THURSDAY, APRIL 11, 1872

NEWSPAPER SCIENCE

WHETHER some knowledge of Science or some love for scientific truth will ever penetrate the masses, may well be questioned when we read such an article as the following, which appeared in the daily paper boasting the largest circulation in the world, and which we reprint almost entire as a curiosity of newspaper literature :—

"What is a Joule?—or who is he, if a Joule is a human being, and not a vegetable—a weapon of offence, or something to drink, or a Phantom? And if Joule be human, why did he not consider that human reason is fallible, and human patience exhaustible, when he penned, or got somebody else to pen, a maddening article which has appeared in the *Nautical Magazine*, from which we gather that the transformations of energy are in their nature similar to the operations of commerce; but with this difference, that in thermodynamics the relative values never vary. This, it seems, is the universal theorem of a Joule; and a red-hot poker must always bear the same relation to sixpence as the contents of a tea-kettle at boiling point bear to a five-pound note. . . . Under the new dispensation the sovereign, 'to which all other forms of energy can be referred,' is to be an unit of heat. On the obverse is stamped 'Joule's equivalent,' and on the other side is inscribed 772 foot-pounds. One unit of heat is the amount required to raise the temperature of one pound of water one degree, and the equivalent for this coin is 772 foot-pounds of work—that is, the work required to be expended to raise one pound weight 772 feet. . . . But what is the new 'Joule's equivalent' to be made of?—cobwebs, leather, or fresh butter?—and who wants to raise a pound weight 772 feet? As a problem of proportion, the theory is, of course, philosophical enough; but it would be just as easy to fix a unit of cold as well as a unit of heat; and, under any circumstances, until Joule comes into the open and tells us who he is, what he means, and when his equivalents are to be put into circulation, society, we fear, will decline to recognise a sovereign as a Joule, or thirty shillings as a Joule and a half."

Now, with the mental condition of the man who could pen such an article as this we have nothing to do; he may go on writing according to his lights every day of the week, and no one but his own friends need interfere to stop him. But there are one or two considerations which arise from the perusal of it not without their importance.

In the first place, bearing in mind the contempt for Science so often apparent in the public utterances of men of high calibre—instances occur to us as we write, and probably will to our readers, of men of the highest culture in literature or art, who never allude to scientific work or to scientific teachers without a scarcely disguised sneer at the inferior part which they play in the national economy—we may, after all, be content that Science is alluded to at all in a paper possessing so large a circulation. The next consideration is one to which we attach the highest importance.

Surely it is now time that scientific men themselves should take a little more trouble than they do—we know it is asking a good deal from them—in the matter of bringing their own work, and the importance of it to the community, before such audiences as the daily papers afford. Were they to do this, the labours of our great scientific teachers—our Huxleys, Tyndalls, and Carpenters—would be enormously lightened. If we hear of an attendance of several thousands at a penny lecture by Huxley at Manchester, or a Sunday afternoon lecture in St. George's Hall by Carpenter, we fancy a love of science is spreading with rapid strides; but the fact is that the strides are not so rapid as they might be, because the labourers on whom progress depends are so few and the area of their lecture work is restricted, whereas many newspapers, on the other hand, number their readers by hundreds of thousands. Until scientific men do this, we must be content with the present state of things. It is in no spirit of invidious comparison that we may remind our readers of the frequent extracts which appear in our columns from *Harper's Weekly*, a political and general paper of very large circulation in the United States, the scientific department of which, containing information of the highest value, is edited by one of the most eminent scientific men of America. But what is the present state of things with us? In the main it is one in which the public is informed of scientific work by others than the doers of the work; and the labour of classifying these writers is not difficult.

In the first place we have, we are thankful to say, a small though gradually increasing number whose labours leave nothing to be desired, who, being men of scientific culture themselves, take a pleasure in their work, and to whom the friends of Science in this country cannot be too grateful. As an illustration of the labours of this class of writers, designed to present to the non-scientific public an account of remarkable scientific phenomena, in popular and yet accurate language, we may refer to one of the most recent publications of this class, an article entitled "A Voyage to the Sun" in the March number of the *Cornhill Magazine*, which we commend to the notice of all aspirants after scientifico-literary fame. The play of fancy which invests with an attractive grace a subject that would appear dry to many, is combined with a happy art of describing scientific phenomena in clear and exact language, in a manner that we have seldom seen equalled. It is impossible to overrate the labours of these gentlemen in the present condition of Science in England.

Secondly, we have a still larger class where the intention is good, but in which the culture, scientific and otherwise, is not so high. In the writings of these Science is apt to run wild: accuracy gives place to imagery, and the would-be learners, after an hour's attempt at gaining knowledge, rise from it, knowing rather less than they did before, and looking upon Science as a fearful and wonderful thing with which the less they have to do the better.

We have next a third class, composed of writers as widely different as the poles, but we place them together because the harm they both do is incalculable. The writer who is anxious to know what a "Joule" is may be taken as the type of one division. Grossly ignorant of all kinds of Science, it is nothing to him that he should bring it into discredit; he is doubtless paid for his work, and we need say no more about him. In the second division we find sometimes high culture, but the writing is not written for Science' sake. It is entirely a personal affair. The advancement of Science gives way to that of the individual and his friends, and any subject written upon is seen through a fog of personality and advertisement.

On the whole we prefer the author of "What is a Joule?" to such a man as this, because we believe he does less harm, and is less likely to mislead "able editors."

There is one grain of comfort even in the imbecilities and inanities of would-be humorous writers in newspapers, that at least they have woke up to the idea that a scientific discovery is worth laughing at. This is a step gained. Twenty years ago, even ten years ago, the name of even so distinguished a scientist as Dr. Joule would have been utterly unknown to the herd of newspaper writers. We must be thankful for even this much; and look hopefully forward to the good day coming when Science will take her place by the side of her sisters, Art and Literature, as equally deserving of popular culture.

GRISEBACH'S VEGETATION OF THE GLOBE

Die Vegetation der Erde nach ihrer klimatischen Anordnung: ein Abriss der vergleichenden Geographie der Pflanzen; von A. Grisebach. 2 vol. (Leipzig: Engelmann, 1872.)

THIS important contribution to a branch of the science which, since the publication of A. de Candolle's "Géographie Botanique" and the promulgation of the Darwinian theories, has been daily acquiring greater value in the minds of philosophical naturalists, is the result of long study and persevering accumulation of data on the part of the learned author. Prof. Grisebach had already, in the "Linnæa" for 1838, given his first views on the limitation of natural floras by climatological influences; and since 1840 he has, in his periodical reports on the progress of geographical botany, entered more or less into the principles and conclusions which he has successively entertained or matured. He now supplies us in these volumes with a methodical digest of the facts he has collected, and of the conclusions he would draw from them. The result is a rich store of materials, which future investigators of the subject must necessarily have recourse to, and the arrangement adopted is perhaps the one best calculated to illustrate that branch of it which is more especially indicated by the title, the influence of climate and physical conditions on the stations and areas of species. But to the general naturalist the value of the work as a book of reference is much diminished by two great deficiencies; there is no summary of the conclusions he would draw from the facts he has detailed, and no index to enable the reader to turn to any individual fact, argument, or deduction, which may have struck him in the perusal of above 1,200 closely printed pages.

The question of the Origin of Species is not entered into, for the author believes that acknowledged facts prove nothing more than the production of varieties through climatological or other influences, but that "however interesting speculations on the genetic connections of organisms may appear, we abandon the territory of facts when we indulge in conjectures on the origin of more widely separated forms or races, of species, genera, or families of plants or animals." "That the limits between a species and a variety are not always to be strictly defined, is no reason," he observes, "why we should ascribe to both an identical process of formation, or that we should regard the forces by which the gradual variations of forms are effected as the only ones by which the multiplicity of nature has been produced."

As far as we have been able to collect the professor's views, his idea seems to be that, whatever may have been its origin, every species now existing on the globe was at some given (or uncertain) time "produced" in one particular spot, the centre of the species, from whence it has, from the natural tendency to multiplication inherent in every organised race, spread in every direction where its progress has not been checked by extraneous causes, generally by climatological or other physical opposing influences, sometimes by the mere struggle with competing races. Wherever a considerable number of species appear to have had their centres within a limited area, that area is termed a centre of vegetation (*Vegetations-centrum*); where the migration of plants from one or more centres is limited by physical obstructions, by mountain chains, seas, adverse climate, &c., the space thus enclosed is the province (*Gebiet*) of a natural flora. For the "centres of vegetation," the author had originally made use of the term "centres of creation" (*Schöpfungs-centren*), which he has now abandoned on account of the objections made to it as expressing some definite process of production. "I, at least," he adds, "under an act of creation, never understood anything else than the operation of certain laws of nature, the further knowledge of which is, as yet, withheld from us. Bentham prefers for the term 'centres of vegetation' that of 'areas of preservation,' when they remain in their original state, as in oceanic islands, a mode of expression to which we might well be reconciled" (p. 523). With regard to the term *Gebiet*, the natural translation would be *region*, but in this instance, with the facility enjoyed by Germans of adopting words of foreign languages, the word "Region" is made use of for areas limited by altitude within the *Gebiet*.

The twenty-four botanical provinces of natural floras which Grisebach had already sketched out in Petermann's *Mittheilungen* are here necessarily taken in detail, investigating under each one—(1) the climate; (2) the prevailing plant-forms; (3) the prevailing plant-formations; (4) the regions, chiefly as to altitude; and (5) the centres of vegetation included in the province. For the "plant-forms" he has carried out a classification founded on that of Humboldt, distributing plants under seven heads—(1) woody plants; (2) succulent plants; (3) climbers; (4) epiphytes; (5) herbs; (6) grasses—including sedges, reeds, &c.; (7) cellular plants: each one subdivided into minor groups. The "plant-formations" are tracts of country whose general aspect is characterised by their vegetation, such as forests, heaths, scrubs, deserts, cultivated tracts, &c.

The two provinces worked out with the greatest care, and for which the materials here collected are perhaps the most deserving of study, as being the most ample, and in both cases checked by the personal experience of the author, are the Forest-province (Waldgebiet) of the eastern continent (the greater part of Europe and temperate Asia), and the Mediterranean region; the one characterised by its vast uniformity, the other by its broken diversity; in both of which the complicated influences of climate, configuration, and soil, have been more carefully observed, recorded, and studied, than in any other quarter of the globe. The Mediterranean region is particularly instructive, not only from the richness of the flora, but from the large number of endemic monotypes (monotypic genera or sub-genera, or widely distinct species), confined to very restricted areas, and of disjointed species—identical species in widely dissevered areas. With regard to the species of narrowly confined stations, Prof. Grisebach believes that the considerations he has brought forward tell decidedly in favour of the conclusion "that monotypes and other rare organisms are not—or, at least, are not generally—to be regarded as the surviving remains of earlier creations, but as evidences of the productive power of the localities where they are now to be found, and from whence no means of migration are within their reach" (p. 364). He can, however, scarcely have paid attention to the various proofs recorded of the gradual reduction of the areas of several Mediterranean species, even within historical times, and still more since an immediately preceding geological epoch—that of the formation of the tufas of the south of France. He does not, indeed, seem to be aware of the instructive memoirs on this subject of Gustave Planchon (see Nat. Hist. Review, 1865, p. 202).

The "disjointed" species, on the other hand, appear to have puzzled Prof. Grisebach, as they have done and will continue to puzzle all speculators on Geographical Botany. Grisebach endeavours to reduce their number as much as possible; sometimes by the discovery of intermediate stations; then, again, by presumed colonisation through man or other agencies; or by showing that supposed identical forms in distant areas are really distinct species, and, therefore, beyond the scope of inquiries limited to the age of now-existing species. But yet, in the Mediterranean as in the Japanese provinces, he is obliged to admit some which occupy two limited areas separated by enormous intervals. Thus, although he supposes that the appearance of *Rhododendron ponticum* on the coast of Portugal may have been the result of introduction by the Arabs, that *Geum heterocarpum*, now only known from the mountain regions of S. Spain and of Elborus in Persia, may yet be found in intermediate localities; yet such suppositions, he admits, can in no way account for the disseverence of the Cedar in the Atlas, the Lebanon, and the Himalaya, or of the *Pinus excelsa* in the mountains of Macedonia and the Himalayas. Unwilling to admit that these and other instances (far more numerous than acknowledged by Grisebach) of widely dissevered stations may be the remains of once continuous areas, he suggests the possibility of the transference of seeds by winds, birds, &c. Birds are, indeed, probably powerful assistants in the migrations of plants. But the effect of winds has been much overrated, as shown for instance by Kerner in a paper recently published in the *Zeitschrift des Deutschen Alpenvereins*, and is made more of perhaps by Grisebach in the present work than by any other observer, and not always on the safest data. Thus he attaches (p. 389) great importance to an "unpublished memorandum of Berthelot's," that is to a label to a specimen of *Erigeron ambiguus*, bearing the words "cette composée, qui a quelques rapports avec les Conyza, est devenue très-commune sur toutes les côtes de Ténériffe après le dernier ouragan." This memorandum is amplified into "On the Canary Islands whose flora was so well known to him, this traveller saw, immediately after a violent hurricane, an annual Synantherea (*Erigeron ambiguus*) which is generally dispersed over the Mediterranean flora, suddenly germinate and take permanent possession of the soil in the most diversified stations," the amplification thus including some half-a-dozen statements not contained in the original memorandum, adding especially the *propter hoc* to the *post hoc*. *Erigeron ambiguus* is one of those plants of which a single individual will produce seed enough to cover a considerable tract of country in the next following season, if favoured by a suspension of those counteracting influences which annually destroy all but one out of thousands, either in the state of seed or of the infant plant; and in Berthelot's memorandum we find no evidence either that the plant was not in the islands before the storm, or that the seed was actually brought by the storm, or that if so brought its germination and early growth were so exceptionally rapid, as to show the plant in an observable stage "immediately" after the storm. The inquiry, however, into the causes of the disseverance of areas, whether due to the gradual extinction of old races, or to the colonisation of new ones, remains one of the most interesting problems for solution in Geographical Botany.

