows the tank and the collection of small pieces of apparatus, the driving gear of the pumps is not shown; but the pumps themselves are drawn in the lower right-hand corner of the figure, and consist of two small metal cylinders fitted with pistons; the connecting gear being so arranged that their movements can be made at will either in similar or in opposite directions. In the figure the fundamental experiment of the mutual action of two pulsating tambours is being shown. Two pulsating elastic spheres show similar results, but are less easy to manage. Some of the other portions of apparatus comprised in the collection are separately shown in Fig. 5. Of these the first is a double tambour whose two faces execute pulsations of similar phase. The second is a double tambour, the two chambers of which communicate separately with the two

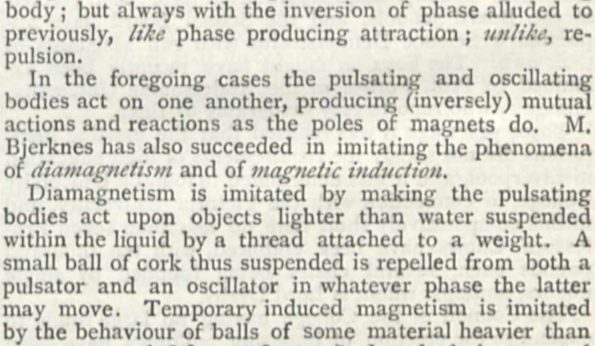


FIG. 3.

pumps, and in which therefore the two membranes execute movements in opposite phases. Thirdly, we have two spheres, of which one (on the left) is mounted so as to execute horizontal oscillations; the other (on the right) to oscillate vertically. It is possible to mount the oscillating spheres, either singly, or in pairs, upon horizontal axes, in which positions they act like mounted compass needles, following the action of another pulsating body; but always with the inversion of phase alluded to previously, *like* phase producing attraction; *unlike*, repulsion.

In the foregoing cases the pulsating and oscillating bodies act on one another, producing (inversely) mutual actions and reactions as the poles of magnets do. M. Bjerknes has also succeeded in imitating the phenomena of *diamagnetism* and of *magnetic induction*.

Diamagnetism is imitated by making the pulsating bodies act upon objects lighter than water suspended within the liquid by a thread attached to a weight. A small ball of cork thus suspended is repelled from both a pulsator and an oscillator in whatever phase the latter may move. Temporary induced magnetism is imitated by the behaviour of balls of some material heavier than water suspended from a float. Such a body is attracted by a vibrating or pulsating body. In the nearest corner of the tank of Fig. 4 are a pair of heavy bodies hung to threads for this very experiment. A little further to the right is shown a support from the top of which is suspended a little cylinder of heavy metal. When the pulsating tambour is held near this it turns round and points towards the tambour as a suspended piece of soft iron does towards a magnet pole. The same support carries a lower arm, from which a thread passes up to a cylinder made lighter than water. This cylinder sets itself broadside to a pulsating tambour, behaving as a piece of bismuth or other diamagnetic body when placed between the poles of an electromagnet. Here the importance of the *medium* in determining by its own density the move-

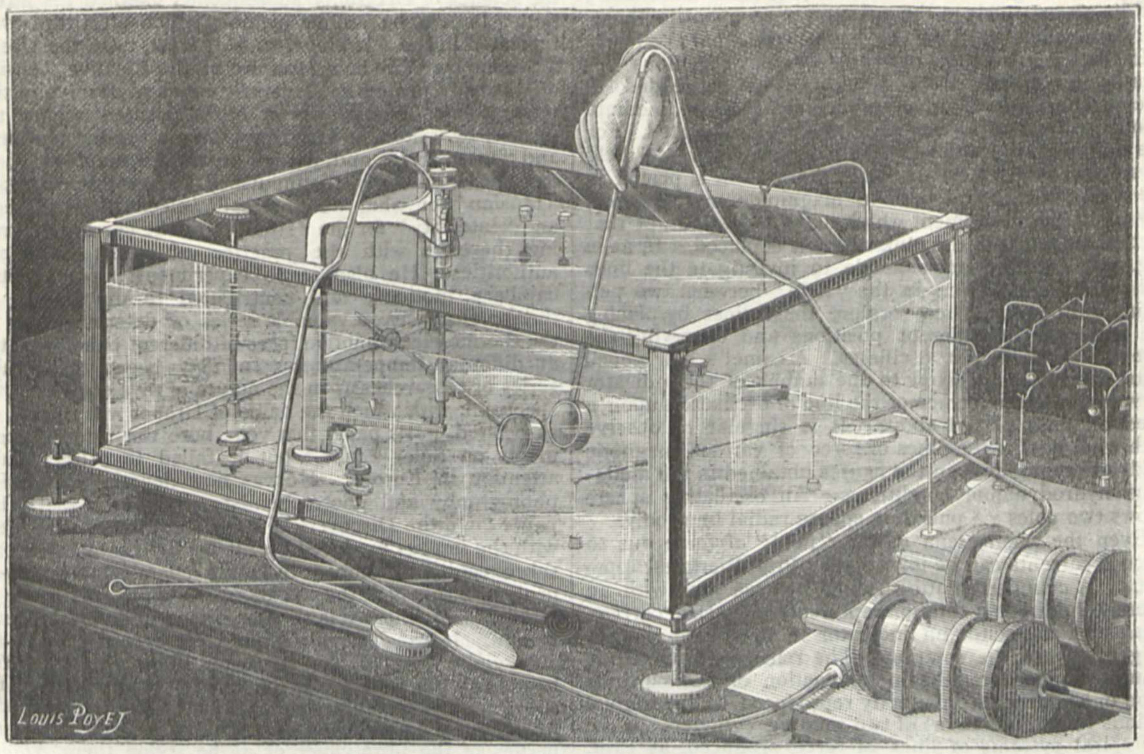


FIG. 4.

ments of the body acted upon, is obvious; and it furnishes an admirable commentary on the views of Faraday and Becquerel on the relation of the magnetic powers of the surrounding medium to the magnetic or diamagnetic properties of bodies.

This particular series of experiments is most instructive;

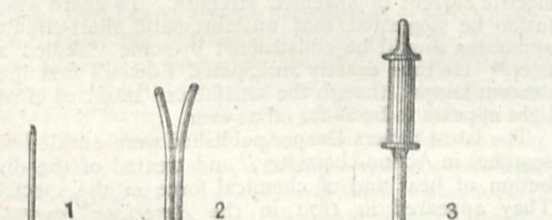


FIG. 5.

and deserves a little further elucidation. If a small heavy ball hung to a float is acted upon by two pulsating tambours whose phases are opposite, it is a question in *which* phase the little ball shall vibrate. Eventually it takes up that of the more powerful pulsation, if they be of unequal power, or of the nearer one if they are unequally distant. The effect is like that on a small suspended bit of iron between two magnet poles of unequal strength, or at unequal distances. Now when a small *heavy* body is set

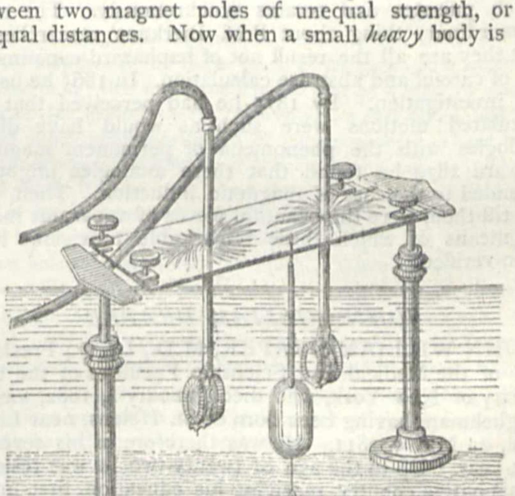


FIG. 6.

pulsating by motions in the surrounding water it moves through a *less* amplitude than the water would have done in its place; for if it receive the same kinetic energy from the medium, its own mass being greater, its velocity will be less; its motions will therefore, relatively to the pulsator that is acting on it be in the same phase, and it will be attracted. On the other hand a body lighter than the surrounding water vibrates with a greater amplitude; and being, relatively to the pulsator, in an opposite phase, will be repelled.

Lastly, we give a drawing of the ingenious indicator by which Prof. Bjerknes has succeeded in tracing the lines of force in the midst of the medium through which such actions as these are propagated. For this purpose a light hollow metal egg-shaped vessel held by a thin flexible steel wire to a heavy foot is placed in the tank. It takes up, both in magnitude *and direction*, any oscillating movement which may be going on at that part of the liquid in the tank where it is placed. If, as in Fig. 6, it is desired, for example, to investigate the lines of hydrodynamic force in the "field" between two pulsating tambours, we may explore these lines by placing the indicator at different positions and observing the direction in which it oscillates. A camel's hair pencil charged with colour fixed to the summit of the indicator serves to inscribe a trace of the line of oscillation upon a sheet of glass placed above. It is singular to observe with what fidelity the lines of force of various magnetic fields are reproduced in the figures obtained in the analogous hydrodynamic conditions. An oscillating sphere shows two poles; a pulsating sphere radial lines only.

Even the phenomena of the "field" of force due to electric currents can be imitated by Prof. Bjerknes' apparatus. A cylinder rotating round its own axis with an alternately directed rotation represents an electric current. Near such an excitor an indicator in the liquid vibrates tangentially to the rotation. The remarkable magnetic figures produced by the mutual action of two currents upon one another are perfectly reproduced by the mutual actions (on an indicator) of two rotating cylinders; while the spiral systems of lines of force produced, as Prof. Silvanus Thompson discovered (see NATURE, vol. xix. p. 83), by the mutual action of a magnet pole and of a current traversing it are exactly reproduced by Prof. Bjerknes' indicator under the influence of an apparatus which pulsates and rotates synchronously. The most extraordinary thing about Prof. Bjerknes' researches is that they are all the result not of haphazard experiment, but of careful and abstruse calculation. In 1865 he began the investigation. By 1875 he had perceived that the calculated motions were such as would have direct analogies with the phenomena of permanent magnets. Toward 1879 he found that these analogies might be extended to the case of magnetic induction. Then, and not till then, were the beautiful pieces of apparatus made, by means of which these remarkable previsions have been verified.