OUR BOOK SHELF

Consumption, and the Breath Rebreathed. By Henry MacCormac, M.D. (London: Longmans, 1872.)

THIS work is written *con amore* by an enthusiastic physician, who has satisfied himself of the truth of the theory he advances, and is now desirous of convincing the rest of the world. The theory broached by Dr. MacCormac is that phthisis or pulmonary consumption, as well as tubercle generally, is always and exclusively the result of the breathing of air that has already been vitiated by respiration. It is well known that air that has once passed through the lungs has undergone important changes. Its oxygen is reduced in quantity, a nearly corresponding amount of carbonic acid has been added, and it also contains certain organic compounds the nature of which has not been very satisfactorily determined, but which are undoubtedly of an effete nature, and analogous in their composition to the disintegrated organic compounds eliminated from the body by the other excretory organs. The extremely deleterious action of the re-introduction into the system of the materials discharged by the intestines is now very generally known, from the inquiries that have been instituted into the nature and origin of typhoid fever; and Dr. MacCormac is perfectly justified from analogy in attributing serious results to the re-introduction into the system by the lungs of the air which has once passed through it, and which is consequently charged with decomposing substances. The carbonic acid alone is bad enough, but even if this were removed as fast as formed and replaced by oxygen, while the animal still continues to breathe the air it has already expired, there can be little doubt that it would speedily feel the effects of the other impurities with which expired air is charged. Under ordinary circumstances the only means of avoiding these effects is to permit free access of air to all and every apartment in which man is confined either by day or night; and so far we cordially endorse the views and recommendations of the author of the work before us. But when Dr. MacCormac states that tubercle is exclusively the result of breathing expired air, we think he carries his theory too far. We cannot put aside in the facile manner he adopts the influence of hereditary predisposition, nor the effects of exposure to damp and cold, when combined with insufficient food. Imperfect ventilation is so common that it is almost always associated with the other probable causes of tubercle, and it is difficult to give instances where tubercular consumption has made its appearance whilst perfectly pure air is continually breathed. But, we think, various considerations render Dr. MacCormac's views untenable. We will not refer to Iceland or to the inhabitants of the elevated plains of the Andes, or of the Steppes of Asia—all of which are sad stumbling-blocks in his way—because, as he says, they are so far off, and our facts in regard to the frequency of tubercle in these regions are perhaps not quite satisfactorily ascertained. But we may call attention to the circumstance that the disease is more common in England than in almost any other country—than in France, for example; yet, surely, the hygienic relations in regard to ventilation are superior in England to those existing on the other side of the Channel.

If air that has been breathed is so certainly the cause of tubercle, the poor population of London and other large towns should not only be decimated, but should be swept off *en masse*, for they all breathe through the night, and through a great part of the day, air so contaminated. Once more, how is it that one member of a household belonging to the upper class is attacked and dies, though all the rest, notwithstanding their being exposed to the same conditions, are preserved? Looking at animals, again, any Indian medical officer will tell Dr. MacCormac that monkeys kept in confinement, though they have never had a roof over their heads and have consequently never breathed air a second time, will die with their lungs stuffed with tubercle. Lastly, the evidence is very strong in favour of Virchow's view, that tubercular matter is originally composed of cells resembling the white corpuscles of the blood, which are either modified white corpuscles, or, as Virchow himself maintains, proceeds from the prolification of connective tissue corpuscles. Whilst disagreeing, therefore, with Dr. MacCormac in regarding the breathing of air imperfectly freed from the products of previous respiration as the exclusive cause of tubercle, we may fully endorse his views upon the desirability of thorough and complete ventilation, especially in our sitting-rooms and sleeping apartments. The exigencies of modern civilisation seem to lead unavoidably to the close herding of mankind; but we confess it is with a sigh of regret that we see year by year long lines of close-packed houses, springing up on what were but recently green fields on every side of this great metropolis. To reach green fields and breathe fresh air is now a day's work.

H. POWER

Theory of Friction. By John H. Jellett, B.D., P.R.I.A. (Dublin: Hodges and Co.; London: Macmillan)

THIS book is, to a certain extent, of the character of a supplement to ordinary treatises on mechanics. It deals with the question of friction by the use of analytical expressions very general in the possibility of their application, on which account perhaps some of the significance of their physical character may be apt to escape the general reader, and the book is thus, perhaps, rather more suitable for advanced than for junior students.

The author brings well into prominence the radical difference between problems in statical and dynamical friction, namely, that the latter are determinate, whereas the former are not necessarily so. He says:—

"When a system of material particles, each of which rests on a rough surface, is subject to the action of external forces, it will in general be found that, of these particles, some will be in a state of motion and others in a state of rest. Everything connected with the moving particles, namely, their positions, their velocities, and the forces, geometrical and frictional, which act upon them, is fully determined by means of the dynamical and geometrical equations. The geometrical and frictional forces which act upon the quiescent particles will also be determinate, unless it be possible to form by elimination one or more equations between the co-ordinates of the quiescent particles *only*. If this *be* possible, the geometrical force replacing every such equation will be indeterminate in intensity."

The character and cause of the analytical indeterminateness in the case of statical friction is enunciated in the following words, which obviously apply also to forces not frictional:—

"If any one or more of the forces acting upon the particles of a system be not determinate functions of the co-ordinates, the number of the unknown quantities will exceed the number of equations, and there will be in general an infinite number of positions satisfying the conditions of equilibrium, disposed in one or more groups, in each of which these positions succeed one another continuously."

There is an interesting chapter on the distinction between necessary and possible equilibrium, arising, so far as friction is concerned, from the fact that the coefficient of dynamical friction is less than that of statical friction, so that "if the system be disturbed from its position of equilibrium by the communication of infinitely small velocities to its several points, when the friction at each point will, of course, become dynamical, a finite force tending to augment the displacement may at once be developed at some or all of these points." The whole point of distinction between this and ordinary unstable equilibrium, when friction is not taken into account, consists in the fact of the infinitely small velocity calling into play a finite force, which it would not do in the case of ordinary unstable equilibrium, in the lapse of a finite time. Without questioning the analytical excellence and interest of the investigation, we may hesitate in adopting the change from statical to dynamical friction as a consequence of the assumption of an infinitely small velocity. We would point to the following problem (page 170) as a good example of the concrete application of the principles of the treatise:—"Two rods, AB, CD, firmly jointed together at B, rest so that A presses against a rough vertical surface, and CD lies on a rough peg in the same vertical; find the limiting positions and the nature of the equilibrium."

At the end of the book there are several problems worked out, namely, the well-known problem of a top spinning on a rough plane, the problem of "friction wheels," and one or two problems connected with the driving wheels of locomotives.

J. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Adamites

I SHOULD not have noticed the letter of "M. A. I.," which appeared in the last number of NATURE, with reference to my paper on "The Adamites," were it not that my silence might be interpreted as an acknowledgment of the justice of the remarks of the anonymous writer. If I had been silent, however, I trust your readers would have had more sense than to accept the dictum of a writer, anonymous or otherwise, who thinks to negative the conclusions of a paper, written at least in a truly scientific spirit, by such nonsense as the reference to *Paddy* and *Taffy*. One looks for reasoning in the criticisms which appear in such a journal as NATURE, and not for a misleading statement of an opponent's position, supported by reference to general conclusions and the use of weak satire. When "M. A. I." condescends to advance an argument, I shall be happy to consider it; and if it should be unanswerable, I shall not hesitate to admit it to be so. Doubtless I ought to feel thankful for the tenderness with which he has trodden on my toes, but I have scant regard for mere courtesy where questions of science are at stake; and in the interests of truth I would rather that the errors of my "unlucky paper" should be openly exposed, than that I should be "damned with faint praise."

Hull, April 8 C. STANILAND WAKE

The Aurora of February 4

THE Scottish Meteorological Society has just received the schedules of its observers in Iceland and Farö for February last. At Stykkisholm, on the north-west of Iceland, auroras were seen on each of the nights of the 3rd, 4th, and 5th, and at Thorshavn an aurora of a remarkably red colour was observed in the S.E and S. in the evening of the 4th. It was also observed at North Uist, Shetland, of a very red colour, and over all the S.E. of the sky; at Monach, the most western island of the Hebrides, and at nearly all the 150 stations which report to the Society, appearing at some places as early as 5 P.M., and continuing visible at others till half-past one on the morning of the 5th. Major Stuart, the Society's observer at Janina, Greece, also reports an aurora on the 4th from 6.30 P.M. to midnight.

On the evening of the 4th much thunder and lightning occurred in Monach, South Uist, Skye, and others of the Western Isles, and on the mainland of Scotland adjacent, even as far inland as Corrimony, fifteen miles west of Loch Ness.

The weather preceding and following this aurora was very remarkable. At Stykkisholm, 22° 43′ W. long., the mean height of the barometer from the 30th of January to the 5th of February was only 28·798 inches, and the wind N.E. throughout, except on one of the days, when it was E. At this same place a storm of wind, with snow showers, began at 1 A.M. of the 30th of January, and continued without intermission for 102 hours, or till 7 A.M. of the 3rd, on which day and on the 4th the weather was fine and seasonable and the wind light.

At Monach, 7°34′ W. long., a storm of wind began at 6 A.M. of January 30 and continued to blow from W.S.W., S.W., and S. till 2.30 A.M. of February 5, having thus lasted about 140 hours.

On the west of Scotland and the Western Isles, a heavy storm of wind from S. or S.W. was blowing during the evening of the 4th, the sky being generally clear, and the aurora, consequently, well seen. But at some places the sky presented a strange lurid appearance, as the aurora appeared through the opening clouds as they drifted past. Shortly after the disappearance of the aurora, the wind moderated and fine weather followed.

But in the east of Scotland the storm from the south, accompanied with drizzle and mist, did not break out till the morning of the 5th, or some time after the aurora had disappeared. It was to have been expected that an aurora extending over so much of the earth's surface would be preceded, accompanied, and followed by very different weather in different regions; and we have seen it coming thirty-six hours after a protracted period of stormy weather in Iceland, closing an equally protracted period of stormy weather in West Hebrides, and preceding a storm of wind and rain in the east of Scotland.

ALEXANDER BUCHAN

Scottish Meteorological Society, Edinburgh, April 8

HAVING seen an account of the aurora borealis which was visible in England on the night of February 4, I think that you or some of your scientific friends might like to know that a very brilliant display of aurora was visible here and in other parts of the West Indies on the same night.

On the night of February 4, I was going from Porto Rico to Puerto Plata in, roughly speaking, lat. 19° N., long. 48° W. The aurora was first seen at 8.30 P.M., was most brilliant at 10 P.M., and gradually died away by midnight; the corresponding times at Greenwich would have been 1 A.M., 2.30 A.M., and 4.30 A.M., February 5.

I have several times seen auroras off the Western Islands, but only remember having seen one several years ago in the West Indies.

There were no pillars or points of light in this aurora, but a bright flush in the northern sky, which surged up and died away again every now and then, and was brightest about 10 P.M.

STEPHEN DIX

H.M.S. *Mersey*, St. Thomas, March 14

THE aurora of February 4 was visible at this point, but seems to have been unobserved, except by a very few. My position was on the deck of a steamboat on the river going from this point to one 23 miles miles higher up. The aurora was first noticed by me at about 7 P.M., hanging over the woods to the north-east, and was mistaken by the Captain for a large fire, a common occurrence in our pine forests. Soon after, the glow, which was a very deep red, extended to the zenith, shading off there, whilst a much fainter red light appeared in the north-west.

My last observation was made at 8.30 P.M., and the light was then still very strong in the north-east. Being then upon a train, and passing through an unbroken pine forest, I could not note the time of disappearance of the display. I saw no streamers.

There was no aurora whatever to the south at any time visible from at least sunset to 8.30 P.M. The facilities for observing the sky in that direction were peculiarly favourable from the position upon the river. F. G. BROMBERG

Mobile, Alabama, U.S.A., March 23

On the Colour of a Hydrogen Flame

A CORRESPONDENT to your last number has troubled himself to propound an elaborate theory, to account for the blue tinge which he states is always exhibited by the flame of hydrogen. There are also several text-books on chemistry which assert that hydrogen burns with a characteristic faint blue flame. It is easy to prove, however, that the flame of pure hydrogen has no blue tinge whatever. The blueness so frequently associated with the flame of hydrogen is really due to the presence of sulphur, as is shown in a little paper I published in the *Philosophical Magazine* for November 1865.* It is possible that the facts mentioned in that paper may be turned to a practical end by some of your readers, and therefore it may not be altogether useless if I put down—for such disposal as you deem proper—one or two interesting phenomena associated with the combustion of hydrogen.

There must I imagine be some people who write text-books on experimental science without having verified any of the facts they state. Otherwise one cannot account for some obvious errors which are propagated from one writer to another. The blueness of a hydrogen flame is one such error, and another still more glaring can be traced back through several high authorities. The fact is stated that a rod of iron, or a sewing needle, remains suspended in the centre of a helix of wire through which an electric current is passing. So long as the helix is animated by the current the iron is said to behave like Mahomet's coffin, and hang in the air without the least contact with any solid body. But this is *not* the case, however strong the current, or small the iron, or however the helix may be disposed.

More serious errors than these are to be met with in some of the little books on science for school use, that are now cropping up like mushrooms. Heads of schools cannot exercise too much caution in the introduction of text-books on science, for they know how a poor class book once in a school is a most difficult thing to eject. It is therefore impossible to over-estimate the value of books for boys written by men like Profs. Huxley, Roscoe, and Balfour Stewart. An extraordinary impulse to scientific teaching has been given by the manuals of these and other eminent authors, and of the gladness with which such books are received by elder boys I, like others, can testify.

And now, as a teacher, permit me, Sir, to tender to the same authors not only my own gratitude, but the genuine and hearty thanks of younger boys for their simply delightful Science Primers. W. F. BARRETT

International College, Spring Grove, W.

[We hope to give in our next number a summary of the experiments to which our correspondent alludes.—ED.]

Barometric Depressions

I HAVE only just seen Mr. Murphy's criticism on my paper, which appeared in your columns on the 21st ult. I intended that paper as a continuation of one which appeared last year. The former aimed at showing that the ordinary variations of the barometer could not be explained by aqueous vapour; the latter at proving that they were accounted for by the heating and cooling of dry air. Into this question of air *versus* vapour the earth's rotation did not enter, and I consequently took no account of it

* A year or two ago I was surprised and amused to read this investigation repeated in the pages of the *Comptes Rendus*. I forget the name of the French chemist who contributed it to the Academy, but he was doubtless unaware of anything I had written on the subject.

in my reasonings. The casual remark, however, which Mr. Murphy fastens on as involving "a serious mistake in the theory of the trade winds," was almost copied from Article 211 of "Tyndall on Heat;" and as to the matter of fact, I think it is Mr. Murphy, and not Prof. Tyndall or myself, who has fallen into error. Even if I saw any reason why east and west winds should exactly balance each other on the earth's surface, I could not accept Mr. Murphy's position, that if the earth were of any other shape the trade winds could not proceed from the medial line to the extremities. He assumes that the trade winds are east winds, *independently of the shape of the earth*, whereas it is just the shape of the earth that makes them east winds. If the earth were a cylinder revolving on its axis, the trade winds (if they could arise under the circumstances) would move directly north and south, and would not be east winds at all; and I can see no reason why they should not extend to the extremity of the cylinder. See "Tyndall," *loc. cit.*

Trinity College, Dublin, April 3 W. H. S. MONCK

Height of Cirrus Cloud

IT would be interesting if any of the readers of NATURE could give some information respecting the usual height of cirrus clouds. Mr. Clement Ley, in his work, "The Laws of the Winds," states—"The time occupied by these clouds in passing from the zenith to 45°, or the contrary, furnishes us with a standard of measurement which is both convenient for simultaneous observations, and also possesses this obvious advantage, that whenever the altitude of the cloud station is at all determinable, none but the simplest of calculations is required in deducing the actual from the apparent velocity." Granted; but it would have been advantageous had he shown by an example what he means. For, he goes on to say, "The ordinary range of the actual rapidity of this current is about twice as great as that of the rapidity of the surface winds, for while the latter, at stations most fully exposed to their violence, rarely attain, in Europe, a velocity of 60 or 70 miles an hour, the most elevated clouds not uncommonly traverse a distance of 120 miles an hour, and occasionally much more." Coupling this with the next statement—"I have only once or twice observed an actually motionless cirrus cloud, and it is on rare occasions that an hour is occupied in passing from the zenith to 45°," let me ask, what would be the vertical height of such a cloud? R. STRACHAN

Low Conductivity of Copper Wire

AS one of very numerous instances which have come under his notice, Sir William Thomson desires to make known the following case of the employment of inferior copper wire in the construction of electrical apparatus. He received lately from a Glasgow bell-hanger a large quantity of cotton-covered copper wire, which was being largely used for the coils of electric bells, and upon having it tested very accurately by means of his new Multiple Arc Conductivity Box, its resistance per metre-gramme was found to be no less than 0·439 of a B. A. unit; that of ordinarily good copper wire for such purposes being about 0·16 of a B. A. unit. J. M.

A Pelagic Floating Fish Nest

AMONG other rarities which I have been fortunate enough to procure since my arrival in the Bermudas, is a pelagic fish nest, similar in most respects to that which Agassiz has so recently described, and which was obtained by the American Expedition in the Gulf Stream in December last, while on the voyage to the West Indies. As I am very busy at present preserving and packing specimens, and the mail steamer nearly due, I have only time to send you (by way of St. Thomas) a brief description of my nest, which has been preserved in diluted alcohol. It was taken from a mass of gulf weed (*Fucus natans*) blown ashore about a month ago. This weed, by-the-bye, has been especially abundant about the Bermudas during the present winter, thousands upon thousands of tons having been cast ashore by the waves during the stormy weather which has prevailed. The size of the whole mass is about eight inches by five as it hangs suspended, the former measurement being its depth. The weed is thicker at the top, and is woven together by a maze of fine elastic threads, affording a raft, from which depends the clustering mass of eggs, which I cannot illustrate better than by asking your readers to imagine two or three pounds of No. 7 shot grouped together in bunches of several grains, and held in position by the elastic thread-work previously mentioned. These threads are amazingly strong, especially at their terminal bases on the fucus sprays, where several are apparently twisted together like the fibres of rope, and are admirably adapted to hold the mass in a position where it must always be subject, more or less, to violence, from the continued agitation of the waves in these stormy latitudes. The sea-weed is not only on the summit, but sundry sprays are interwoven with the mass of eggs, thereby rendering the fabric still more solid and secure. It is truly a wonderful specimen of Nature's handiwork; a house built without hands, resting securely on the bosom of the rolling deep.

J. MATTHEW JONES

"An Odd Fish"

SOME short time ago I observed in one of the daily papers an account of "an odd fish" which had been captured, and described by Prof. Agassiz as a denizen of the Gulf weed, on which it is said to walk with legs, and not to swim as other fishes do.

From the above account I suppose that I must have caught the fish in question in July last, during the homeward voyage of H.M.S. *Charybdis*, in lat. somewhere about 15° N., and from the Gulf weed, as described by Prof. Agassiz. The preparation I shall be happy to present to the British Museum if it should turn out to be a species of which no specimen exists in that institution.

It will be observed that the pectoral fins are developed into arms, and the ventrals into legs, though less perfect in form than are the arms.

Sir Philip Egerton has seen it, and pronounces it to be a species of blenny, a shallow water fish; and Capt. Spratt has kindly informed me that it recalls to his mind a theory entertained by the late Prof. Forbes, that the Gulf weed is the product of a shallow water, such as existed before the subsidence of the Miocene formation; and that it may contain a shallow sea fauna, although found in latitudes where the ocean is deepest.

It is a curious fact if such be the case, and one which would appear to have its counterpart in the deepest holes from which Forbes dredged molluscs, which have continued to live therein, and to have survived their congeners of former geological epochs.

J. E. MERYON

The Law of Variation

IN Mr. A. W. Bennett's notice of the sixth edition of the "Origin of Species," he calls attention to the insufficiency of the theory of "Natural Selection" to explain original variations, and says, "If it is admitted that important modifications are due to 'spontaneous variability,'" &c. Now is there no cause for primary, or spontaneous variability?

Is it not presumed under the law of inheritance that, in order that the offspring may be the *exact type* of the parent form, all the conditions of generation and life, and all the forces that affect life, whether generating or external, must be *precisely the same?* Strictly speaking, under the varying circumstances of life, this is never the case; hence slight individual variations; for no individual force can operate as a cause without its effect. These caused variations may sometimes be wide, and may be helpful or hurtful; if helpful, "Natural Selection" would take them up and preserve them and improve them. A. J. WARNER

Marietta, Ohio, March 14

Actinic Power of the Electric Light

MR. MEEZE says in NATURE of the 4th, "May not the great actinic power of the electric light be due in a great measure to the secondary waves produced by the magnitude of the disturbing force?"

This may be true, but there is a cause for the fact which is known to exist, namely, that the electric light is bluer than solar light, that it is to say, it contains a greater proportion of the shorter and more refrangible waves, which have the greatest actinic power. This is due to the absorption of more of the shorter than of the longer waves—in other words, absorption rather at the blue than at the red end of the spectrum—which takes place in the sun's atmosphere. In the magnesium light also, great actinic power is associated with a blue tint.

JOSEPH JOHN MURPHY

Protective Mimicry

IN NATURE, No. 126, for 28th ult., at p. 436, M. G. Pouchet is recorded to have stated in a paper read before the Academy of Sciences, first, that prawns accommodate their colour to that of surrounding objects; second, that removing their eyes prevents this change of colour.

Of the truth of the first assertion I presume there is no doubt; but of the second I should much like to learn further, for when we speak of Protective Mimicry in all the lower forms of life, we do not assume that there is any ratiocinative mimicry. Yet if this power of protective mimicking in the prawn is dependent upon eye-sight, *i.e.*, upon the power of conveying impressions upon the optic nerve to the brain, does it not cease to be "mimicry" as generally understood, and pass into the order of mental volition? If so, how vast and interesting is the consideration!

I hope that Mr Darwin, Mr. Wallace, or some other of your scientific contributors will enlighten through your columns

March 31 IGNORAMUS

CRANIAL MEASUREMENTS

WHILE engaged in the investigation of another matter, I was induced to make a series of cranial measurements, and these I wish to record under the impression that they may be of use in the hands of some future worker, though by themselves they are not of much value.

The measurements were made at Wakefield, in Yorkshire, during 1868-9, and are those of the working-classes of the town and neighbourhood. Careful inquiry was made as to the birthplace and parentage of each subject, and no measurements are given save of those belonging to the basin of the rivers Calder and Aire. The type of the people is pre-eminently Saxon, and the results may therefore be taken as pretty accurately representing the configuration of the crania of modern Yorkshire.

Attached are also the average height and weight for each decade, and a calculation of the average cephalic index.

The measurements of the head were taken by large callipers, and are simply the greatest bi-parietal and occipito-frontal diameters, and the measurement of the face is from the tip of the chin to the root of the hair on the forehead.

The average cephalic indices of the whole would show men to be slightly more brachio-cephalic than women (by ·75), while the result of the whole is decidedly eurycephalic.

The cephalic indices of each decade of age would lead us to believe that dolicho-cephalic people have a better chance of life than the brachio-cephalic people, unless we believe that the form of the cranium alters between thirty and forty years of age.

The entire table leads me to believe that there is not much value to be placed in such cranial measurements for the purposes of racial distinction; certainly not in isolated skulls; for see the curious variations of measurement in couples of the same sex taken from the same decade, as shown in the table below:—

Age.	Length of head.	Breadth of head.	Cephalic Index.	Difference in Cephalic Index.
Years.	Inches.	Inches.		
3	7·25	5·25	72·41	15·59
3	6·25	5·50	88·00	
14	7·12	5·37	75·42	8·55
14	7·12	6·00	84·27	
25	7·37	5·75	78·02	8·04
23	6·62	5·75	86·86	
32	5·87	6·12	104·26	26·12
35	7·00	5·75	82·14	
38	8·00	6·75	84·37	19·83
43	8·00	6·00	75·00	35·71
47	7·00	7·75	110·71	
52	7·75	6·00	77·42	5·31
52	7·25	6·00	82·76	
65	7·00	5·50	78·57	9·21
69	7·12	6·25	87·78	

For the purpose of contrasting the results I have obtained in the measurements of height and weight, I add a translation of Quetelet's tables:—

MEN.			WOMEN.		
Age.	Size.	Weight.	Age.	Size.	Weight.
	Ft. In.	Lbs.		Ft. In.	Lbs.
Birth	1 7·527	7·052	Birth	1 7·008	6·413
1	2 3·401	22·040	1	2 3·136	20·497
2	2 7·377	26·418	2	2 6·708	25·125
3	2 9·858	29·115	3	2 9·455	27·440
4	3 0·692	33·214	4	2 11·020	31·253
5	3 2·776	36·807	5	3 2·340	34·162
6	3 4·964	39·750	6	3 4·620	36·905
7	3 7·779	44·433	7	3 7·152	40·044
8	3 10·068	49·061	8	3 8·832	43·683
9	4 0·307	53·094	9	3 11·254	49·458
10	4 2·473	57·569	10	4 1·128	53·425
11	4 4·484	61·381	11	4 2·196	57·855
12	4 5·504	68·324	12	4 4·236	67·320
13	4 7·234	77·846	13	4 6·3[illegible]4	75·079
14	4 10·543	89·262	14	4 8·964	83·973
15	5 1·378	102·288	15	4 10·063	91·026
16	5 3·386	117·672	16	4 11·032	97·946
17	5 5·743	126·510	17	5 1·176	108·175
18	5 6·684	135·018	18	5 1·488	117·003
19	5 7·164	139·558	19		(not given)
20	5 7·356	143·261	20	5 1·800	120·030
25	5 7·788	150·512	25	5 2·076	121·397
30	5 7·788	151·857	30	5 2·160	121·529
40	5 7·440	151·658	40	5 1·212	124·857
50	5 5·904	148·661	50	5 0·423	128·826
60	5 4·524	144·363	60	4 11·673	125·034
70	5 3·888	138·919	70	4 11·604	118·400
80	5 3·404	134·930	80	4 11·294	112·551

MALES.