JOHN WILLIAM DRAPER

JOHN WILLIAM DRAPER, M.D., LL.D., President of the Medical and Scientific Faculties of the University of New York, who died January 4, 1882, was an Englishman, having been born at St. Helens, near Liverpool, on May 5, 1811. He was therefore in his seventy-first year. Up to the age of twenty-two he was resident in his native country, receiving his education, first under private tutors, and afterwards studied chemistry in the University College, London, then known as the University of London. In 1832 he emigrated to the States, and continued his studies at the University of Pennsylvania, where, in 1836, he took the degree of M.D. Meantime his talent for original research had manifested itself in the production of several memoirs, which appeared in the pages of the *Journal* of the Franklin Institution. The first of these (published in 1834) was "On the Nature of Capillary Attraction"; whilst a second was devoted to a discussion of the most eligible method of constructing galvanic batteries of four elements. In 1835 he published an account of some experiments made to detect whether light exhibits any magnetic actions. Several branches of the science of electricity subsequently claimed his attention. In 1839 he wrote a memoir, which afterwards was reprinted in the *Philosophical Magazine*, "On the Use of a Secondary Wire as a Measure of the Relative Tension of Electric Currents." It is instructive to observe in this memoir how Draper's exact mind revolted against the misuse, by writers on electricity, of the words "tension" and "intensity"; and, though he himself employed both terms, he carefully distinguished between them, using "tension" for what we now call "electromotive force," and "intensity" for the "strength of the current," agreeing therefore with the practice of many continental authorities. He also made experiments upon electro-capillary motions, and contributed to the science of thermo-electricity, a valuable series of determinations of the thermo-electromotive force of different pairs of metals at different temperatures. In 1837 began the notable series of researches upon the nature of rays of light in the spectrum, with which the name of Draper will always be associated. His paper that year bore the title "Experiments on Solar Light," but it failed to attract much attention in Europe. He was now devoting himself to photography and photo-chemistry with great zeal. His paper "On the Discovery of Latent Light," in 1842, dealt with the images produced by rays of light which are only subsequently developed by some chemical reaction—a process with which the art of photography has made us familiar, but which was then a curious and novel phenomenon. It was Draper who first discovered that in the ultra-violet part of the spectrum there are absorption bands like the Fraunhofer lines in the visible part of the spectrum. To enumerate the works which proceeded from Draper's pen upon the chemical and physical properties of the ultra-violet, or as he styled them, *tithonic* rays, would be inadmissible here. Suffice it to say that the greater part of the fifty memoirs mentioned in the Royal Society's Catalogue related to this subject, and the most important of them are to be found reprinted in his "Scientific Memoirs," published in 1878. In this volume may be found the pregnant suggestion for a standard of white light for photometry of a piece of platinum foil of given size and thickness, raised to a white heat by an electric current of specified strength. To guard against fusion he suggested that an automatic short-circuiting apparatus should be constructed by some "skilled artificer." He thus exactly anticipated Edison's first incandescent lamps: though the satisfactory standard of white light appears to be as far off as ever.

The latest papers Draper published were entitled "Researches in Actino-chemistry," and treated of the distribution of heat and of chemical force in the spectrum. They appeared in 1872 in the *American Journal of Science* and in the *Philosophical Magazine*. During these years of work Draper held important appointments, first in Hampden-Sidney College, Virginia, where he was Professor of Chemistry, Natural Philosophy, and Physiology, and afterwards (1839) in the University of New York, where he was Professor of Chemistry and Natural History, a post modified two years later into that of Professor of Chemistry in the Medical College of the University. In addition to the original memoirs enumerated above Dr. Draper wrote several valued text-books of science; a Text-book of Chemistry in 1846, and a Human Physiology in 1856, both of which works went through several editions.

Dr. Draper's literary activity manifested itself however in other directions, and he has left an enduring mark in literature as a philosophic historian of no mean merit. The "History of the Intellectual Development of Europe," published in 1862, has been translated into all the current languages of European nations. His "History of the American Civil War," a work which appeared between the years 1867 and 1870, when the bitter animosities of the strife were still raging, is distinguished by an impartiality of tone and a philosophic elevation remarkable in a historian, and trebly remarkable in one who wrote in times so little remote from the stirring events recorded. In 1874 Dr. Draper published a "History of the Conflict between Science and Religion," a work which attracted some notice, and for which a preface was written by Prof. Tyndall to introduce the work to English readers. Though unequal to the preceding works in merit, and marred by assumptions that detract from its value, it nevertheless showed great vigour of intellect and philosophic power.

Dr. Draper leaves two sons, both of whom are known to science: Prof. John Christopher Draper, whose works on Physiology are well known on both sides of the Atlantic, and Prof. Henry Draper, whose labours in spectrum analysis, and on the construction of silvered glass specula for telescopes, are too well known to require mention. Dr. Draper leaves behind him an honourable and well-won fame; and his removal leaves a gap amongst the older generation of American scientific men which a few years ago would have been irreparable. Happily amongst the younger generation there are many whose talents have amply qualified them to step into the gap. In the breasts of all who desire the progress of science, regret for the loss they have sustained cannot but be mingled with satisfaction that the mantle falls upon the worthy shoulders, not of one successor, but upon a crowd of apt followers in the footsteps of the departed veteran.

NOTES

ALL but Fellows of the most recent date will hear with regret of the death, on Saturday, of Mr. Richard Kippist, who for nearly fifty years acted as librarian to the Linnean Society. Born in 1811, he was, when quite a lad, clerk in the office of Mr. Joseph Woods, F.L.S., architect, and an accomplished botanist. His taste for botany either originated or was acquired when under that gentleman, with whom he travelled, and afterwards assisted in the publication of "The Tourist's Flora." Mr. Woods leaving London for Lewes, Mr. Kippist, in February, 1830, entered the service of the Linnean Society, then in Soho Square. On Prof. Don's (the librarian's) death in 1842, Mr. Kippist, then an Associate of the Society, was elected by the Fellows his successor. Mr. Kippist contributed various botanical papers to the Linnean Society, which were published in their *Proceedings* and *Transactions*; the most important of which was that on the existence of spiral cells in the seeds of *Acanthaceæ*. He was an original Member of the Royal Microscopical Society, and an Associate of the Royal Botanical Society, Regent's Park. For a number of years Mr. Kippist suffered from asthma and chronic bronchitis, which materially affected his earlier active habits. He retired from office in 1880, after fifty years' service. He identified himself completely with the Society and its officers, securing the esteem of successive presidents and Councils, and the respect of succeeding generations of Fellows. Latterly he carried his methodical habits and his zeal for the Society's welfare to a degree that might have been distasteful to those younger Fellows who were not acquainted by experience with his life-long, single-minded devotion to the Society. These qualities, however, were duly appreciated by those conversant with the affairs of the Society, and whenever opportunity served, fit expression was made of the sense entertained of the value of his services, so that when, a year or two since, Mr. Kippist's failing health no longer enabled him to discharge his duties, the graceful action of the Council in allowing their old servant to retire on full pension was universally approved of by the Fellows. Mr. Kippist's complete devotion to the duties of his office left him little leisure for other work, while his modest, retiring habits led him to shun society. His published memoirs are therefore few in number, but they are marked with the scrupulous fidelity so characteristic of the author. They relate exclusively to botanical subjects.

PREPARATIONS for the forthcoming Electrical Exhibition are drawing their slow length along. The only really complete exhibit at present is that of the Postmaster-General, and this, as an historical exhibit, is very good indeed. The South-Eastern Railway also made a very good show, and the Electric Light and Power Generator Company are in position; but much remains to complete the Exhibition, and it will be another fortnight before it can be considered ready for inspection. On the evening of the 17th inst. the Edison lamp was shown in operation. The Concert Room was illuminated by over 200 of these pretty little lamps, each of which gives 16 candle-power. An extremely handsome chandelier was erected in the centre of the room, and its effect was very brilliant. The steadiness and uniformity of the Edison incandescent lamp is very marked, and it compares in this respect very favourably with the Swan and the Lane-Fox lamps. A large party gathered together and dined between the rays of this brilliant light, but, as it very often happens under such circumstances, an accident occurred which put out the lights for nearly an hour. This was, however, the fault of the engine, the safety-plug of which had blown out. The Exhibition generally produced a very favourable impression.

THE Geographical Society have now on exhibition a relief map of the equatorial region of Africa, constructed within the last twelve months for Col. Grant by Mr. James B. Jordan. The area included in the map is nine times greater than the British Isles, and nearly nine times less than the total area of Africa. It was therefore considered necessary to adopt the horizontal scale of one inch to twenty-five miles, and the vertical scale of one inch to five thousand feet. This gives an exaggerated idea of the mountains, but in relief maps this cannot be avoided if we wish to show the principal features of a country. The construction of the relief was a work of nearly twelve months. An accurate map had to be made on a given scale from carefully collected data; this was transferred to clay by a kind of pantagraph of Mr. Jordan's (senior) invention, a cast taken, and the present relief map constructed of papier-maché. There were several reasons for making it of this material: one, its lightness would enable it to be hung like a picture; another, the impossibility of its cracking and chipping as clay does; it represents nature better, and it can be easily repaired if the housemaid pokes a hole through it with her brush. When looked at in the light striking upon one side, the aspect of Africa in the interior is no longer the barren waste of the maps of fifty years ago; the interior, with its deeply-set lakes and the swelling lands round them, looks as if it could not but be inhabited by human beings, and it is so. All the data as to altitudes, latitudes, longitudes, and sections were taken from the accounts of the several travellers who have discovered or visited the interior, and Mr. Jordan has, in his well-known painstaking and conscientious manner, followed out the observations of these authors in a most accurate manner. Though it is clear to all that the model cannot be sufficiently correct where no observations had ever been made, still with his skilful hand and artistic taste, Mr. Jordan has produced a relief map which would bear comparison with any in Europe.

WE learn that the report that the bodies of the missing *Jeannette* men have been found on Wrangel Land is erroneous; they are no doubt those of part of the crew of the whaler *Vigilant*. Several of the members of the expedition have reached Jakutsk. The French journal *L'Exploration* publishes an extraordinary letter purporting to have been received from one of the members of the expedition, describing the wandering of the ice-bound *Jeannette*, the horrors and beauties of an Arctic winter, and other features, which must be the product of a French imagination. Has some wag been imposing an extract from one of Jules Vernes' works on our guileless contemporary? Of course no credence is given to the authenticity of the letter at the *New York Herald* Office; it seems clear that no such letter could have reached Europe yet, and certainly there was no Frenchman on board the *Jeannette*.