Age.	No. of Individuals.	Height.	Weight.	Length of head.	Breadth of head.	Face.	Cephalic Index.
		Feet. In.	Lbs.	Inches.	Inches.	Inches.	
3 to 4 months . . .	8	1 11·00	12·00	5·12	4·12	3·94	80·47
6 to 12 ,, . . .	8	2 2·50	21·12	5·69	4·62	4·50	81·20
12 to 18 ,, . . .	10	2 4·50	22·50	5·50	5·00	4·75	90·91
18 months to 2 years .	20	2 5·25	23·25	6·33	5·12	5·00	80·88
2 to 3 years . . .	14	2 9·50	25·25	6·75	5·20	5·33	77·04
3 to 5 ,, . . .	17	3 5·00	36·17	6·62	5·37	5·37	81·12
5 to 7 ,, . . .	9	3 7·50	39·89	6·87	5·75	5·81	83·70
7 to 10 ,, . . .	17	4 3·25	56·75	7·09	5·75	6·12	81·10
10 to 15 ,, . . .	40	4 7·76	78·50	7·25	5·75	6·50	79·31
15 to 20 ,, . . .	22	5 5·17	120·33	7·50	6·00	7·12	80·00
20 to 25 ,, . . .	13	5 7·67	152·00	7·50	6·00	7·33	80·00
25 to 30 ,, . . .	18	5 7·25	149·50	7·50	6·00	7·67	80·00
30 to 40 ,, . . .	29	5 7·00	146·33	7·11	6·00	7·00	84·37
40 to 50 ,, . . .	37	5 2·50	148·00	7·83	6·00	6·00	76·63
50 to 60 ,, . . .	47	5 8·12	139·50	7·50	5·87	7·50	78·27
60 to 70 ,, . . .	20	5 8·12	126·00	7·40	5·75	7·33	77·70
83½ years	1	5 10·00	174·00	7·87	6·00	6·87	76·24
Total	330					Average. .	80·04

FEMALES.

Age.	No. of Individuals.	Height.	Weight.	Length of head.	Breadth of head.	Face.	Cephalic Index.
		Feet. In.	Lbs.	Inches.	Inches.	Inches	
10 weeks	1	1 6·00	10·00	4·87	3·87	3·62	79·44
6 to 12 months . . .	9	2 1·57	16·29	5·71	4·75	4·75	83·19
12 to 18 ,, . . .	11	2 4·56	19·50	6·25	4·87	4·98	77·92
18 months to 2 years .	8	2 5·87	22 94	6·39	5·05	5·08	79·03
2 to 3 years . . .	9	2 7·94	25·44	6·35	5·35	5·37	84·25
3 to 5 ,, ...	13	2 11·62	30·31	6·75	5·25	5·35	77·78
5 to 7 ,, ...	17	3 4·91	39·03	6·86	5·37	5·57	78·28
7 to 10 ,, ...	7	3 11·75	51·50	6·79	5·41	5·79	79·68
10 to 15 ,, ...	35	4 2·50	75·74	6·88	5·59	6·29	81·25
15 to 20 ,, ...	49	5 0·94	110·14	7·08	5·67	6·65	80·08
20 to 25 ,, ...	24	5 6·95	121·00	6·57	5·51	6·44	83·87
25 to 30 ,, ...	44	5 1·96	119·45	6·99	5·88	6·66	84·12
30 to 40 ,, ...	49	5 1·43	124·74	7·22	5·36	6·71	74·24
40 to 50 ,, ...	64	5 2·70	132·34	7·31	5·77	6·27	78·93
50 to 60 ,, ...	46	5 2·66	135·17	7·32	5·80	6·44	79·79
60 to 70 ,, ...	17	5 1·94	133 29	6·93	5·52	6·64	79·65
70 to 80 ,, ...	5	5 2·10	123·50	7·27	5·82	6·47	80·06
Tota	408					Average .	79·30

LAWSON TAIT

ONE SOURCE OF SKIN DISEASES

OBSCURE affections of the skin of the face of men especially are well known to specialists to be widely spread. They are commonly classed as *ekzema*, and while causing great discomfort especially at night, show nothing, or almost nothing, to the eye, if the patient be otherwise in pretty good health. Skin specialists frequently ask patients whether they have been using any new sort of soap, but no one seems hitherto to have traced any distinct communication between soap and this troublesome disease.

As I have been able pretty distinctly to do so in reference to myself, probably a brief notice of the facts may not be out of place in NATURE, where it is likely to be of more popular benefit than if committed to the pages of a medical journal, in which the inferences of "mere laymen" are not greatly reputed. It is a fact but very little known to the multitude of both sexes who use the "Prime Old Brown Windsor Soap" of the perfumers' shops, that by far the largest proportion of it is manufactured from "bone-grease." Few more beautiful examples of chemical transformation are to be found in the whole range of chemical manufacture than this one. At one end of a long range of buildings we find a huge shed heaped up with bones, usually such as are of little value to the bone-turner or brush-maker, in all stages of putrefaction as to the adherent or inherent portions of softer animal matter attached to them, the odour of which is insupportable.

These are crushed and ground to a coarse powder, exposed to the action of boiling water under pressure, sometimes of steam, until the grease and marrow are extracted.

We need not here pursue the subsequent treatment of the rest of the material from which bone glue and "patent isinglass" are prepared, the latter of which we often eat in the soups and jellies of the pastrycooks, and finally to the "bone dust," or phosphate of lime, nearly free from animal matter, which is produced for the use of the assayer and the china manufacturer, &c., as well as for other purposes in the arts.

But let us follow up the bone-grease, which is of a dark tarry brown colour, and of an abominable odour.

By various processes it is more or less defæcated, bleached, and deodorised, and is separated into two or three different qualities, the most inferior of which goes to the formation of railway or other machinery greases, and the latter is saponified, and becomes, when well manufactured, a hard brown soap, still, however, retaining an unpleasant smell. It is now, after being remelted, strongly perfumed, so that, like the clothes and persons of the magnates of the Middle Ages, its own evil odour is hidden by the artificial perfume.

This is the "Fine Old Brown Windsor Soap" of most of our shops. The natural brown colour of the grease gives it the right tint in the cheapest way, without the colouring by caramel, which was the original method of manufacture.

Like all other things, there are cheap and dear Windsor soaps; and for the production of the former little is done beyond saponifying and casting into blocks or bars. Were we to rely upon the many experiments that have been made as to the degree of elevation of temperature at which putrescent or other contagious matter is deprived of its morbific power, we might conclude that boiling and saponifying had made this hitherto putrescent grease innocuous.

It seems, however, more than doubtful that such is the fact in this case, for the soap thus made seems to be capable of communicating skin diseases when rubbed on the face for use in shaving.

But another promoter of irritation is not unfrequently also found. Whether it be that it is more profitable to the soapmaker to have a liberal proportion of the finer particles of the ground bone made up with the soap, or that these are difficult to separate completely, the fact is that bars of this "Brown Windsor Soap" are to be bought containing a rich mixture of those small sharp angular fragments of bone which before boiling was putrid. When a piece of such soap is rubbed hard to a man's face, the skin is more or less cut and scored by these bony particles held in the soap like emery in a head "lap," and thus the skin is placed in the most favourable state to absorb whatever there may be of irritant, or contagious, or putrid in the soap itself. The existence of the bone fragments is easily verified by solution of the soap in water or alcohol, and examination of the undissolved particles with a lens; and I can readily, if need be, send you a piece of such soap for examination.

Now, without occupying too much of your space, I may just state that I have while using such shaving soap thrice suffered from ekzema of the face. On the first occasion I derived no benefit from treatment by the two most celebrated dermal surgeons in London, and at last the disease went away of itself after giving up shaving for a time. I had by me a quantity of this brown soap, and through inadvertence took to using it again, for a time without effect; but when dry and hot weather came, with it came a recurrence of the skin disease, which also again, after some months of discomfort, went away. Curious to make sure whether or not the soap was the real cause, I a third time employed the soap deliberately to see if the ekzema was due to it. I was in excellent health, and in about three weeks I found the disease reestablished, so that I think the soap must be viewed as found guilty. Good white unscented curd soap is now my resource, and with no ill-effects.

Ekzema is always a distressing complaint even when affecting those in the most robust health. With those of bad constitution or lowered health, however, it seems to degenerate into bad or intractable skin diseases, so that probably this notice may not be deemed useless or uncalled for.

R. M.

THE SCHOOL OF MILITARY ENGINEERING

THERE are few educational establishments, in this country at any rate, that fulfil their object so aptly and so well, as the School of Military Engineering at Chatham. When we remember the many sciences and technical accomplishments with which the officers of the Royal Engineers are conversant, and the practical use that many of them are required to make of their acquirements, it is very obvious indeed that, to be successful, the system of education must be a most complete and substantial one. It is, in truth, necessary that a man entering either of the scientific corps of the army—the Royal Artillery or Royal Engineers—should not only be intuitively quick and clever, so as to grapple with the multifarious subjects of study, but it is moreover quite as indispensable that he should be at the outset sufficiently strong and healthy to withstand the wear and tear of so much hard work. To become a Mr. Toots would, we fear, be the fate of many young gentlemen, were they passed through the Woolwich Academy, and into these departments of the Army, without first undergoing a rigid medical examination; for the severe and lengthy curriculum is such as would certainly jeopardise the health of any but the strongest constitutions. Commissions in the Royal Artillery and Royal Engineers, be it remembered, have for many years past been obtainable only by open competition, the successful candidates being admitted into the Royal Military Academy, whence they are passed into the Army when found properly qualified. But to compete successfully for admission to the Academy in the first instance, involves already a knowledge of mathematics, of experimental and applied sciences, of languages, and other subjects too numerous to detail, such indeed as is scarcely possessed by other well-educated professional men; and this, bear in mind, is but the starting-point of the scientific soldier's education. At the Academy, where the course of special instruction sometimes continues for three years, he has to pass from a lower to an upper section, and when successfully through the examinations that beset him at every turn, he receives his commission in a provisional sort of way only. The successful Academicians highest on the list are sent to Chatham, to commence instruction in their duties as Royal Engineers, while the remainder complete their education at Woolwich and Shoeburyness, as lieutenants in the Royal Artillery. And if, after all this, there are yet dissatisfied spirits, who still exhibit a craving for more, then there is the staff college, the advanced class, instruction certificates, and other ends to be attained, enough in all conscience to satisfy the most ambitious.

It is to the School of Military Engineering that the young lieutenants of Engineers are sent for instruction in their various duties, and it is only after passing through a two years' course at this establishment that their commissions are actually secured to them. The professors, or instructors, as they are termed, are all officers of some years' standing in the corps, appointed by reason of their intimate acquaintance with the special subjects that they teach. These subjects are not only very various, but are, moreover, always increasing, as our system of warfare continually improves. Thus, besides the subjects of surveying, construction, estimating, fortifications, telegraphy, and other more ordinary, though not less practical, matters, there have been added of late years, chemistry, photography, army signalling, torpedo service, &c., all of which the Royal Engineer must know something about.

It is evident that mere theoretical instruction in matters like these would be of little use to men who occupy such practical appointments as are filled by most Engineer officers, and it is in this respect that the School of Military Engineering may claim superiority over kindred establishments. The studies, workshops, laboratories, and demonstrating schools are of the most complete description, while the outworks and broken ground upon the Chatham lines and around the Brompton Barracks afford ample scope for the practical prosecution of those studies which require a wide field of operations. It is this practical manner of going about one's duties that is calculated above all things to impart a thorough knowledge, and to inspire officers with true confidence in their abilities. Fortifications are designed, parallels drawn, mines prepared, bridges constructed, and other siege duties executed by the students themselves, to render them conversant with their duties practically as well as theoretically, while the appointment of temporary telegraph stations, the experimental application of explosive and torpedo charges, the actual exercise of signalling, both by day and night, impart experience which could not, of course, be gained by teaching or lectures in the schools.