AMONG the special articles in the *Annuaire* of the Bureau des Longitudes (Paris, Gauthier-Villars) for 1882 are a historical sketch of the development of astronomy, by M. Faye; on the intra-Mercurial planet, by M. Tisserand; and M. Janssen's pape. on his photograph of Comet *b* 1881, with copy of the photograph. From the same publishers we have the *Annuaire* of the Montsouris Observatory, which is largely devoted to meteorology. Besides various tables for the use of agriculturists, and a variety of meteorological tables, we have several chapters discussing in detail agricultural meteorology; a meteorological *résumé* of the agricultural years 1873-81; chemical analyses of air and water; general investigation on atmospheric Bacteria; purification of sewage, &c.

A MOVEMENT is on foot in the United States, we learn from the *Daily News*, for securing the adoption of a uniform standard of time throughout that country. Considerable disagreement exists, however, as to the best standard to be adopted—that is, whether Washington or New York, or Pittsburg or Greenwich time shall be observed. The strongest claim appears to be put forward in favour of Washington, not only as being the capital city, but as possessing the well-known Naval Observatory, which, being the only national astronomical institution, should, it is contended, do for the United States what Greenwich does for Great Britain. The Signal Service Bureau proposes to utilise its system of telegraphic communication for distributing accurate time signals to all important points.

A REMARKABLY rapid disappearance of a flaming solar protuberance was observed last August by Herr Spörer, who describes the phenomena in the *Astronomische Nachrichten*. About 5 p.m. on the 2nd this protuberance was observed with broad base and intense luminosity, reaching a height of about one minute, while further out it appeared as a loose, less luminous cloud; the entire height being about four minutes. Herr Spörer, having passed to another part of the sun's disc for about five minutes, was surprised to find on return that in this short time the whole lower part of the protuberance had completely disappeared, while all that remained of the upper part was a few small isolated clouds.

WE have received several of the sheets of the "Enciclopedia Popular Ilustrada de Ciencias y Artes," which is being published in Madrid under the care of Mr. Frederick Gillman, Mining Engineer there. Mr. Gillman seems to be doing most of the work himself, and the undertaking is a formidable one. It is, however, highly creditable; the text is evidently based on the best existing English and German Cyclopædias, and the abundant illustrations are nearly all that could be wished. When one considers the state of education in Spain, Mr. Gillman's attempt to diffuse elementary instruction in this form must be regarded as a really philanthropic undertaking, to which we wish the greatest success.

THE colour of water forms the subject of a recent inaugural dissertation by Herr Boas, in Kiel (*Wied. Beibl.* No. 11). After reviewing previous observations, he describes his own experiments, the first of which were qualitative, sunlight being sent through water in a zinc tube about 46 feet long, closed with glass plates. Distilled water thus gave a fine deep blue-green colour; the red was quite gone, the yellow feeble, while the maximum brightness was in the green. Water of the Kiel supply let no light through the length of the tube stated; with half the length it appeared deep orange; blue and green failed. In his quantitative experiments the author illuminated two screens with the same light-source (sodium light or a gas flame), before which was placed red glass, or sulphate of copper solution. The light from one screen went through water in a tube; that from the other along the tube outside. Both beams were brought into a position for comparison by means of total-reflection prisms; the screens were shifted till equal brightness was reached, and from their position the coefficients of absorption could be approximately inferred. The decrease of absorption towards the blue in the case of distilled water is thus clearly shown Herr Boas further studied the polarisation of the light issuing from the water, by depolarising it. It was weakly polarised in a plane passing through the sun and the direction of the beam. Experiments with a view of detecting fluorescence had a negative result.

ON Saturday afternoon a series of interesting experiments on a practical scale were carried out in the grounds of the Crystal Palace with asbestos paint, in order to test its qualities as a protective covering against fire. This paint is a new and special preparation of asbestos, and is being introduced by the United Asbestos Company, of 161, Queen Victoria Street, E.C. The asbestos in a finely divided state is mixed with a fluid material, and is used in a similar manner to other paints. Unlike them, however, it is uninflammable, and not only so, but is capable of communicating this valuable attribute to such substances as it may be applied to. This applies alike to cotton fabrics and to timber or other inflammable materials used for constructive or decorative purposes. Hence its great value in connection with theatrical properties and appliances, especially those connected with the stage arrangements. Several experiments were made, all of them reported completely successful so far as proving that the paint is a powerful protection against conflagration.

AT the coast it may readily be observed that a red coloration is very common among invertebrate animals, and even fishes. And according to M. de Merejkowski (*Compt. rend.* Paris Academy of Sciences), even the animals coloured yellow, brown, green, and black have always a scarlet red pigment, which in their case is hidden by others. The red pigment, he finds, is always the same substance, viz. that known as *tetronerythrine;* he has verified its presence in 104 species (invertebrates and fishes). The question arises, What is the physiological *rôle* of this widely expanded substance? The author finds evidence that it corresponds to hæmoglobin in higher animals; serving for cutaneous respiration by virtue of its great affinity for oxygen. Thus, as regards distribution in organs, wherever oxygen has to be largely consumed by the tissues, there tetronerythrine is abundant. This is illustrated by skin tissues in immediate contact with the oxygen of the water; by the organs of respiration (*e.g.* in sedentary annelids, the tetronerythrine is concentrated in the branchiæ, the rest of the body having only traces); by muscles, and such an organ as the muscular foot of Lamellibranchiates. Next, as to distribution in the animal kingdom: sedentary animals are often redder and have more tetronerythrine than errant animals; the latter, which by constant change of place, are always in water holding plenty of oxygen, not having the same need of a special substance to increase the oxygen absorbed by the tissues. Then the fact that tetronerythrine occurs by preference in invertebrates, where hæmoglobin is wanting (and only exceptionally in higher animals), points to similarity of function in these substances. It is further pointed out that animals provided with yellow cells (parasitic algæ), which are proved to produce free oxygen in the tissues, are without tetronerythrine, or have very little of it.

THE following appointments to the staff of the Normal School of Science and Royal School of Mines have been made by the

Lord President of the Council:—J. F. Main, M.A., D.Sc., Professor of Mathematics and Engineering at University College, Bristol, Assistant Professor of Mechanics and Mathematics; F. Orpen Bower, B.A., Demonstrator of Botany at University College, London, Lecturer on Botany; Frank Rutley, F.G.S., Assistant Geologist on H.M. Geological Survey, Lecturer on Mineralogy; J. Russell Smith, Instructor in Mechanical Drawing.

THE Lord President of the Council has appointed Mr. Haddon, Professor of Zoology in the Royal College of Science, Dublin, Assistant Curator in the Natural History Department of the Dublin Science and Art Museum.

MR. J. M. SCHUVER has forwarded to *Petermann's Mittheilungen* an account of his proceedings since his departure from Cairo last January. He reached Khartum on March 19, and leaving again on April 4, he travelled by way of Senaar to Famaha (Fazogl), where he arrived on April 28. Fadassi was reached on June 12, and on the way Mr. Schuver ascertained that the Termat affluent of the Blue Nile rises in the Sori Mountains, west of Fasuder, and not half a degree to the south near Belletafa, as has been supposed. There is a stream called Turmat near Belletafa, but it is an affluent of the Jabus. At Fadassi Mr. Schuver met with a series of misfortunes, and was himself taken seriously ill with fever. On July 30, however, he was able to start on a trip to the south, and after thirty-eight days' travelling returned to Fadassi. During this journey he explored the Amam country, which is watered by two affluents of the Jabus, as well as that of the Legha Gallas; he also proved that the Jabus rises a degree further south than is shown to be the case on Petermann's map, and that the great Lake and River Baro are situated a degree further to the south of Fadassi, and he defined the exact line of water-parting between the two Niles as far as the 8th parallel. Mr. Schuver intended to start from Fadassi on January 1 of this year to explore the vast unknown regions down to the equator, but in so doing he will have to make a considerable *détour* to the west to avoid the country of the Legha Gallas, from which in his previous visit he escaped with great difficulty.

A PRIZE of 5000 lire (say 190*l.*) is offered by the Reale Istituto Veneto "for the best history of the experimental method in Italy." The application of this method to the physical sciences is chiefly to be expounded, with special regard to all that is noteworthy in the four centuries from the beginning of the fifteenth to the end of the eighteenth, including the discovery of the Voltaic pile. Some account is also required of the progress and rapid development of the economic and social sciences by means of the experimental method. Memoirs must be sent in before the end of February, 1885. Foreigners may compete, and the language may be Italian, Latin, French, German, or English.

MAJOR W. GWYNNE HUGHES, Deputy Commissioner of British Burma, has just published a useful little volume on the hill tracts of Arakan, of which he was lately superintendent. Two of its sections are devoted to their history and ethnology, and the volume is accompanied by a map (scale 32 miles to an inch) of the eastern frontier of British Burma.

PROVINCIAL museums have begun to appear in Russia, and we learn that the Natural History Museum opened last week at Yaroslavl already contains 50 skulls, 250 birds, 500 birds' nests, with eggs, a complete collection of seeds of all wild plants, 1200 fossils, and 5000 minerals, together with interesting collections of useful and noxious insects and plants, and a collection of plants classified according to the soils they grow upon.

NUMEROUS antique objects have recently been found in an ancient German tomb near Lindelbach (Franconia), and have been presented by the proprietor to the University of Würzburg. They all date from the Bronze Age.

COL. VENUKOFF, now in Paris, has written to the Geographical Society there, stating that the exploration of Turcoman Land by Russian topographers is progressing rapidly, and that Lieut. Loukiomov has proceeded as far as Seraks on the banks of the Tejent River. At the same sitting letters have been read from the French exploring party in Central Africa. They had been written from Bokhara to M. Bischoffsheim, who, not confining his assistance to astronomers, has been the principal patron of the expedition. A later telegram to M. Bischoffsheim states that the party had arrived at Krasnovodsk.

THE recently published volume of the "Materials for the Geology of Caucasus" contains a paper, by M. Batsevitch, on the naphtha-valley of the Apsheron peninsula. Towards the north, east, and south the valley is bounded by a *cirque* of Pliocene rocks of the Aralo-Caspian formation, and towards the west by the mud-volcano Bog-Boga. The valley itself, three miles long and three miles wide, is filled by naphtha-bearing formations, and it contains the richest wells of Balakhan and Sabuntchi. Towards the west it joins the great crevice, or rupture of rocks, which runs west and east from the mud-volcano Saghilpiry. As to the origin of the Apsheron naphtha, the author considers it a result of gaseous emanations from submarine mud-volcanoes of the post-Pliocene period.

THE telephone has penetrated even to Russian Turkestan, as we learn that Samarkand is in telephonic communication with Katty Kourgan, forty-four miles distant.

THE death is announced, at the age of ninety years, of the widow of the late Sir William Fairbairn.