But it is not only the officers who benefit by the Engineering School at Chatham. The non-commissioned officers, also, are required to attend instruction in field works, and can, indeed, if they desire it, pass through the entire system of study, a course imperative on all those desirous of promotion to "foremen of works," or to other similar positions. The sappers, too, are well acquainted with at least one trade, or calling, and as every company of Engineers is made up from a due proportion of all trades, it is obvious such a complete and intelligent body of men is ofttimes invaluable. Thus it is that, in the Colonies, in Australia, New Zealand, South Africa, and other stations where detachments of Royal Engineers have been sent, their services have been found so truly valuable, every available talent being at once at hand for the carrying out of the engineering and other kindred duties necessary to be fulfilled in the occupation of a rough untravelled country. As an instance of this, we need point merely to the recent Abyssinian Campaign, which may justly be called a triumph of engineering—a gigantic piece of road-making in fact—rather than a victory over half-naked Africans; for here we have in something like six months, a rough tract of country surveyed and mapped out, four hundred miles of road made, a line of railway laid down, telegraph communication established, wells sunk, and all this over and above the transport of a large body of men and war material.

The subject of torpedoes and submarine mines was so recently discussed in these columns, that we need not again refer at any length to this latest military science just now under special investigation at Chatham. But before concluding these few remarks, we may make mention of some experiments upon an extensive scale that were not long since made with these terribly destructive machines. The charges were fired from the shore by means of electricity, the signal for their discharge being given from the distance almost of a mile; and to show the control and certainty exercisable in the system employed, there was, in one instance, a steamer made to pass harmlessly over one of the charges, which immediately afterwards, at a given signal, blew into fragments a launch following in tow.

H. B. P.

LYELL'S PRINCIPLES OF GEOLOGY

THE appearance of a new edition of the "Principles of Geology" would mark a fitting time to pass in review the state of Geologic Science, to count up what has been added to the treasury of truth, and inquire in what direction and by what methods the pioneers of Science encourage us to search for new facts. Within the limits of a short review, however, it is impossible to do more than call attention to a few of the more striking points which seem to illustrate the principles which we should apply to the examination of the phenomena of the crust of the earth.

We have before us the first edition of the "Principles of Geology," published in 1830, and that just issued in 1872. It is a remarkable fact that any work on a science which has made such rapid progress as Geology has within the last forty-two years, should, while maintaining the foremost place, have remained so little altered during that period. Almost all the passages which lay down the principles remain word for word as they were originally given to the world; the changes made from time to time being chiefly in the introduction of better illustrations or the consideration of new questions which the progress of research has raised; but to all we find the same methods applied, and from all the same conclusions drawn as to the operation of nature in the production of the visible crust of the earth.

What, then, are the principles laid down? Thoroughly to understand this, we ought to follow our author through the interesting outline he gives of the progress of geological inquiry, in order to realise fully the opinions which prevailed when he first entered the arena. But we will only refer to the views of Hutton, which most nearly approach those of Sir Charles Lyell, who points out that "the characteristic feature of the Huttonian theory was the exclusion of all causes not supposed to belong to the present order of nature. . . . But Hutton had made no step beyond Hooke, Moro, and Raspe, in pointing out in what manner the laws now governing subterranean movements might bring about geological changes if sufficient time be allowed. He therefore required alternate periods of general disturbance and repose; and such he believed had been and would for ever be the course of nature" (1st ed. p. 63, 11th ed. p. 76).

The views which Hutton and his eloquent illustrator

FIG 1.—DWARF'S TOWER (ZWERGLI-THURM) NEAR VILSCH IN THE CANTON OF VALAIS.
(From a Sketch by Lady Lyell, taken September 1857.)

Playfair taught were far from meeting with general reception, and Lyell had to combat the catastrophic views of their opponents, and also to carry Hutton's uniformitarian principle further than Hutton himself allowed, and show by an appeal to observations in regions which are and have recently been in a state of volcanic activity that local catastrophic action is not inconsistent with continuity of causation. "There can be no doubt," says Sir Charles, "that periods of disturbance and repose have followed each other in succession in every region of the globe, but it may be equally true that the energy of subterranean movements has been always uniform as regards the *whole earth*. The force of earthquakes may for a cycle of years have been invariably confined as it is now, to large but determinate spaces, and may then have gradually shifted its position, so that another region which had for ages been at rest became in its turn the great theatre of action" (1st ed. p. 64, 11th ed. p. 77).

Our author places before us a vast array of facts collected by himself and others all over the world, which show the ceaseless waste going on by rain, rivers, sea, frost, and ice.

> The hills are shadows, and they flow
> From form to form, and nothing stands.

He explains how all the land must in time be carried away and one vast ocean roll all round the world were there no compensating forces. But then he points out to us that nature does provide a compensating action in the accumulation of volcanic ash and lava thrown out during eruptions, in the upheaval of large tracts of land from below the sea, and still further, that it is part of nature's plan to shift the scene of action.

We will select a few examples from the facts adduced in proof of the gradual waste of the land.

Speaking of the effect produced by rain, our author says:—"It is not often that the effects of the denuding action of rain can be studied separately or as distinct from those of running water. There are, however, several cases in the Alps . . . where columns of indurated mud varying in height from 20ft. to 100ft., and usually capped by a single stone, have been separated by rain from the terrace of which they once formed a part, and

* "The Principles of Geology, or the Modern Changes of the Earth and its Inhabitants considered as illustrations of Geology." By Sir Charles Lyell, Bart 11th and entirely revised edition. (London: J. Murray, 1872.)

now stand at various levels on the steep slopes bounding narrow valleys" (p. 329). "This mud, which is very hard and solid when dry, becomes traversed by vertical cracks after having been moistened by rain, and then dried by the sun. Those portions of the surface which are protected from the direct downward action of the rain by a stone or erratic block, become gradually detached and isolated." "The lower part of some of these ancient columns . . . has acquired new capping stones by the wearing out at the surface of blocks originally buried at great depths" (p. 332).

There they stand, a measure of the mass of drift that has been carried away by rain, as workmen sometimes leave a pillar of brickearth or clay here and there over a field to measure the depth of the earth they have removed.

They remind us also of the small pedestals of limestone which large boulders have sometimes preserved for themselves in the same way, and of the ice pillars where the thick stone cap had to keep off the sun instead of the rain.

By the courtesy of the publisher we are able to subjoin a sketch given by our author of an isolated stone-capped column seen by him near Viesch (Fig. 1).

In considering the action of rivers, Sir Charles notices how the clearing of forests increases the erosive power of the rain water. Speaking of a ravine in Georgia, he says, "before the land was cleared it had no existence, but when the trees of the forest were cut down, cracks three feet deep were caused by the sun's heat in the clay, and during the rains a sudden rush of water through the principal crack deepened it at its lower extremity, from whence the excavating power worked backwards till, in the course of twenty years, a chasm measuring no less than 55ft. in depth, 300 yards in length, and varying in width from 20ft. to 180ft., was the result" (p. 339).

In many parts of France the destruction of the woods has proved a source of very great injury, as they caught the rain and parted with it slowly, the roots all the while protecting the soil. But, now that the woods have been cut down, the water runs off at once, scouring away the earth from the slopes of the hills, and in the valleys causing sudden floods which sweep everything before them.

In America it is especially interesting to watch the effect produced by man in this way upon climate and water supply.

We are shown the power of rivers, especially in flood, to tear away and transport to long distances the broken masses they find in their path. The glacier and ice-sheet, too, are for ever grinding and wearing the solid rocks away. But space will not allow us to give more than one other example, and we will select the formation

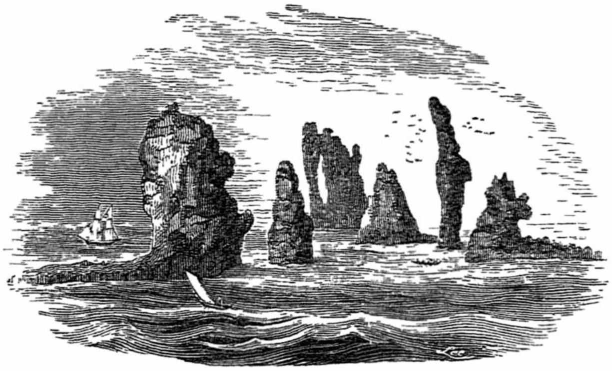

FIG 2.—GRANITE ROCKS TO THE SOUTH OF HILLSWICK NESS, SHETLAND

of a pinnacle of solid rock by the action of the sea, which it will be interesting to compare with the column of indurated mud, of which we have given a sketch above.

In considering the waste of sea cliffs, our author quotes Dr. Hibbert's account of a passage forced by the waves through rocks of hard porphyry, where the sea tears large masses of stone from the sides and forces them along, sometimes to a distance of no less than 180 ft., and adds: —"Such devastation cannot be incessantly committed for thousands of years without dividing islands, until they become at last mere clusters of rocks, the last shreds of masses once continuous. To this state many appear to have been reduced, and innumerable fantastic forms are assumed by rocks adjoining these islands, to which the name of Drongs is applied, as it is to those of similar shape in 'Feroe'" (p. 512). (Fig. 2.)

By such illustrations we are taught how ceaseless and how powerful are the destroying agencies of nature. But where is all this matter transported to? Sir Charles Lyell takes us out into mid-ocean, where he points out to us the icebergs carrying their load far and wide, and dropping it here and there over the sea bottom in warmer climes. On the shingle beach we see it travelling, and in the deep blue sea, says Dr. Tyndall, we see finely-divided matter still travelling on. With our author we examine the deltas of the great rivers, the Nile, the Ganges, and the Mississippi; and he shows us that some of the material is for a time arrested there. He tells us of the most recent discoveries in mid-Atlantic, where a chalky mud is being deposited over an area wider than that over which the ancient chalk sea has been traced; where swarms of little creatures live and die, and drop their tiny shells in such countless millions that the mud is in a great measure made up of them; where they

Sow
The dust of continents to be,

and give to us the explanation of the conditions under which that great deposit known as the Chalk was formed. Sir Charles Lyell refers to this in the following passage: "A fallacy which has helped to perpetuate the doctrine that the operations of water were on a different and grander scale in ancient times, is founded on the indefinite areas over which homogeneous deposits were supposed to extend. No modern sedimentary strata, it was said, equally identical in mineral character and fossil contents, can be traced continuously from one quarter of the globe to another. But the first propagators of these opinions were very slightly acquainted with the inconstancy in mineral composition of the ancient formations, and equally so of the wide spaces over which the same kind of sediment is now actually distributed by rivers and currents in the course of centuries. The persistency of character in the older series was exaggerated; its extreme variability in the newer was assumed without proof. In the chapter which treats of river deltas and the dispersion of sediment by currents, and in the description of reefs of coral now growing over areas many hundred miles in length, I shall have opportunities of convincing the reader of the danger of hasty generalisations on this head. I may also mention in this place that the vast distance to which the White Chalk can be traced east and west over Europe as well as north and south, from Denmark to the Crimea, seemed to some geologists a phenomenon to which the working of the causes now in action present no parallel. But the soundings made in the Atlantic for the submarine telegraph have taught us that white mud formed of organic bodies similar to those of the ancient Chalk, is in progress over spaces still more vast" (p. 109).

The teaching of Sir Charles Lyell is that all the rocks have been formed from pre-existing rocks as far back as we can trace them, in the same manner as they are being formed now, and that those which we see preserved are such as from their nature or surrounding circumstances were fittest to survive the various denuding forces to which they would from age to age be subjected.

Surely this is the true theory of evolution applied to geology. It does not, on the one hand, hold that the world has been going on always just as it is—that after a long period, during which all the varied forces of nature have been in full activity, the earth could be found in the same state as it was at the commencement. Nor, on the other hand, does it teach that the earth has been developed according to any original tendency or impulse, but that by the *uniform* action of forces such as we see now in operation it has been *evolved* out of previous states.

Nor is the objection valid that there is any "weakness or logical defect" in the teaching which would limit the inquiry to the period of which we have a record in the crust of the earth. If the true methods are employed, it is no objection to the methods themselves that their application is not more extended.

What were the possible or necessary first combinations out of a chaotic mass is a fair subject for investigation; but an author is no more to be censured for excluding it from a work treating of the visible crust of the earth, than a philosophic writer on the history of England is to be blamed for not including in his inquiry the conditions of that part of the earth now represented by our island previous to its last emergence from below the sea.

T. McK. HUGHES

(*To be continued.*)

NOTES

PROF. HUXLEY'S friends will be rejoiced to hear that he has returned to this country, with his health and strength fully recruited by his absence from work; and that he has already resumed his lectures at the Government School of Mines.

THE *Examiner* prints the following extract of a letter from M. Elisée Reclus, dated Zurich, March 18:—"I am able at last to tell you that I am free. After having been kept for a long time in prisons, and sent from one prison to another, I left Paris for Pontarlier, escorted by two police agents, who left me on the free soil of Switzerland. While breathing and enjoying the pure air of liberty, I do not forget those to whom I am indebted for my freedom. Having been claimed by so many Englishmen as a student of science, I shall work on more than ever to show them my gratitude by my works and deeds."

THE Astronomer Royal will hold his first reception, as President of the Royal Society, on Saturday evening, the 27th inst.

IT will be seen from our report of the Proceedings of the Chemical Society that Prof. Cannissaro has been selected by the Council to deliver the Faraday lecture on Thursday, May 30.