ACCORDING to Mr. G. Levison the light emitted by the little fire-flies that abound in the neighbourhood of New York exhibits, when examined in the spectroscope, a peculiarity worthy of note. The blue and violet rays are wanting, and those of least refrangibility are predominant. In the light emitted, of the various preparations of phosphorus itself very little can be discovered except green rays.

PROF. KONRAD KELLER, of Zürich, the well-known zoologist, is about to undertake a scientific exploring tour to the shores of the Red Sea. The journey will last several months.

GLARUS has been the scene of another great landslip. A mass of rock 300 metres high has fallen from the summit of the Rothrisi, swept away a forest above Ennenda, devasted some valuable land, and destroyed the roads. It fortunately missed the village, and no lives were lost. There being nothing in the weather to account for the many landslips that lately have occurred in Switzerland, the phenomena are ascribed in great measure to the frequency of slight earthquake shocks, twenty-one of which have been observed in various parts of the country since the beginning of December.

THE *American Naturalist* announces the death, at the age of twenty-seven years, of Mr. J. D. Putnam, President of the Davenport Academy of Natural Sciences, the success of which is largely owing to Mr. Putnam's exertions. Mr. Putnam had devoted considerable attention to entomology.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♀) from India, presented by M. Kessels; a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. John Verinder; three Young Otters (*Lutra vulgaris* ♂ ♂ ♀), British, presented by the Reading Angling Association; seven European Scorpions (*Scorpio europæus*) from Nice, presented by Mr. T. D. G. Carmichael, F.Z.S.; two Macaque Monkeys (*Macacus cynomolgus* ♂ ♀) from India, two Arabian Gazelles (*Gazella arabica* ♂ ♀) from Arabia, deposited.

OUR ASTRONOMICAL COLUMN

SOLAR PARALLAX FROM OBSERVATIONS OF MARS.—In an appendix to the Washington Observations for 1877, Prof. Eastman, of the U.S. Naval Observatory, deduces "a value of the solar parallax from meridian observations of Mars at the opposition in 1877." In September, 1876, a circular was addressed from Washington to the principal observatories in both hemispheres, inviting co-operation in systematic meridian observations of Mars at the close opposition of the following year, and in response series were received from the Cape of Good Hope, Melbourne, Sydney, Cambridge, U.S., Leyden, Kremsmunster, and San Fernando, but Prof. Eastman excludes from his investigations the observations at the last two observatories, in the absence of sufficient details as to the methods and instruments employed. In the circular it was proposed to follow virtually the method of observation adopted at Pulkowa, by Prof. Winnecke in 1862, but it is stated, "The prescribed method of observing was *fully* carried out at only *two* stations and *partially* at one. Where the plan of the circular was strictly followed, the character of the work was decidedly superior to that where the directions were disregarded."

The results of the comparisons are thus given:—

	Sun's Parallax. "	No. of Comparisons.
Washington and Melbourne	8·971 ...	19
Washington and Sydney	8·885 ...	7
Washington and Cape of Good Hope	8·896 ...	7
Melbourne and Leyden	8·969 ..	27
Melbourne and Cambridge, U.S. ...	9·138 ...	10

With respect to the large value of parallax given by comparison of Melbourne and Cambridge, Prof. Eastman remarks: "This difference may arise from the method of observing over inclined threads at Cambridge, for the agreement of the results among themselves is very satisfactory; but, whatever the cause of the discrepancy may be, it has not been deemed advisable to employ these values in obtaining the final result."

The mean of the remaining sixty results, with regard to the computed weights, gives for the solar parallax, 8"·953 ± 0"·019.

It has been assumed that this method of determining the sun's parallax is certain to give too large a value, and Mr. David Gill, now H.M. Astronomer at the Cape, has suggested a definite cause; but Prof. Eastman, after experimenting upon Jupiter, does not find in his case that Mr. Gill's theory holds good. He intends, however, to pursue the investigation upon the disk of Mars.

VARIABLE STARS.—An ephemeris of the variable stars, similar to those of previous years, has been issued by the "Astronomische Gesellschaft" for 1882. It contains the times of maxima and minima of most of the variables whose periods are known, including, in addition to Algol, five stars of the Algol-type, viz. λ Tauri, S Cancri, δ Libræ, U Coronæ, and U Cephei. A minimum of Mira Ceti is fixed to February 3—this phase has been much less observed than the maximum. Both this minimum and the following maximum on May 23 are dated about ten days earlier than Argelander's formula of sines would indicate, but the observations of the last ten years have shown additional perturbation. A minimum of χ Cygni is dated February 20, and a maximum on August 25. The following are Greenwich times of minima of Algol:—

	h. m.		h. m.		h. m.
Feb. 1,	8 28	March 10,	15 4	April 2,	13 35
15,	16 33	13,	11 53	5,	10 24
18,	13 22	16,	8 42	22,	15 17
21,	10 10			25,	12 6
24,	6 59			28,	8 55

Minima of S Cancri occur February 16 at 11h. 23m., March 7 at 10h. 38m., March 26 at 9h. 54m., and April 14 at 9h. 9m.

For U Cephei (Ceraski's variable) calculated times of minima are:—

	h. m.		h. m.		h. m.
Feb. 1,	15 8	March 3,	13 3	April 2,	10 58
6,	14 47	8,	12 42	7,	10 38
11,	14 26	13,	12 22	12,	10 17
16,	14 6	18,	12 1	17,	9 56
21,	13 45	23,	11 40	22,	9 35
26,	13 24	28,	11 19	27,	9 15

A minimum of U Coronæ is dated February 6 at 10h. 7m.; the period is 3d. 10h. 51·24m.; the extent of variation about one magnitude.

THE ROYAL ASTRONOMICAL SOCIETY.—We are happy to be able, on the authority of Prof. Winnecke, to correct a mis-statement in this column, referring to the decease of M. Gautier as leaving Prof. Plantamour the senior Associate on the list of this Society. Notwithstanding some reports to the contrary, Prof. Winnecke informs us that this position is occupied by Prof. Rosenberger, who is still alive and in good health. Forty-five years have elapsed since the Society's gold medal was presented to Prof. Rosenberger, at the hands of Sir George Airy, for his masterly and elaborate researches on the motion of Halley's Comet. He was elected an Associate in April, 1835.

THE GREAT COMET OF 1881.—On January 7 and 8 Prof. Winnecke obtained good determinations of the position of this comet, which is still well observable with the great refractor at Strasburg. Its apparent diameter was about 30", and there was a condensation presenting the brightness of a star of 13½ m. The resulting places are—

	M.T. at Strasburg. h. m. s.	R.A. h. m. s.	Decl. ° ′ ″
January 7	... 7 49 6 ...	22 50 21·70 ...	+57 48 59·0
8	... 7 33 3 ..	22 52 49·72 ...	+57 42 15·2

It will be seen that Dr. Dunér's ephemeris in the *Astronomische Nachrichten* still gives the comet's position pretty closely.

THE DETERMINATION OF ELECTROMOTIVE FORCE IN ABSOLUTE ELECTROSTATIC MEASURE

HAVING already described my absolute sine electrometer before the Physical Society and at this year's meeting of the British Association, there is no necessity for describing here more than the prominent features of the instrument. Two plates of brass, each about one foot square, their surfaces being rendered true planes, are connected together, as a rigid body, by four ivory axes passing through both plates near their corners. On these axes are placed (between the plates) washers of mica, which serve to keep the plates asunder and parallel at a very small distance from each other. One of the plates is continuous; the other (the guard plate) has in its centre a square aperture whose side is 3 centimetres long, and in this aperture hangs a very light disk of aluminium suspended from the top of the guard plate by two Wollaston platinum wires each about 7·5 inches long. The disk is flush with the guard plate when it rests against four fine screws attached to the latter. The system of plates is movable, as a rigid body, round a horizontal axis, and its motion is produced by a micrometer screw (1-16th of an inch pitch) working against an insulated portion of the lower edge of the continuous plate; thus the screw tilts the system out of the vertical to a measurable amount. The horizontal axis of the plates is carefully levelled with a cathetometer, and the exact distance between the plates is determined by three readings of a spherometer taken at the aperture of the guard plate (previous to the insertion of the disk) before the mica washers are inserted between the plates (the plates being in complete contact), and three readings at the same points after the insertion of the washers. The vertical distance between the centre of the axis of plates and the point of the micrometer screw is 15 inches; the weight of the disk ·2568 grammes; and the head of the micrometer screw is a circle 3 inches in diameter, divided into 1000 equal parts.

The essential principle of the instrument will be understood from the following figure. B is the horizontal axis about which the plates C (the continuous plate) and G (the guard plate) are tilted by the fixed micrometer screw A. The disk is represented by the full line D in the centre of the guard plate.

To measure the E.M.F. of a battery, put C in connection with the positive pole, while the negative pole and the guard plate (and, with it, the disk) are connected with earth.

If N is the attraction exerted on the disk by the charge on C, W = weight of disk, θ = angle of deflection of the plates from the zero, or vertical, position, we shall have, when the disk is *just* out of contact with the little screws which keep it flush with the guard plate,

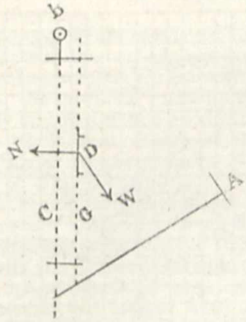
$$N = W \sin \theta \quad . \ . \ . \ . \ . \ . \quad (1)$$

For the particular instrument which has been constructed for me by Mr. Groves of Bolsover Street, the above equation becomes (using the circular measure for the sine)

$$V = \cdot 0456 \sqrt{m} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

in which V is the difference of potential between the poles of the battery, and m is the number of turns of the micrometer screw from the vertical position (in which $\theta = 0$) to the limiting position of equilibrium, or that in which the disk is *just sustained* out of contact with the screws.

The disk is observed from behind the guard plate by means of a microscope attached rigidly to the plate and moving, of course,



with it. The slightest motion of the disk can be thus seen; and when, by tilting the plates, the attraction N ceases to cause a motion of the disk, we know that the limiting inclination θ is attained.

As there would be great difficulty in determining the vertical position of the plates accurately, I do not seek to determine it, but use a differential method. Thus, suppose that we use n cells in each of which the E.M.F. is E, and let the reading of the micrometer be m when the limiting position is reached; now use n' of the cells, and let the reading for equilibrium be m'; then we know $m - m'$ but not m and m' separately. Substituting nE for V in equation (2), we have

$$n^2E^2 = (\cdot 0456)^2 m.$$

Also

$$n'^2E^2 = (\cdot 0456)^2 m'.$$

$$\therefore \quad E = \cdot 0456 \sqrt{\frac{\Delta}{n^2 - n'^2}}, \quad . \quad . \quad . \quad . \quad (3)$$

where Δ stands for $m - m'$.