THE Council of the Society of Arts has invited members of the Society to forward to the secretary, on or before April 29, the names of such men of high distinction as they may think worthy of receiving the Albert Medal, instituted to reward "distinguished merit in promoting arts, manufactures, or commerce." The recipients of the medal since its foundation, in 1864, have been Sir Rowland Hill, K.C.B., the Emperor of the French, Prof. Faraday, Sir W. Fothergill Cooke and Sir C. Wheatstone, Sir Joseph Whitworth, Baron von Liebig, M. de Lesseps, and Mr. Henry Cole, C.B.

MR. H. E. ARMSTRONG has been appointed Lecturer on Botany and Vegetable Physiology at the University of Durham College of Medicine, Newcastle-upon-Tyne.

A NUMBER of gentlemen connected with the Iron and Steel Institute, from the different parts of the Kingdom, and also from the Continent, assembled last week to the number of 200 or 300 at the Teeside Works, Middlesborough, belonging to Messrs. Hopkins, Gilkes, and Co., to witness the first public trial of the rotary puddling machine of Mr. Danks, to which we have recently referred. The machine has been in work for two or three weeks, and realises all that has been claimed for it by its inventor, and all that has been stated of its practicability by the Iron and Steel Institute Commission, which was sent to the United States to investigate the working of the machine. On Friday the gentlemen present saw the machine charged two or three times with molten metal, and generally the heat took about an hour, with all the different preparations, from the time of drawing the heat till the introduction of another. The quantity puddled at one time was between 5 and 6 cwt. generally, but as high as 1,000lbs. have been put into the furnace at one charge. The iron, after leaving the furnace, was hammered, and then re-heated and rolled into bars, the quality of which was stated to be very superior. They were all produced from No. 4, Cleveland pig iron. The "fettling" consisted of American ore and pottery mine. The important adjunct of a "seezer," which is part of Mr. Danks's invention, is not yet built, so that the operation was not complete. An unexpected occurrence happened later in the day, an opinion having been received from counsel that Mr. Danks's patent was not valid. A meeting was held between Mr. Danks and most of the gentlemen who had entered into the provisional arrangement to pay him by the 10th of April 50,000*l*. for the right of 200 of his furnaces, to which we have already alluded, and he was informed that the arrangement would not be ratified. The question remains open, and is entrusted to a committee of the gentlemen interested, who will report to a future meeting.

THE establishment is announced of a Meteorological Observatory at the top of the mountain of Puy-de-Dôme. The original cost of 1,000fr. will be borne one-half by the State, one-fourth by the town of Clermont, and one-fourth by the Council-General of Puy-de-Dôme. The annual cost of its maintenance will devolve on the town of Clermont.

CAPTAIN H.R.H. THE DUKE OF EDINBURGH, K.G., has signified his intention of becoming a vice-president of the Institution of Naval Architects.

UNDER the new management and direction of the Royal Polytechnic Institution, it has been determined to re-establish the scientific department of the Institution, and Mr. Edward V. Gardner has been appointed Professor of Chemistry. We understand that the Institution is about to arrange a well-organised laboratory, proper chemical accessories for lectures, classes, analyses, &c., of which due notice will be given in the papers when the arrangements are completed.

THE Council of the Literary and Philosophical Society of Leicester have received from Mr. John Bennett the sum of 20gs., for the purpose of offering prizes to students of Natural Science, and as an inducement to the useful occupation of that leisure which is afforded by shortened hours of labour. Mr. Bennett's prizes will be awarded immediately after Easter Week, 1873, according to the following plan :—1. Geology—Three prizes will be given of the value of 3gs., 2gs., and 1g. for the best collections of the Rocks of Leicestershire, named, and with the localities given from which they were obtained. 2. Botany—Three prizes will be given of the value of 3gs., 2gs., and 1g. for the best collections of dried specimens of the Flowering Plants of Leicestershire, properly mounted, with the name, locality, and date of gathering attached to each; and classified according to the natural system. The scientific name must be given to each plant, and the popular name or names when it has any. 3. Freshwater life, animal and vegetable—Three prizes will be given of the value of 3gs., 2gs., and 1g. for the best aquaria, containing not more than two gallons of water, stocked with animal and vegetable life from the ponds, brooks, and rivers of Leicestershire, accompanied by a list of the specimens, with their scientific and popular names, and the locality and date of collection.

MR. JAMES CHAMBERLIN, of Norwich, announces that, with the idea of improving the breeding of pheasants, he will award ten prizes varying in value from 1*l.* to 5*l.* for the best brace raised during the present year, on conditions which may be learned on application.

IT is intended to form early in May a class for the study of Botany in the field belonging to the series of Church of the Saviour Science Classes. The object of the class is to enable Science students and others to obtain a practical knowledge of Systematic Botany, and to familiarise themselves with the form, structure, and habits of the principal flowering plants of the district. As the class will be limited in number, the names of intending students should be sent at once to the teacher—Mr. Joseph W. Oliver, 35, Cannon Street; to Mr. W. T. Bulpitt, Albert Road, Aston; or to the secretary, Mr. W. H. Hemming; when arrangements will be made for a preliminary meeting.

DR. FRASER will deliver two lectures on April 19 and 26 at 8 P.M., before the Fellows of the College of Physicians, on "The connection between the chemical properties and the physiological action of active substances;" and on "The antagonism between the actions of active substances."

THE third course of Cantor Lectures of the Society of Arts for the season will be by Prof. Barff, on "Silicates, Silicides, Glass, and Glass-painting," and will be delivered on Monday evenings, from April 8 to May 13.

WE understand that at the request of the executors of the late Sir James Y. Simpson, his friend, Prof. Duns, has undertaken to write his biography.

THE *Journal of Botany* mentions the appearance of a new botanical journal, under the title of *Journal de Botanique, pure et appliquée*, edited by M. G. Huberson, to appear fortnightly. It will contain, besides original communications, translations, extracts, and abstracts of botanical papers presented to the Académie des Sciences.

THE Literary and Philosophical Society of Manchester has just published the tenth volume of its "Proceedings," containing an unusual number of papers of great value and interest.

WE have received a copy of the lectures delivered at the Lecture-room of the Industrial and Technological Museum, Melbourne, for the autumn session of 1871. They deal with such subjects as Geology and Palæontology in their application to useful purposes, Respiration, Radiant Energy in relation to the spectrum, Forest culture in its relation to industrial pursuits, and various branches of manufacture. How long will it be before our Home Government undertakes such work?

A VERY useful addition has been made to the series of publications issued by order of the Secretary of State for India in Council, in the form of "A Continuation of Maps of the British Provinces in India and other Parts of Asia, 1870."

DR. STOLICSZKA, the palæontologist of the Geological Survey of India, has, during his stay on deputation in Kutch, made, according to the *Times of India*, an extremely valuable collection of zoological and fossil specimens. The doctor, it is said, anticipates that fully one-half of the latter are new to science.

THE sale of Wombwell's Menagerie, to which we referred a few weeks since, took place at Edinburgh on Tuesday last. Among the prices realised were the following :—Tasmanian devil, 3*l.* 5*s.*; Diana monkey, 7*l.*; mandrill, 30*l.*; ditto, 5*l.*; Anubis baboon, 10*l.* 10*s.*; ditto, 8*l.* 10*s.*; condor, 15*l.*; emeu, 7*l.*; pelicans (two), 6*l.* 15*s.* each; nylghau, 26*l.*; ditto, 10*l.* 10*s.*; lama, 15*l.*; boomer kangaroo, 12*l.*; ocelot, 6*l.* 10*s.*; African porcupines (three), 5*l.* 10*s.* each; wombat, 7*l.*; Polar bear, 40*l.*; brown bear, 7*l.*; performing leopard, 20*l.*; performing leopardess, 20*l.*; ditto, ditto, 20*l.*; performing hyæna, 3*l.* 5*s.*; lion, "Wallace," 7½ years old, 85*l.*; royal Bengal tigress, in cub, 3 years old, 155*l.*; lion, "Duke of Edinburgh," 3 years old, 140*l.*; lionesses, "Princess" and "Alexandra," about 3½ years old, 80*l.* each; lioness, "Victoria," 4 years old, in cub, 105*l.*; black-maned lion, "Hannibal," 6½ years old, 270*l.*; lion, "Nero," 7½ years old, 140*l.*; lion, "Prince Arthur," 18 months old, son of "Hannibal," 90*l.*; lion, "Prince Alfred," 18 months old, son of "Hannibal," 90*l.*; spotted hyæna, 15*l.*; Burchell zebra, 50*l.*; gnu, 85*l.*; male tusked elephant, 7 feet 6 inches high, nearly 8 years old, 680*l.*, bought for the Zoological Gardens, Manchester; female elephant, 5 feet 6 inches high, 145*l.*; two boa constrictors, 6*l.* each; Malabar squirrel, 5*l.*; male Bactrian camel, 7 feet high, 12 years old, 19*l.*; female ditto, in calf, 6½ feet high, 10 years old, 30*l.*; ditto, ditto, in calf, 6½ feet high, 5 years old, 23*l.*; male ditto, 5 feet high, 11½ years old, 14*l*; female ditto, in calf, 5 feet high, 1½ years old, 14*l.*; male dromedary, 7½ feet high, 5 years old, 30*l.*; female ditto, 6½ feet high, 14 years old, 21*l.*; male camel calf, born February 6, 1872, 9*l.* 10*s.* The sale produced nearly 3,000*l.*

THE severe frost of March 21 has done an incalculable amount of damage to the fruit crop. Apples, pears, and cherries appear to have suffered most severely. It is a remarkable circumstance that although the majority of the flowers have been killed in the bud, the central part being turned perfectly black, yet the flowers expand and present externally a perfectly uninjured appearance. The *Garden* estimates the damage done to the potato crop in Jersey by the spring frosts at many thousands of pounds.

ALTHOUGH the Brighton Aquarium has been formally opened to the public, it is still in a very unfinished condition, owing to a disagreement between the proprietors and the contractor, and the severe illness of the engineer. At the time of its inauguration by Prince Arthur, on Easter Monday, but one tank was supplied with fish. When completed, the collection will by no means be confined to marine animals, a portion of the building being devoted to fresh-water tanks.

THE Senate of the University of Bombay has recently been engaged in investigating a scandal in connection with the Matriculation Examination, the passages set in Latin being taken entirely from books which one of the examiners had during the previous term made the special subject in his own class.

THE *Engineer* states that the oxyhydric light has not proved a success in Paris, and that it has been discontinued in the public lamps on the Boulevard des Italiens.

MESSRS. WATERLOW AND SONS, of 66, London Wall, announce that the invention of an entirely new method of producing a number of copies of the same manuscript without the use of ink, by a very simple process which they term printing by electricity, and to which we have already referred, may now be seen in operation on their premises.

WE have received a circular from the Secretary of the Philadelphia Philosophical Association, containing a statement of its leading principles, and an outline of the method pursued in carrying them out. These principles are stated to be :—1, That force is persistent ; 2, That all knowledge is relative ; 3, That philosophy is the synthesis of the doctrines and methods of science ; 4, The critical attitude of philosophy is not destructive, but constructive ; not sceptical, but dogmatic ; not negative, but positive. The Association appears to have been established in November 1871, and proposes to select a number of suitable papers, or parts of papers, for publication in a Quarterly Journal.

A CORRESPONDENT at Brighton describes a solar phenomenon visible on the afternoon of April 8, at 5.35 P.M. The sun being just within the upper part of a mass of light clouds, through which it shone with a white glare, there appeared a distinct belt of colours, in order and apparent width exactly like those of an ordinary rainbow, but apparently flattened above. Half a minute afterwards a second belt appeared, equally bright, and with no interval between the two. At the same time a fainter belt appeared to the right, but not forming a part of the same circle as the others. The three were visible together, but did not last above a minute. After the unusual appearance was first noticed, the sky above was tolerably clear, with a few light upper clouds. After the prismatic lines had faded, there was that diffused white glare round the sun which is commonly said to betoken windy weather.

THERE is now every prospect that the getting of coal by machinery will be more generally adopted than hitherto. At present it has only been adopted at a few places, but a new machine, patented by Messrs. Gillott and Copley, has just been tested at the Wharncliffe Silkstone Colliery, near Barnsley, in the presence of a number of mining engineers from various parts of the kingdom, and with most satisfactory results. In 136 minutes a bank of coal, 58 yards long and four feet eight inches thick, was cut to a depth of three feet one inch. The quantity of coal so cut would be about 80 tons in the time stated. In connection with coal machinery a hydraulic coal breaker, patented by Mr. Clubb, of London, has just been very successfully tested at the Oaks Colliery, Barnsley.

AN Indian paper prints the following interesting account of a fight between a hyæna and a man :—"About five days ago a party of six natives coming towards Deyra through the Mohun Pass, were attacked by a hyæna ; it made straight at one of them, and flew at his throat. The poor devil stretched out his hands to keep off his assailant, on which the hyæna bit them severely ; his companions, instead of coming to his aid, took refuge in some adjoining trees ; the man, finding himself thus deserted and his hands in a mutilated state, pluckily turned on his enemy, and seized his nose with his teeth, roaring out in the best way he could for assistance. By this means he secured the animal, and his companions, taking courage, came down from their secure position, and belaboured the beast to death with sticks. I saw the unfortunate man at the dispensary, where he had gone to have his wounds dressed, and was shown the head of his enemy having his teeth marks on the nose. I believe this is almost an unprecedented instance in the annals of natural history, as a hyæna is well known as a most cowardly brute, never venturing to attack man, but preying chiefly on dogs, carrion, and young children."

ANNUAL ADDRESS TO THE GEOLOGICAL SOCIETY OF LONDON, FEB. 16, 1872

BY J. PRESTWICH, F.R.S., PRESIDENT

(*Continued from page* 433.)

Our Coal-measures and our Coal-supply

WHILE the presence of water has determined the early settlement of population, the existence of coal has given rise to exceptional local growths of that population, quite irrespective of the original cause of settlement. The existence of coal has created new wants, developed vast energies, enormous resources, and has established great industries dependent upon it for their maintenance and prosperity. Natural causes, unceasing and ever renewing in their action, maintain our supplies of water in a condition of constant and unfailing operation. They are physical and geological agents, equally in force in the past as in the future of the earth's history. Not so with coal, which is a store of the past, and of which we can look for no renewal. Our Coal Measures, great as they are, have defined limits, whereas our wants seem to have no bounds. With the increasing magnitude of the latter our fears of the extent of the former have increased, and have given rise to much speculation and much discussion. At first the estimates of the duration of our coal-fields were little more than guesses ; but the subject has of late years been treated in a systematic manner, and in all its various bearings, in the able works of Hull, Jevons, and Warington Smyth. To obtain more precise data on these important questions, the Royal Commission of 1866 was appointed, with your President-elect, the Duke of Argyll, at its head. On the practical and economical questions different members of the Commission and separate committees have made valuable reports. I wish on this occasion merely to direct your attention to some of the more special geological bearings of the questions discussed in one of the committees, of which the lamented Sir Roderick Murchison was chairman, the object being "to inquire into the probability of finding coal under the Permian, New Red Sandstone, and other superincumbent strata."

On the evidence laid before this committee regarding England north of the Bristol coal-field, Prof. Ramsay was deputed to report, while the south of England was relegated to myself. The one district embraces all the unproved older secondary tracts between the different well-known coal-fields of the central and northern portions of England. The other district takes in that occupied by the later Secondary and the Tertiary strata, already the subject of a valuable paper in our Journal for 1856, by Mr. Godwin-Austen. The excellent mapping of our coal-districts by the Geological Survey, and their accurate sections through the several coal-fields, furnished Prof. Ramsay with data which have enabled him to prolong these sections across the intervening tracts with a degree of certainty which gives them very great value. He has presented us with 32 such sections, which, when published, will, with the text already before the public, show how great has been the task, and how successfully it has been accomplished.

The area of the exposed coal-measures of England may be estimated at about 2,840 square miles. To these Mr. Hull had added 932 square miles of coal-measures overspread by newer formations. The investigations of Prof. Ramsay lead him now to conclude that this latter total of unproved coal-measures may be increased to 2,988, to which may be added 153 miles of the Bristol coal-field, making a total of 3,141 square miles of Coal-measures under the Permian, New Red, and Triassic strata of central and northern England, or of 301 square miles more than the area of all our exposed coal-fields. This branch of the inquiry embraces curious questions of variations in the mass of the coal-measures, in the thickness of the strata, and in the number and persistence of the coal-seams. The extent and magnitude of the faults bounding so many of our coal-fields, is also a point of great difficulty, especially when it is complicated by denudations of pre-Permian and of pre-Triassic age ; and in this intricate inquiry it must be borne in mind that it is only a question of superposition and faulting, but one also of removal and replacement, involving a number of important geological problems. Especially is it necessary to distinguish steep old-surface and submarine valley denudations from faults.

The other inquiry relating to the possible range of the coal-measures under the Jurassic, Cretaceous, and Tertiary strata of the south-east of England, involves questions of a much more hypothetical character, and can, in the absence of positive information, only be treated on purely abstract geological reasoning. Still it is one essentially within the range of inquiry, and the collateral geological data we possess are sufficient to guide and direct those inquiries. There are two primary points to be determined:—First, how much of the area under investigation remained dry land during the Carboniferous period, and was therefore never covered by Coal-strata. Secondly, supposing the Coal-strata to have spread over a portion of that area, how much of them escaped subsequent denudation? With regard to the first question it is comparatively easy, where the Palæozoic rocks now form the surface, to determine the antiquity of that surface, but where the old rocks are covered by great masses of other strata it becomes very difficult to determine the original conditions. Mr. Godwin-Austen has ingeniously sought to establish the position of the old coast-lines of the Carboniferous and other periods, the area of the old coal-growth, and the great features of the ancient physical geography of this period in Western Europe. I have given more especial attention to relations of the Secondary and Palæozoic formations to one another and to those points which depend upon physical conditions connected with the nature and age of old disturbances and denudations, the direction and position of the great anticlinal and synclinal lines, to the correlation of certain strata, and the dimensions of the overlying strata.

The great lines of disturbance traversing Central and North-eastern England are subsequent to the Carboniferous period, and the many detached coal-basins separated by the Penine chain and the Derbyshire hills, together with the Mountain Limestone forming those ranges, are held to be portions of one great Carboniferous formation, which, in its entirety, spread from the south of Scotland to central England, and, as we shall observe presently, probably still farther south. This great Carboniferous deposit was originally bounded on the north either by the uplands of the Scottish-border counties, or, possibly, by the Grampians; on the west by the high lands of Cumberland and Wales; while on the south we find no old exposed land-surfaces of older Palæozoic age until we reach Brittany and Central France. With respect to the deposits going on during the Carboniferous period in this area, Professor Phillips was the first to show that the lower Carboniferous series puts on, as it trends north from Derbyshire, more sedimentary conditions—that the Mountain Limestone there begins to show traces of the proximity to land, which increase rapidly in proceeding northwards,—beds of shale and sandstone and subordinate beds of coal gradually setting in in the limestone series, and increasing in importance as they approach the older border land. In the same way the approach to an old barrier-land on the south and west is supposed by Professor Ramsay to be indicated in the overlying Coal Measures by the increase in number and thickness of the beds of sandstone in the south of the Staffordshire and Shropshre coal-field, and Mr. Hull connects that old land with the Cambrian and Silurian rocks of Leicestershire.

If such were the case, the question arises, did this form a barrier which cut off the Carboniferous deposits from extending over the south of England, or was it only a partial barrier which in no way prevented the extension southward of the Carboniferous rocks?

It has been supposed that during the Carboniferous period a spur from the Silurian district of Wales extended eastward from Herefordshire into central England, dividing the coal-fields of Shropshire and Staffordshire from those of Gloucestershire; and that against this old Silurian tract the Coal Measures of South Staffordshire die out. If carried farther eastward it would limit the southern prolongation of the Coal Measures of Leicestershire, and then pass under the Oolites of Northamptonshire and the Cretaceous series of Norfolk; and so great an expansion has been given it southward, that it would equally exclude the Coal Measures from the area of the south-east of England. We have, however, no sufficient evidence of the continuous extension of these old rocks eastward of Staffordshire. Palæozoic rocks show, it is true, in Leicestershire; but there the Coal Measures wrap round them, and the older rocks seem merely to be an island in their midst. At those spots in the southern counties where they have been proved underground, I imagine they were raised by disturbances of a later date than the Coal Measures, and did not form part of the land surface of the Carboniferous period. As just mentioned, the older Carboniferous rocks show deeper-sea conditions as they trend from north to south, and the same deep-sea conditions existing in Derbyshire are found to prevail in the Mountain Limestone of Belgium, while, at the same time, similar slight indications of distant land, in the presence of intercalated shales and imperfect coal, reappear and increase westward in their range into the district of the Boulonnais, in France. There is nothing to show but that the spur of old land stretching eastward from Herefordshire was merely a promontory ending in Warwickshire, and round which the Carboniferous sea passed and extended southward uninterruptedly to Belgium and the north of France, and westward to Somersetshire and South of Wales, spreading over all this wide area first the Mountain Limestone and then, in due order, the Coal Measures. Of the existence of these formations over the south-western and south eastern portions of this area we have proof in Wales, Somersetshire, and Belgium. The intermediate area is covered by Jurassic, Cretaceous, and Tertiary formations, which hide from us the older rocks whose position it is our object to determine.

Just as with the disturbance which at a later period caused the Mountain Limestone of the Penine chain to break through the great expanse of Coal Measures originally spread over the central and northern counties of England, and brought up to the surface the disturbed and disjointed coal-strata, of which, after subsequent denudation, we have the isolated portions remaining in the existing coal-fields, so was the area of Southern England traversed by the earlier axis of Palæozoic rocks of the Ardennes and Mendips, bringing up the Coal Measures in like manner along their northern flanks in separate basins and troughs, some of which are uncovered by newer strata, while other basins not exposed on the surface may still possibly exist beneath the newer strata of the south-east of England. They have in fact been proved to exist under considerable portions of those newer strata of north-western France and of Belgium, and under some of the older Secondary strata in the south-west of England.

The probable continuation of this great range of Palæozoic rocks from the Rhine to South Wales, passing underground in the south of England, was shadowed out by Buckland and Conybeare in 1826, commented on by Dufresnoy and Elie de Beaumont in 1841, by M. Meugy in 1851, and more fully investigated and discussed by Mr. Godwin-Austen in 1855. These views having been controverted, the subject was fully discussed by the Commission, and again in the separate report drawn up by myself.

All geologists are agreed upon the age of this great east-and-west axis of disturbance. It took place after deposition of the Coal Measures, and before the deposition of the Permian strata. Its effects, all through its range, are singularly alike. It was not so much a great mountain-elevation, as a crumpling up and contortion of the strata for a breadth of many miles, and along a length of above eight hundred miles. The Silurian and Devonian rocks are thrown up by it into a number of narrow anticlinals, and the flanking coal-strata are tilted, turned back on themselves, squeezed and contorted in the most remarkable manner,—the same type of disturbance being apparent whether in Westphalia, Belgium, France, Somerset, or Pembroke. These great flexures have also resulted in throwing the Coal Measures into deep narrow troughs, having a length of many miles and a width of but very few.

In France, these disturbed old strata are covered transgressively by Jurassic, Cretaceous, and Tertiary strata, and in Somerset by Permian, Liassic, and Jurassic strata; they sink beneath the Oolites at Frome, and reappear in Belgium from beneath the Cretaceous strata. What becomes of them in the intermediate area? It is not to be supposed that a line of disturbance of such great magnitude could have been intermittent. The coal-trough has, in fact, been followed from near Charleroi, where it passes under the Cretaceous and Tertiary strata, to Mons, Valenciennes, and Bethune, a distance of eighty-six miles. Along the whole of this line, the Chalk and overlying beds extend, with a thickness varying from 500 to 900 feet around Mons, decreasing to from 250 to 300 near Valenciennes, and increasing again towards Bethune. At Guines the Chalk was found to be 670 feet thick, and at Calais 762 feet. On the other side, the coal-trough of Somerset passes eastward under the older Secondary rocks, which in their turn pass under the Cretaceous and Tertiary strata of Wiltshire; but no attempt has been made to follow Coal Measures beyond a distance of six miles from their outcrop, where the overlying strata have been found to attain a thickness of about 450 feet.

The original supposition that the Secondary strata maintained, in the main, their regular sequence, and, to a certain extent, their thickness over large areas has long been proved to be erroneous;

but we were hardly prepared until lately to learn how rapid the variation in their thickness is. Mr. Hull has now shown that the Great and Inferior Oolites thin out from a thickness of 792 feet in Gloucestershire to 205 feet in Oxfordshire, and the Lias and Trias from 1090 feet to 400 (?) feet; while in like manner the Trias decreases from 5600 feet in Lancashire and Cheshire, to 2000 in Staffordshire, and 600 feet in Warwickshire. We also know that on the northern flank of the Mendips, the Trias, Lias, and Oolites tail off, although their dimensions in Gloucestershire are so considerable. It would appear that all the Secondary rocks, except those of the Cretaceous series, show a distinct thinning-out in their range southward, which is doubtless due to the existence of an old pre-Triassic land on the south—such as would have been formed by the prolongation of the Palæozoic rocks of the Ardennes and Mendips through the south of England. It has been urged, on the other hand, that this thinning-out is a proof of the existence of a still older land in that area; but as the argument is based on the evidence of rocks of post-Carboniferous age, it is clear that, whether the land were of Cambrian and Silurian, or of Devonian and Carboniferous age, the result, as affecting the Secondary rocks, would be the same.

This thinning-out of the Secondary strata has now been proved not to be merely hypothetical. At three points, on or near the presumed line of the old underground range, the Tertiary and Cretaceous strata have been traversed in well-sections, and Palæozoic rocks found to underlie them at once, without the intervention of any Triassic, Liassic, or Oolitic strata. Thus at London the presence of red and grey Sandstones, apparently of Palæozoic age, has been proved under the Chalk at a depth of 1,114 feet. Again, at Harwich and at Calais, strata of early Carboniferous age have been found also immediately under the Chalk, at depths respectively of 1026 and 1032 feet. There is therefore reason to believe that the underground ridge of the Mendips and the Ardennes passes in a line from Frome through North Wiltshire, Berkshire, Middlesex, North-east Kent, and between Calais and Boulogne, at a depth beneath the Secondary strata of not more than from 1000 to 1500 feet, while the coal-troughs, which may flank this range on the north would, judging from the analogy of the structure and relations of the same rocks at Mons and Valenciennes, be met with at depths very little, if at all, greater.