Of course it is obvious that, to reduce any error of reading to a minimum, it is advisable to use for n and n' a large number and a small number, respectively. With the present instrument it is not possible to use more than about fifty Leclanché cells, because these produce such a large displacement of the disk that the amount of play allowed is exhausted.

A series of experiments carried out last summer in Prof. G. Carey Foster's laboratory gave for the E.M.F. of each cell of a battery of fifty Leclanchés ·00475 absolute electrostatic units.

This was obtained on the supposition that the E.M.F. was the same in all the cells, a supposition which is extremely improbable.

Within the last few days I have repeated the experiments on a different principle. My first idea was to work with a battery of Grove elements. Each element consisted of a test-tube containing a saturated solution of sulphate of zinc, and inside this a smaller test tube containing nitric acid, both test-tubes having the same axis, and both fitted into a paraffin cork, or stopper. A little zinc rod (surrounded with a very thin glass tube open at its lower end) plunged into the liquid of the outer test-tube and came up through the paraffin stopper; a platinum wire came up similarly out of the nitric acid; and electrical communication between the liquids was maintained by an aperture in the inner test-tube, through which the fumes of the nitric acid passed into the outer.

The resistance of the cells was, of course, enormous. They were formed into a battery, and supported in a wooden board soaked with paraffin.

The result then obtained for the E.M.F. of the Grove was much below what I knew to be about its value. The reason of this appeared to be that, with the great internal resistance of the battery, the external resistance was not sufficiently great. I therefore *diminished the internal*, and at the same time *increased the external*, resistance by inserting threads of asbestos through the apertures in the inner test-tubes, the extremities of every thread dipping into both liquids, and also by suspending each cell separately by a fine silk thread, about 2 feet long, from a fixed horizontal glass rod. The result was an increased, but still unsatisfactory, value of the E.M.F., and the unsatisfactory result was due to the fact that the nitric acid gradually attacked the zinc rods.

The employment of cells of exceedingly high resistance for the measurement of electromotive force is open to the serious objection that with them it is necessary to have a practically infinite external resistance, and this it is not always easy to attain. Even with the Thomson quadrant electrometer such cells give an uncertain result. When we have to trust for conduction to fumes or a moist film between two glass vessels containing the liquids, we occasionally get no indication whatever from the electrometer, and it is only by shaking up the cells that the requisite conductivity is obtained.

The above form of battery was abandoned for a series of chloride of zinc elements. Here the internal resistance is comparatively small, but we must not assume all the cells to have the same E.M.F. I therefore took forty of these elements, and compared their electromotive forces by a Thomson quadrant electrometer. In this way I found a variation of more than 8 per cent. in the E.M.F. of two cells.

Denote the electromotive forces of the cells by E_1, E_2, E_3, ... and let D stand for the electromotive force of a given Daniell, or any other element whose E.M.F. is to be found absolutely; and let the *ratios* of E_1, E_2, ... to D, as determined by a Thomson quadrant electrometer, be r_1, r_2, r_3. . . . .

Now suppose that we use any number of the cells with the absolute sine electrometer, and that the sum of their electromotive forces, $(r_1 + r_2 + r_3 + \ldots)$D, is denoted by D.$\Sigma r$. Note the reading of the micrometer screw when the limiting deflection of the plates is reached. Then use a smaller number, whose total E.M.F. is represented by D.σr, and take the new reading. If Δ is the difference of readings, we have by equation (3)

$$D = \cdot 0456 \sqrt{\frac{\Delta}{(\Sigma r)^2 - (\sigma r)^2}} \quad . \quad . \quad . \quad . \quad (4)$$

The ratios r_1, r_2, . . . must, of course, be marked on pieces of paper attached to the outsides of the corresponding cells.

I quote the result of the measurement of the E.M.F. of a particular Daniell. Taking observations with 39 of the chloride of zinc cells and with 10 of them I found

$$\Delta = 14 \cdot 2\,;$$

also the registered values of the ratios r_1, r_2, . . . gave in this case

$$\Sigma r = 50 \cdot 427 D\,; \quad \sigma r = 12 \cdot 834 D\,;$$

and by substituting in equation (4) we have

$$D = \cdot 00352 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (a)$$

absolute electrostatic units as the E.M.F. of the Daniell.

Again, taking observations with 39 and 20 of the cells, I found

$$\Delta = 11 \cdot 17\,;$$

$$\Sigma r = 50 \cdot 427 D\,; \quad \sigma r = 25 \cdot 918,$$

and these numbers substituted in (4) give *exactly* the value (*a*) above.

It is not possible, with the present instrument, to work with two batches of cells differing slightly in number; for I find that in some cases I cannot be certain of the reading corresponding to limiting equilibrium within about one-fifth of a revolution of the screw head. This uncertainty is of no consequence when Δ is large; but it is capable, I believe, of being almost completely got rid of.

Sir William Thomson's final estimate of the E.M.F. of a Daniell is

$$\cdot 00374$$

absolute electrostatic units ("Electrostatics and Magnetism," p. 246).

The Daniell cell used in the above experiments was a particular form of "gravity" arrangement, and I have good reason to believe that its E.M.F. was somewhat below that of a normal Daniell. Hence the value obtained for its E.M.F. may be quite consistent with Sir William Thomson's number.

I hope before long to determine by means of the absolute sine electrometer the E.M.F. of a cell which is also known in electro-magnetic measure, on account of the supreme importance of such a measurement in the theory of light.

I may in conclusion refer to a possible objection. The force of "stiction" may be supposed to interfere with the reading of the limiting position of equilibrium. Practically the objection is groundless, for we can always (force of stiction notwithstanding) attain this position very nearly. Having done so, a very slight tap on the base of the instrument is sufficient to free the disk and take it slightly out of focus, where it remains. Then move the plates forward by means of the micrometer screw until the guard plate again catches up the disk. We thus get the position of equilibrium without the interference of stiction at all.

I am now having the instrument altered by Mr. Groves. A very light and flat gilt disk of mica suspended by silvered silk fibres will replace the aluminium disk, and the distance between the plates will be varied within very narrow limits, so as to show whether the cushion of air between the plates exercises any influence on the results.

The range of tilting of the plates will also be increased so as to allow of the employment of a large number of cells. In this case the equations previously used must be replaced by equations of the forms—

$$\operatorname{Sin}(\theta+\alpha)=k\,E^2,$$
$$\operatorname{Sin}\alpha=k'E^2,$$
$$\tan(\theta+\alpha)-\tan\alpha=c,$$

where k, k', and c are known constants. In these equations we can, of course, take α very small, as before, and get a very approximate and easily obtained solution by using expansions to the third order of small quantities—as I shall show in a subsequent communication on the completion of my experiments.

GEORGE M. MINCHIN

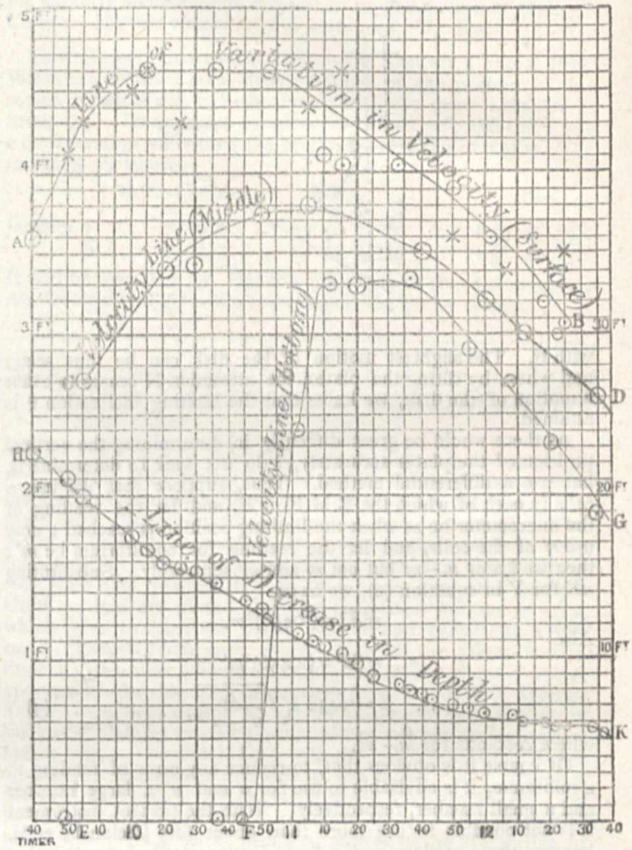
Royal Indian Engineering College, Cooper's Hill,
December 1

VELOCITIES IN TIDAL RIVERS

A PAPER "On the Relative Value of Tidal and Upland Waters in maintaining Rivers, &c.," by Mr. Walter R. Browne, M.Inst.C.E., late Fellow of Trinity College, Cambridge, has been lately published by the Institution of Civil Engineers. The main object of it is to prove, as a general principle, though by no means applicable in every case, that the main agent which keeps clear the channels of tidal rivers is not the run of tide passing up and down them every twelve hours, but the upland or fresh waters which pass down them at the period of low water, more or less aided by the oozing out of salt water which has soaked into the banks while covered with the tide.

The author, with a view to check his conclusions by actual experiment, resolved to investigate the actual velocity at the bottom of a tidal channel during an ebb tide; since it is clear that, whatever the velocity at the top, it is the bottom velocity alone which produces any scouring effect. In the very largest rivers, above the action of the tide, the bottom velocity differs but little from the surface velocity; but in smaller streams it is generally much less than the surface velocity, and the ratio between the two decreases rapidly as the depth increases. The case of a tidal river however is somewhat different, because then the level of the bottom is below the surface of the ocean outside, and this must have a certain effect in ponding back the river current. Accordingly two sets of experiments, made at a carefully-chosen spot on the River Avon at Bristol, showed that for about two-thirds of an ebb tide, and even when the surface velocity was at its highest, the bottom velocity was absolutely *nil*. The water at the bottom then seemed to start suddenly into activity, and almost immediately assumed a velocity agreeing fairly with that observed in ordinary rivers above the tidal area. The two sets of experiments were made with different meters, at different states of the tides, and at different times of year; so that they amply confirmed each other. The stillness of the bottom was further proved by the board, supporting the rod on which the meter was hung, coming up with a deposit of silt upon its surface, showing that, far from any scouring being in progress, actual deposition was taking place. The second set of experiments was the most accurate, the meter having been specially made and tested for the purpose. The results are plotted on the accompanying diagram.

In the diagram the line A B represents the probable variation in the surface velocities as sketched from the various observations. The small circles represent the observations made at different times by the meter, and the crosses represent observations made, as a check upon these, by floats at the surface. It will be seen that the meter observations are by far the most satisfactory. The line C D is similarly sketched from the observations of the velocities at the middle of the depth. It will be observed that here the maximum velocity is attained later than at the surface, and just when the latter is beginning to fall off. The line E F G and the circles contiguous to it refer to the bottom velocity. It will be seen that it rises from nothing to a tolerably high value, with very great abruptness, just at the time when the surface velocity begins to diminish: it is probable, however, that



the change is not so much connected with this as with the decrease in depth, which is given by the line H K and the contiguous circles. These are plotted to one-tenth the scale of the velocity observations, and the sudden flattening of the curves about 12 noon marks the beginning of what the author terms the low water period.

It is believed that the fact of a current having a high velocity at the surface and absolutely none at the bottom has not been previously observed, and it may have considerable bearing on the general theory of the motion of rivers, as well as on the more practical points dealt with in the paper.

ON THE ECONOMICAL USE OF GAS-ENGINES FOR THE PRODUCTION OF ELECTRICITY[1]

THE lecturer pointed out, that as long as the chief practical use of electricity was in telegraphy it was the quickness of action, rather than the ability to transmit large amounts of power to a distance, that formed the chief feature in the employment of electricity; but that in this exhibition the numerous practical examples of the electric transmission of power, rather than the electric transmission of signals, formed without doubt the leading feature.

Much had been heard about the dynamo-electric machines which generate the electric current; but while electricians were

[1] Abstract of a lecture delivered in French in the Salle du Congrès, at the Electrical Exhibition, Paris, by Prof. W. E. Ayrton, F.R.S.

engaged in considering the differences between the various kinds of these machines and the improvements that can be effected in them, the mechanical engineer should give his careful attention to the possible improvements that can be made in the engines that drive the electric generators.

As long as the lighting of our large cities was performed by gas the cheap manufacture of illuminating gas was the important question, but now that electric lighting bids fair to displace other systems the question that has special interest is, not the extraction of illuminating gas from coal, but the employment of the store of energy in the latter to set in rapid rotation dynamo-electric machines for producing the electric current used in lighting.

At present steam-engines are chiefly used to drive the dynamo machines, but even with the best engines and boilers it is well known that the fuel consumption is excessive compared with the actual work done. So good an authority as Sir William Armstrong has recently said that with a good condensing engine only one-tenth of the whole heat energy of the fuel is realised in useful work, and this is no exaggeration of facts. What therefore must be said of a small engine and boiler of the ordinary type? The main reason why the efficiency of even the best steam-engines is so low is because in an ordinary engine steam can only be used at a comparatively low temperature; for it can be proved that, with the temperatures which can be used in condensing-engines, the efficiency of even an imaginary perfect engine, without friction and loss of heat, cannot exceed $\frac{2}{10}$, or only double the efficiency of a good modern steam-engine; that is to say that a good engine of large size uses only $\frac{1}{10}$ of the total heat, and that it is not possible to use more than $\frac{2}{10}$ with an engine of perfect mechanism.

It may be assumed that in large compound marine engines the fuel consumption is about 2 lbs. per indicated horse-power, but it cannot yet be said that engines of this class and of very high power will be used in central stations for electrical purposes; at any rate it must be remembered that besides other considerations there is a great objection to the use of a single very large engine to electrically light a district, for the accidental stoppage of this engine would plunge the whole neighbourhood into darkness.

Engines and boilers of the portable type are those generally used now for electrical purposes, and in a competition in England of several of the best engines of this class the fuel consumption was about 4 lb. per indicated horse-power per hour; but in daily practical work it may be assumed that 6 to 7 lb. more nearly represent their usual fuel consumption. This gives an efficiency of only about $\frac{1}{30}$.

With a hot-air engine there is this great disadvantage, that it is extremely difficult to prevent the lubricants from being burnt and the air vessel being injured by heat, since the latter vessel must be kept as hot or hotter than the air, because the temperature of the air is raised by an *external* fire. The only other motor suitable for electrical purposes (apart from machines driven by water or wind power) is the gas-engine. In the latter the power is obtained by the admission of an explosive mixture of gas and air into the cylinder, and the piston is driven by the explosion produced on the ignition of this mixture.

Now there is this great difference between a hot-air engine and a gas-engine, that in the latter the high temperature arising from the explosion is produced *inside* the cylinder, and not outside: so that, although the gas at the moment after explosion is extremely hot, the cylinder, piston, and lubricant may be kept cool by an external stream of water, which is of course impossible in a hot-air engine where the air is heated from the outside. Again, the very high temperature developed in the cylinder after the explosion has taken place is rapidly reduced by the piston doing work before there is time for the gas to give up much of its heat to the cylinder and piston. Steam, however, can only be used at a very high temperature, provided the apparatus is made exceedingly strong.

With the present temperatures employed, the theoretical efficiency of a gas-engine might be raised from 56 to 75 per cent., if loss of heat by conduction, radiation, and convection, as well as friction, could be prevented; while in a condensing steam-engine the greatest efficiency that could be obtained with the present temperatures employed could never exceed about 20 per cent.

It was thus shown that practically a gas-engine admits of being worked with much greater *efficiency* than either a steam-engine or a hot-air engine—that is to say, the percentage of heat the former turns into mechanical work is much greater than with the latter two. It was, however, necessary to consider the *economy* of working, which depends on the relative price of the fuel employed, and other items of working cost. Comparative estimates were therefore given of the working cost of a steam-engine of the portable type and of an Otto gas-engine, both indicating 30 horse-power, for 300 days of nine hours each (the horse-power about necessary to keep alight the 400 Swan incandescent lamps used to illuminate the Salle du Congrès during this lecture). The cost of the coal-gas was taken at three shillings per 1000 cubic feet (or about 13½ centimes per cubic metre, only about half the actual price in Paris), and it was thus seen that, in spite of the very great relative efficiency of the gas-engine, the cost of working with ordinary coal-gas is greater than in the case of the steam-engine. Ordinary coal-gas, however, has been prepared for producing not heat, but light, and has therefore been elaborately purified at a considerable cost, so that when used in a gas-engine it is used for a purpose quite different from that for which it was intended.

A gas-engine burning illuminating gas is, in fact, in the same position as was a few years ago an electromotor, or machine for converting electric energy into mechanical power. An electromotor is an extremely efficient machine, but the fuel burnt to produce the electricity was, until quite recently, zinc, and consequently was far too expensive to allow the use of electromotors to be commercially successful. So in the same way, if it is attempted to work gas-engines by burning illuminating gas at even 13½ centimes the cubic metre, or half the actual price of the ordinary gas in Paris, they cannot even be worked as economically as steam-engines, in spite of their superior efficiency and of the much smaller cost for superintendence. But if it be possible to manufacture for their use a cheap heating gas in the same way as it is now possible to produce electric energy economically by burning coal, which is a much cheaper fuel than zinc, then the result, as you will see, becomes just the reverse, and small gas-engines driven with such gas not only greatly surpass in economy steam-engines of the same size, but produce energy at a cheaper rate per horse-power than the largest steam-engines ever made.

The lecturer then described what had been done by Dr. Siemens and others who have made a heating gas for furnace work by means of passing air only, or air with a small admixture of steam, through a mass of burning fuel. Such gas, however, contains too much nitrogen (60 to 70 per cent.) to be suitable for gas-engines and other purposes requiring it to be used in small quantities, and the plant is large and costly. Reference was then made to what had been done by Mr. Dowson of London, who has perfected a gas-generating apparatus, into which he passes steam at pressure with a certain portion of air. This he effects by an arrangement similar to a steam-engine injector or a jet pump. The air thus drawn into the generator serves to keep the column of fuel through which it passes at a high temperature, without an exterior fire, so that the decomposition of the steam and the other chemical reactions take place without interruption. The working of the generator is thus regular, and the gas is produced without fluctuations in quality.

Experiments were made with a eudiometer, in which were three volumes of the Dowson gas and one of oxygen, and on exploding the mixture, 36 per cent. of the total disappeared. This corresponded with the following composition of the Dowson gas, viz. hydrogen, 20 per cent.; carbon monoxide, 30 per cent.; carbon dioxide, 3 per cent.; and nitrogen, 47 per cent. by volume. It was also shown that this gas burns without smoke or any deposit of soot on a piece of porcelain, whether placed above or in the middle of the flame.

About 50 per cent. of this gas is combustible, and its calorific power, or the number of heat units produced by the combustion of a cubic metre, is 1,558,358. Its calorific intensity is 2268° C. To compare it with ordinary coal-gas we may take the calorific power of a cubic metre of the latter to be 5,590,399, and its calorific intensity as 2554° C.

In the Otto gas-engines a large proportion of air is mixed with the coal-gas, so that the effect of the explosion may continue during the stroke of the piston by the air taking up some of the heat produced; and as the Dowson gas requires less air for its combustion, it is found that in the same cylinder there is not more nitrogen and unused oxygen in the charge of Dowson gas with its mixture of air, than with coal-gas and the quantity of air which is given to the latter. That is to say that the same power can be developed in the engine with coal-gas or Dowson gas if the supply of gas and air be exactly proportioned.

The comparative explosive force of the two gases calculated in the usual way is as 3·4 : 1, *i.e.* coal-gas has 3·4 times more energy than the Dowson gas. But because the combustion of carbon monoxide proceeds more slowly than that of carburetted hydrogen gases, and because the diluents present in the cylinder affect the weaker gas more than the coal-gas, in practice, with an Otto engine five volumes of the Dowson gas are used for one volume of coal-gas.

A table was given showing all the working expenses of an Otto gas-engine indicating 30 horse-power, and driven by the Dowson gas for 300 days of nine hours each, so that these expenses might be compared with those given for the steam-engine and the gas-engine worked with coal-gas. These figures showed that a gas-engine worked with Dowson gas costs about 45½ per cent. less than when worked with coal-gas at 3*s.* per 1000 cubic feet, and about 47½ per cent. less than a steam-engine of the portable type, after allowing in each case for repairs and depreciations, and interest on capital outlay. The most striking feature, however, was that with a steam-engine consuming 6 lbs. of coal per indicated horse-power per hour, and without adding any allowance for fuel used in getting up steam, and after work is done, 217 tons of coal are required to give the same power as 39 tons of coal converted into gas by the Dowson process. This represents a saving of about 88 per cent. in the weight of fuel.

Another practical consideration was that the quantity of the Dowson gas required to give the equivalent of 1000 cubic feet of coal-gas was only 24 to 27 per cent. of the weight of the coal necessary for the latter. A further point of great interest is that a series of trials made with 3½ horse-power (nominal) Otto engines driven by the Dowson gas, have proved that 1 *horse-power* (*indicated*) *is obtained with a consumption of gas derived from* 1·46 *lbs. of coal* after allowing for the gas burnt in the manufacture of the gas as well as 10 per cent. for impurities and waste of the coal. With gas-engines of larger power the loss due to friction is proportionally less, and the consumption of gas per indicated horse-power is less, thus with a 16 horse-power (nominal) engine which can indicate up to about 40 horse-power, the Dowson gas required would be about 90 cubic feet per indicated horse-power per hour, and this would give a consumption of coal of *only* 1·2 *per indicated horse-power per hour.*

Moreover, with a cheap heating gas not only can a saving in the motive power be effected for electric lighting, but this gas can also be used for domestic and industrial purposes, such as cooking and heating. It burns without smoke, so that when it is used in districts where there are many factories, or where much coal is consumed, not only will a great saving be effected, but in addition there will be freedom from a dark depressing atmosphere—the presence of which, the lecturer remarked, was the bane of London, and the absence of which formed the greatest charm of Paris.

NEW BIRDS FROM THE SOLOMON ISLANDS

AT a recent meeting of the Linnean Society of New South Wales Mr. E. P. Ramsay, F.L.S., &c., Curator of the Australian Museum, read descriptions of the following six new birds from the Solomon Islands :—

Astur versicolor.—The whole plumage above and below is of a bluish slate-black, the base of the quills below ashy white. The length is about 17 inches, the wing 9·7. The immature nd young birds are also described.

The adult male of *Nasiterna finschii* is described as having a crimson patch on the abdomen; otherwise like the female, which alone was previously known. The young of this species is also described; they differ in having a rosy tint on the cheeks.

A fine pigeon is described, and called *Ianthœnas philippanæ;* it is allied to *I. pallidiceps*, but is not so dark in the plumage, being of a bluish slate colour, except the head and throat, which are white, with an opaline rose tint; the metallic reflections of the body are rose and light green; length 15 inches, wing 9¼ inches. Two other pigeons of the genus Ptilopus have been dedicated to officers of Her Majesty's Navy.

Ptilopus richardsii.—A very beautiful and distinct species, having the head, neck, and all the under surface French gray, a very faint lavender crown, the wings and tail green; the former have a rosy carmine oblong or lanceolate spot on the scapulars; the latter has a terminal band of pale yellow. The nest, eggs, and young of this species are also described.

Ptilopus lewisii.—This bird was previously described in the same journal, and referred to *Ptilopus viridis*, and afterwards determined as the female of *Ptilopus eugeniæ* (Gould). A large series of both sexes and the young show it to be a new species. The general colour is green, the chest with a large patch of violet-purple. A description will be found in the *Proceedings* of the Linnean Society of New South Wales, vol. iv. 1879, p. 73.

Ptilopus johannis of Sclater is stated to be the male of *P. solomonensis* of Gray, and to = *P. ceraseipectus* of Tristram.

A fine new Chalcophaps has been named after its discoverer, Mr. Alex. Morton, *Chalcophaps mortoni;* it is like *C. chrysochlora*, but larger, and has no band on the shoulder; the young had been previously described under the name of *C. chrysochlora*, var. *sandwichensis;* the name is now altered to that of *mortoni*, and the adult described.

Myiagra cervinicauda, Tristram.—The male of this species is described, the type-specimen being a female; it belongs to the *M. plumbea* group of the genus.

Sternoides minor.—A smaller species than either of the previously known species, and differs in having a more curved bill, and all the secondaries, as well as the primaries, of an earthy-brown tint. Length about 7½ inches, wing 4·3, tarsus 1 inch.

A second paper by the same author contains a description of a new honey-eater of the genus *Plectorhyncha*, or of a new genus very closely allied to it. This species, which is of a uniform dull fulvous brown, has been named *P. fulviventris.* It comes from the south-east coast of New Guinea. Length about 8 inches, wing 3·8, tail 3·2, tarsus 1 inch.

Mr. Ramsay stated that the trustees of the Australian Museum had recently received large collections from their collector in the Solomon Islands, and were daily expecting further consignments from New Guinea.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 12, 1881.—On the interference of phenomena of thin plates with special reference to the theory of Newton's rings, by W. Fenssner.—On the dispersion of aragonite in an arbitrary direction, by V. v. Lang.—Remarks on Herr Lamansky's works on fluorescence, by O. Lubarsch.—Upper limits for the kinetic energy of moved electricity, by H. R. Hertz.—On disaggregation of electrodes by positive electricity and explanation of the Lichtenberg figures, by E. Reitlinger and Fr. Wächter.—Researches on the height of the atmosphere and the constitution of gaseous bodies (continued), by A. Ritter.—Contributions to the theory of electromagnetism, by W. Siemens.—Researches on the volume constitution of liquid compounds, by H. Schröder.—On the theoretical determination of vapour pressure and the volumes of vapour and liquid, II., by R. Clausius.—On an equation which satisfies the kinetic energy of vibratory movements, by S. Oppenheim.

Journal de Physique, December, 1881.—Hydroelectric and hydromagnetic phenomena, by C. A. Bjerknes.—Variation of indices or refraction of gypsum with temperature, by H. Dufet.—On the measurement of temperatures by means of the mercury thermometer, by M. Pernet.—On the singular polarisation of electrodes, by A. Solokoff.—Discourse of M. Dumas at the International Congress of Electricians.

Rivista Scientifico-Industriale, December 15, 1881.—Displacements and deformations of the spark in air by electrostatic action, by R. Righi.—On some curious conformation of the spark in air, by the same.—Endogenous origin of the roots of plants, by S. Briosi.

THE last two parts of the *Memoirs* (*Trudy*) of the St. Petersburg Society of Naturalists contain, besides the minutes of proceedings, the following interesting papers (vol. xi. fascicule 2):—A preliminary report on the structure of corals, and on the origin and development of the egg of the *Medusa leucope* before fructification, by K. S. Mereshkovsky.—Materials for the flora of the Onega region, by A. K. Hünter; and of the neighbourhood of Povenets, in the government of Olonetz, by Chr. Gobi.—(Vol. xii. fascicule 1):—A geological description of the neighbourhoods of Krasnoye and Tsarskoye Selo, by R. Kudryavtseff and J. Lebedeff (with map and plates).—On the aërial roots of the *Acanthoriza aculeata*, by K. Friedrich (with plates).—On the influence of light on mushrooms, by K. Regel.—On the Imatra waterfall and Imatra stones, by P. Venukoff.—Report on the expedition to the White Sea, by L. Tsenkovsky. This volume is dedicated to the memory of the late Prof. Kessler.—Zoologists will find valuable contributions to the knowledge of Russian zoo-geography in the researches of MM. Khlebnikoff, Nikolsky, and Lavroff as to the fauna of the governments of Novgorod, Astrakhan, and Kaluga, published in vol. xi. of these *Memoirs*.

SOCIETIES AND ACADEMIES

London

Royal Society, December 15, 1881.—"On some Effects of Transmitting Electrical Currents through Magnetised Electrolytes." By Dr. G. Gore, F.R.S.

This communication treats of a class of electro-magnetic rotations observed and examined by the author. The rotations are produced in liquids by means of axial electric currents either in the interior of vertical magnets, electric or permanent, or near the poles of such magnets; and differ from rotations previously produced in liquids placed in those positions, by the absence of radial currents, to the influence of which rotations in the interior of hollow magnets have hitherto been ascribed. In the full paper it is stated that "the whole of the results may be explained by the well-known principles of electro-magnetism."

It is here shown that a column of an electrolyte placed under similar conditions to an iron wire or rod when subjected to electro-magnetic torsion (*i.e.* inclosed by an electro-magnetic helix, and traversed axially by an electric current), is twisted in a similar manner to the wire or bar. This effect, however, in the case of a liquid, is not limited to paramagnetic substances, nor is the direction of torsion altered by the magnetic character of the solution.

The rotations produced in liquids by means of axial currents are opposite in direction at the two ends of the magnet-tube, are strongest at the poles and at a little distance beyond them, and null at the centre of the tube:—they may be produced at a distance of several inches beyond the poles. The directions of rotation within the tube, and to a short distance beyond the poles, are, in the case of an electro or a permanent magnet, opposite to those produced by a voltaic solenoid; a magnet-tube, therefore, has three points of no rotation with an axial current, viz. one at its centre and one near each end, whilst a solenoid has only the former one. The existence of the outer neutral points produced by a magnet depends upon the position of the latter to the liquid, and the distances of those points from the poles of the magnet are affected by various circumstances which are described in the communication. If the magnet is wholly above the portion of the liquid traversed by the axial current, the outer neutral points do not occur.

By the influence of a vertical current, the liquid as a whole may be made to rotate in either single direction; the motion at one end of the column, therefore, is not dependent upon the opposite direction of motion at the other, and torsion is not a necessary form of the effect. The reaction of the liquid in the production of the rotation is neither upon another portion of the liquid, nor upon the electrodes, nor upon the walls of the containing vessel, but upon the adjacent magnetised body; the rotation of the liquid is confined to the portion traversed by the vertical current.

Under suitable conditions the phenomenon of rotation is definite, conspicuous, and strong, and is usually more powerful with a tubular electro-magnet than with a voltaic coil alone; a very thin iron tube weakens the effect of the coil, whilst a thick one reverses the motion and makes it stronger. The system of rotations, either with a coil or magnet, is also perfectly symmetrical. The directions of rotation produced by a coil alone are independent of the magnetic nature of the wire of the coil. Like other electro-magnetic effects, the rotations are not prevented by the interposition of metallic screens, provided they are non-magnetic. The rotations may be easily produced by the aid of a current from three or four Grove's elements, especially if permanent bar-magnets are used instead of a voltaic coil. The rotations by means of vertical currents in the liquid may be produced by the influence of coils or magnets, either above or below the liquid, as well as around it; with magnets, however, in the former positions, no external reversal points occur. A magnet placed entirely above or below the liquid produces the same directions of rotation as a coil placed either above, below, or around it. The direction of rotation produced in a liquid above a coil by an *upward* current in the liquid agrees with that produced by a *radial centripetal* one.

A rotation apparatus of the same kind, interposed as a screen, does not prevent or appear to affect the movements.

Each electrode may be made to separately revolve in the presence of a coil or magnet, by the well-known influence of the radial currents in them; and the directions of rotation are the same with a magnet as with a coil. In this respect the motion produced by radial currents differs from that produced by vertical ones. With each electrode, diverging currents produce dextro- and converging ones lævo-rotation. The rotation of the electrodes by means of radial currents appears to be independent of that produced in the liquid by means of vertical ones.

The rotation also of the vessel containing the liquid may be obtained independently of that of the electrodes, by means of the vertical current in the liquid, without the aid of the radial currents in the electrodes.

The rotations produced by a vertical axial current are not confined to liquids, but may also be produced in a solid conductor, and probably therefore with any body conveying an electric current or discharge.

The directions of rotation produced in liquids by means of radial currents under the influence of a magnet or coil, are the same as in the solid electrodes, and are lævo at all positions with centripetal currents and dextro with centrifugal ones, when the North Pole is above.

A given direction of axial current, whether in a solid or liquid conductor, whether above or below a given magnetic pole, and whether that pole constituted the upper or lower end of a coil or magnet, produced the same direction of rotation. A given direction of radial current also, whether in the electrodes or electrolytes, or above or below a given pole, provided that the pole was not altered in position, produced the same direction of rotation.

Various other phenomena, such as temporary reversals of the direction of rotation, successive action of the coil and iron tube, &c., &c., are recorded in the paper.

With a Solenoid.—A current flowing upwards from a south to a north-seeking pole produces dextro rotation at the former, and lævo rotation at the latter. *With a magnet* these two directions are reversed at all distances between the two neutral points near the poles of the magnets, but not beyond. The phenomena therefore of rotation are more complex with a magnet than with a solenoid.

The reversals of direction of rotation which occur when a tubular magnet is employed appear to be due to the inner surface of the magnet and to the position of that surface in relation to the current in the liquid. The direction of rotation and the points of reversal appear to be all independent of each other.

The action of radial currents is more simple than that of axial ones, especially near the poles of a magnet. With radial currents, either in the liquid or electrodes, there is no reversal either at the centre of the magnet or coil, or at the poles or beyond them.

The experiments show in a conspicuous manner the difference of property of the interior surface of a hollow magnet and of on a solenoid having the same kind of poles at their corresponding ends. This difference of property is well known, but is illustrated in the paper in a new way experimentally.

The whole of the foregoing results are illustrated by experiments.

Mathematical Society, January 12.—S. Roberts, F.R.S., president, in the chair.—Dr. G. J. Allman and Mrs. Bryant were elected Members, and Mr. G. H. Stuart was admitted into the Society.—A vote of thanks was passed to the Norwegian Government for the present of a copy of the new edition of Abel's works.—The following communications were made:—The invariants of a certain orthogonal transformation, with special reference to their use in the theory of the strains and stresses of an elastic solid, by Mr. W. J. C. Sharp.—Some formulæ in elliptic functions, by the Rev. M. M. U. Wilkinson.—Complete determination of the real foci, and of the vector equation, of a given ellipse with respect to any proposed point, by Prof. Wolstenholme.—On the calculation of symmetric functions, by Mr. J. Hammond.

Royal Horticultural Society, January 10.—*Hylecætus dermestoides:* Mr. Pascoe showed a male and a female specimen of this British beetle, and alluded to the report that it feeds on the wood-boring species, but does not itself bore the wood. Mr. Maclachlan remarked that it was an open question whether this idea were true.—*Glastonbury Thorn:* Dr. Masters exhibited specimens of this plant received from Mr. Boscawen, with buds and fruit. It was flowering later than usual. He also showed a variegated sport of the common laurel from the same gentleman.—*Willow, species of:* Some specimens of new species of willow, *e.g. S. holosericea*, &c., were received from Dr. Fraser, of Wolverhampton. It was suggested that they were hybrids or accidental importations. They were forwarded to the Kew Herbarium.—*Carica condamarcensis, Fruit of:* A fruit of this plant was received from Mr. J. A. Henry, of Edinburgh. It was raised from seed sent by the late Prof. Jameson of Quito, and had been fertilised by the late Prof. Dickson.—*Nitrogen in worm-casts:* Dr. Gilbert described some experiments he had made in order to ascertain the proportion of nitrogen in worm-casts; which latter, according to Mr. Darwin, amount to between 17 and 18 tons per annum per acre, of ·2 inch in depth. He collected the casts of two or three weeks' formation, and found, by analysis of the *dried* mould, that it contained ·35 per cent. of nitrogen, which is higher than that of mould of pasture land, viz. ·25–·3 per cent. in the first nine inches, or two or three times as high as that of arable land, but not so rich as highly manured kitchen garden mould. Ten tons per acre would, therefore, yield 80 lbs. of nitrogen per annum, or more than double that of ordinary meadows without manure. The conclusion was that no gain accrued to the soil except from what the worms brought up from below, as by trenching.—*Plants exhibited: Columnæa Kalbreyerana*, with satin-like pendulous secund leaves and yellow flowers, from New Grenada, exhibited by Messrs. Veitch. It received a botanical certificate. *Tecophilæa cyanocrocus*, from Chili. This had flowered previously at Kew. It was brought by Mr. G. F. Wilson. A small bulbous plant with slender tubed and globular perianth of lilac colour, brought by Mr. Maw from Mount Ida, was exhibited by the Rev. H. H. Crewe. It was referred to Kew for identification and name [*Colchicum montanum*, Bieb.]. *Lygodictyon Forsteri*, a fine specimen of a climbing fern, from Mr. Green, of Kingsford Stanway, near Colchester. *Dracæna Goldiana*, exhibited by Mr. Wills, flowering for the first time in this country, with variegated foliage, received a botanical certificate.

Victoria Institute, January 16.—A paper on "Biblical proper Names, personal and local, illustrated from Sources external to Scripture," was read by the Rev. H. G. Tomkins. Communications from Prof. Sayce, MM. Renouf, Lenormant, Naville, &c., followed, and a discussion ensued, in which Dr. Rassam and others took part.

PARIS

Academy of Sciences, January 9.—M. Jamin in the chair.—The following papers were read:—Documents relative to the subject of Papin's stay at Venice, by M. Daubrée. Papin went to Venice with Paul Sarotti, a Venetian senator whom he met in London, and who had founded an academy in his own house in Venice (beginning about 1632), with a valuable library. M. Daubrée, in a recent visit to Venice, gained some information about the work done at the meetings. The Sarotti Academy still existed in 1690.—On the powers and roots of linear substitutions, by Prof. Sylvester.—Experimental study on metalloscopy, hypnotism, and the action of various physical agents in hysteria, by MM. Dumontpallier and Magnin. Among other things, the authors suppose there is an intercrossing of sensitive and motor fibres in the dorso-lumbar region of the spinal cord, occasioning simultaneous movements of the upper limb on one side, and the lower on the other; excitation of the surfaces of the latter causes movement of the former. This may explain the walk of quadrupeds, of man "on all-fours," &c. The nervous hyperexcitability of hysteric persons in a state of hypnotism is illustrated. The so-called radiating neuric force in hysterics is merely a manifestation of physical acts called into existence (peripheric modifications caused by physical agents).—On the processes of coppering cast-iron, employed at the Val d'Osne, by MM. Mignon and Rouart. They use a distinctly acid solution, whereas *alkalinity* is the basis of M. Weil's method (in which the organic acid is only an accessory).—The Secretary gave the gist of a volume of memoirs by Prof. J. P. Cook of Harvard.—M. Dumas presented a fine work by M. Civiale, "Voyages photographiques dans les Alpes."—On an extension of the arithmetical notion of genus, by M. Poincaré.—On algebraic forms with several series of variables, by M. le Paige.—Differential equations of motion of waves produced at the surface of a liquid by the emersion of a solid, by M. Boussinesq.—On some consequences of the principle of Gauss in electrostatics, by M. Croullebois.—On a sound-transmitter with stringed sounding-board, by M. Bourbouze. A microphone is placed on the sounding-board of a piano or like instrument, and is affected by the strings vibrating in unison with sounds produced (with the voice or an instrument) near them. Such a transmitter is very sensitive.—Measurement of the interior resistance and the electromotive force of electric machines in action, by M. Cabanellas.—Note on the theory of formiates by M. Maumené. Thermal researches on oxychlorides of sulphur, by M. Ogier.—On a carbonic ether of boeïneol, by M. Haller.—On the formation of bases of the quinoleic series in the distillation of cinchonine with potash, by M. Œchsner de Coninck.—On terpine, by M. Walitzky.—On the existence of an automatic rhythm common to several nerve-centres of the medulla oblongata, by M. Fredericq. With inspiration (respiratory centre) there is diminution of arterial pressure and acceleration of pulsations (*i.e.* minimum of action of centres for vasomotors and for stoppage of the heart). With expiration and respiratory pause, the effects are opposite. This intermittent activity occurs apart from all change in the state of the thoracic organs, provided the blood bathing the medulla oblongata has a certain degree of viscosity; if it be too much arterialised, the three centres more or less suspend their action.—On the positions of equal luminous intensity in twin crystals, between crossed Nicols, and application to the study of the concentric bands of felspar, by M. Lévy. The felspars in rocks are generally formed by juxtaposition of *concentric bands*; and in these the optical properties vary irregularly, though the crystallographic orientation seems the same. Some have tried to explain this by supposing a variation in the chemical composition of the bands. M. Lévy pronounces this insufficient, and regards the bands as often due to a submicroscopic association of hemitropic lamellæ of a fundamentally single felspar, according to the laws of albite and of pericline.—On the artificial reproduction of analcime, by M. de Schulten. His former method was heating a solution of caustic soda in sealed tubes of ordinary French glass. In another, he mixes solutions of silicate and aluminate of soda, such that the silica and alumina are in the same ratio as analcime, adds some lime-water (to facilitate crystallisation), and heats in a copper tube at 180° for eighteen hours. While analcime, in natural specimens, has optical properties indicating the quadratic form, the author's first artificial reproduction gave crystals apparently rhombohedral, and his second, distinctly cubical crystals.—Study of subterranean waters in the department of the Meuse, by M. Holtz. Some parts of France, such as Normandy, are almost entirely without subterranean waters, owing to the refractory nature of their ground, but it is otherwise with the departments of the north-east (Meuse included), in the oolithic zone.—M. Pernolet indicated several examples of the diffusion of carbon.

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