To the north of this area it is probable that the thickness of the overlying rocks is greater; but we have no means of knowing exactly. In Northamptonshire the Great and Inferior Oolites and the Lias have been found not to exceed together 880 feet, at which depth the New Red Sandstone was reached; but its thickness was not proved beyond 87 feet; while at Rugby, the Lias was found to be about 905 feet thick, below which 136 feet of beds of New Red Sandstone were passed through. Looking at the proved thinning out from north to south of the New Red and Permian strata, there is no reason to suppose that they would be found of any very great thickness in the southern counties. Even immediately to the south of the known coal-fields of the Midland counties, the trials for coal have not yet proved any very great thickness of these rocks. It would seem, in fact, that the extensive tracts of Chalk, Oolites, and Trias, forming the substrata of our Midland and Southern counties, constitute but a comparatively shallow crust filling up the plains and valleys of Palæozoic rocks, the great framework of which stretches apparently at but a moderate depth under our feet, and of which the highest ridges only, such as those of the Ardennes and Mendips, now rise above ground.

It is clear, therefore, that in any search for coal, the relation of the Secondary and the Palæozoic groups of rocks to one another being perfectly independent, the latter must be considered entirely on their own internal evidence, and apart from the bearing of the newer rocks covering them and forming the present surface, except possibly in a few cases where old lines of disturbance have proved points of least resistance, and yielded again, as suggested by Mr. Godwin-Austen, to later movements, which have equally affected the overlying formations.

It may be asked if any correlation can be established between the coal-measures of Bristol and South Wales and those of France and Belgium. So far as the identity of any particular bed of coal or of rock, it is impossible, and we should not expect it; for the variation in all the beds of any coal-basin is well known to be so great and rapid, that in the different parts of the same basin it is often difficult, and sometimes impossible, to establish any correlation; while in adjacent basins, such as those of Wales and Bristol, or of Hainaut and Liége, such attempts have, with few exceptions, hitherto utterly failed. There are, however, more general features which serve to show, at all events, some relationship. The great dividing mass of from 2,000 to 3,000 feet of rock called Pennant exists in both the Welsh and Bristol coal-field; and the total mass of coal-measures is not very different, it being 10,000 to 11,000 feet in the one, and from 8,000 to 9,000 in the other, and there being in Wales 76, and in Somerset 55 workable seams of coal. In the Hainaut (or Mons and Charleroi) basin, the Measures are 9,400 feet thick, with 110 seams of coal; in the Liége basin 7,600 feet, with 85 seams; and in Westphalia 7,200 feet, with 117 seams. On the other hand, none of our central or northern coal-basins, with the exception of the Lancashire field, exceed half this thickness, and more generally are nearer one fourth. Further, the marked difference which exists between the northern coals and those of Wales and Somerset, the preponderance of caking-coals in the north, and of anthracite, steam, and smiths' coal in the south, equally exists between our northern coals and those of Belgium, which latter show, on the other hand, close affinities with those of Wales and Bristol. I am informed by two experienced Belgian coal-mining engineers and good geologists, who have twice visited our coal-districts, that the only coals they found like those of Belgium were the coals of South Wales and Radstock—there was the same form of cleavage, the same character of measures, and the same fitness for like economical purposes. Organic remains help us but little, but too little is yet known of their relative distribution. The plants are, as usual, the same; so also are shells of the genus *Anthracosia*, and a number of small *Entomostraca*; while there is a scarcity of many of the marine forms which are more common in some of our central and northern fields. That, therefore, which best indicates the relation between the coal-fields of the south-west of England and those of the north of France and Belgium, is the similarity of mass and structure, uniformity of subjection to like physical causes, and identity of relation to the underlying older and to the overlying newer formations.

It was in the north that the conditions fitted for the formation of coal first set in. The common *Stigmaria ficoides* and various Coal Measure plants appear at the base of the Carboniferous or in the Tuedian series of Northumberland, which there overlies conformably the Upper Old Red Sandstone; and productive beds of coal exist low down in the Mountain-Limestone series. These disappear in proceeding southward, and the great productive coal-series becomes confined to beds overlying the Millstone Grit. If the coal-growth set in earlier in the north, it seems to have been prolonged farther south, under more favourable conditions, to a later period. What those conditions were—whether the proximity of a greater land-surface, of a longer and greater subsidence, with more numerous rests—we cannot yet pretend to say.

Of the prolongation of the axis of the Ardennes under the south of England there can be little doubt; nor can there be much doubt that the same great contortions of the strata, which in Belgium placed the crown of the anticlinal arch at a height of four or five miles above the level of the base of the accompanying synclinal trough, to the bottom of which the Coal Measures descend, and was the cause of similar folds in the Coal Measures of Somerset and Wales, were continued along the whole line of disturbance, and that the preservation of detached portions of the same great supplementary trough is to be looked for underground in the immediate area, just as it exists above ground in the proved area; for the minor subordinate barriers dividing the coal-basins can, I conceive, in no way permanently affect the great master disturbance, by which the presence of the Coal Measures is ruled. Whether, however, admitting that the Coal Measures were originally present, they have been removed by subsequent denudation is another question.

(To be continued.)

SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie, December 1871. A considerable part of this number is occupied by a valuable paper "On valeric acids from different sources," by Erlenmeyer and Hell. They prepared isobutyl iodic acid, and from this the corresponding iodide, which they treated with alcoholic potash to convert it into potassic valerate; the valeric acid from these reactions had no action on polarised light. They prepared valeric acid from valerian root, and this also had no rotating action on a polarised ray. A series of experiments was made on the valeric acids obtained from active and inactive amylic alcohols, and also on the acid obtained from leucin; this latter is found to rotate a ray of polarised light to the right, but not to so great an extent as the acid which is obtained from the left-handed amylic alcohol. The acids from isobutyl cyanide, from valerian root, and from inactive amylic alcohol, show very great similarity; whilst the acids from the active alcohol and from leucin agree in most of their properties. The valeric acid made from inactive amylic alcohol is almost certainly isopropacetic acid, and that from the active alcohol is probably methethacetic acid, although the authors consider that the latter acid might possibly be a molecular compound of two isomeric acids, such as isobutylformic and methethacetic acids. Besides this communication, there are several important physiologico-chemical papers, together with translations of two others from foreign periodicals.

THE *American Naturalist* for February commences with an exhaustive account of the Mountains of Colorado by Dr. J. W. Foster, read before the Chicago Academy of Sciences. Mr. E. L. Greene, in a short paper on the Irrigation and the Flora of the Plains, shows how a gradual alteration is going on in the character of the flora of those parts where a system of irrigation has been established, *Typha* and other marsh and water plants supplanting the original inhabitants of the drier plains. Mr. John G. Henderson, on the former range of the buffalo, brings forward evidence to show that the buffalo was at a not very remote period extremely abundant over almost the whole of the Northern United States, while he thinks that it is doomed in a short time to become extinct like the great Irish elk, the mastodon, and the dodo. The remainder of the number is occupied with reviews and short notes.

A CONSIDERABLE portion of the *Canadian Naturalist*, vol. vi., No. 2, is occupied with a report of the Edinburgh meeting of the British Association. Prof. Dawson continues his note on the Post-pliocene Geology of Canada. Prof. H. A. Nicholson (late of Edinburgh) contributes an article on the "Colonies" of M. Barrande, in which the best account we have yet seen is given of the celebrated theory of the French palæontologist. Dr. J. W. Anderson has a short article on the Whale of the St. Lawrence; Mr. S. W. Ford some notes on the Primordial Rocks in the vicinity of Troy, N.Y.; and Mr. E. S. Billings a paper on some new species of Palæozoic Fossils belonging to the classes Pteropoda and Brachiopoda.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 21.—"New Researches on the Phosphorus bases," by Dr. A. W. Hofmann, F.R.S. Ten years since the author presented to the Royal Society a series of papers on the remarkable group of phosphorus compounds first discovered by Thenard in 1847. These researches were devoted to the investigation of the tertiary and quartary derivatives of phosphoretted hydrogen, exclusively accessible by the methods then known. Since then numerous attempts have been made to prepare the primary and secondary phosphines, but with no result until the present time. The author wishing to obtain pure phosphoretted hydrogen for lecture experiments, was led to prepare it by the action of water or soda on the beautiful compound of phosphoretted hydrogen and hydriodic acid. The ease with which this body decomposed led the author to think that it might be made available for the production of the missing compounds. For this purpose it was necessary to liberate phosphoretted hydrogen in the presence of an alcohol iodide under pressure. This could be done by heating together the phosphonium iodide and alcohol iodide in presence of some substance capable of slowly decomposing the former body, such as zinc oxide. This process yields the alcoholic phosphines, easily giving rise to the formation exclusively of primary and secondary phosphines. A further simplification of the process was tried, namely, by utilising the hydriodic acid from the phosphonium iodide in the formation of the alcohol iodide to be acted on by phosphoretted hydrogen. This was accomplished by digesting the phosphonium iodide with the alcohol; by this method it was found that only the tertiary phosphines and the quartary phosphonium compounds already known were produced, but which were more easily and plentifully obtained by the new than by the old method. The reactions by which the various groups of phosphines are produced from phosphonium iodide are as follows, the reaction being assumed to take place in the methyl series:—

Primary Phosphines

$$2\,CH_3I + 2\,(H_3P.HI) + Zn\,O = 2\left[(CH_3)\,H_2P.HI\right] + Zn\,I_2 + H_2O$$

Secondary Phosphines

$$2\,CH_3I + H_3P.HI + Zn\,O = (CH_3)_2\,HP + Zn\,I_2 + H_2O$$

Tertiary Phosphines

$$3\,(CH_3.HO) + H_3P.HI = (CH_3)_3\,P.HI + 3\,H_2O$$

Quartary Phosphonium compounds

$$4\,(CH_3.HO) + H_3P.HI = (CH_3)_4\,PI + 4\,H_2O$$

The primary and secondary methylic derivatives of phosphoretted hydrogen are prepared by placing together in a sealed tube 2 molecules of methylic iodide, 2 molecules of phosphonium iodide, and 1 of zinc oxide. The mixture is heated to 100° for six or eight hours, when the reaction is complete; on cooling the tube contains a white crystalline solid, and also a considerable amount of compressed gas. The crude product of the reaction is first treated with water, which decomposes the salts of monomethylphosphine, liberating it as a gas, which is collected in concentrated hydriodic acid; and secondly with potash, which decomposes the salts of dimethylphosphine, and liberates the dimethylated phosphine as a liquid. The whole process must be conducted in an atmosphere of hydrogen, as the two bodies are powerfully acted on by the oxygen of the air.

Methylphosphine $CH_3\,H_2\,.\,P$, is a colourless and transparent gas of a most overwhelming odour, which, by cooling and by pressure, can be condensed to a colourless liquid floating on water. It boils at −14° under a pressure of 0·7585 metre. At 0° it began to liquefy at $1\frac{1}{4}$ atmospheres pressure, and at $2\frac{1}{2}$ atmospheres it was entirely liquefied. At 10° liquefaction commenced at $2\frac{1}{2}$ atmospheres and was completed at 4 atmospheres pressure, and at 20° under a pressure of 4 and $4\frac{1}{2}$ atmospheres. The volume weight of the gas was determined by decomposing a known weight of the iodhydrate over mercury. Experiment gave the number 24·35, the theoretical value being 24. Methylphosphine is nearly insoluble in water free from air; if it contain air the gas disappears, owing to oxidation; it is rather soluble in alcohol, more especially at low temperatures; ether dissolves but little at ordinary temperatures, but at 0° one volume of ether dissolves in less than 70 volumes of methylphosphine. When gently heated in contact with air it takes fire, as it does also in pressure of chlorine or bromine. By its union with acids it forms a remarkable series of salts, distinguished by the remarkable property of being decomposed by water.

The chlorhydrate is obtained by mixing methylphosphine with gaseous hydrochloric acid, the gases at once condense to beautiful four-sided plates; the iodhydrate $CH_6\,PI$ is obtained by passing the gas into a concentrated solution of hydriodic acid; it can be crystallised in plates, which may be easily sublimed.

Dimethylphosphine $(CH_3)_2\,HP$, obtained as above, is a transparent colourless liquid which is lighter than water and insoluble in it; readily soluble in alcohol and ether. Its boiling point is 25°. In contact with the air it instantly takes fire, and burns with a powerfully luminous phosphorus flame. It unites easily with acids, all its salts being exceedingly soluble. The chlorhydrate furnishes with platinum perchloride a fine crystalline salt.

Methylphosphine passed into fuming nitric acid is absorbed and oxidised, with the formation of a new acid, small quantities of phosphoric acid being also produced. The excess of nitric acid is removed by evaporation in a water bath, and the phosphoric acid by boiling with lead oxide, which forms the lead salt of a new acid which is soluble in acetic acid, and lead phosphate which is insoluble. The lead salt is decomposed by sulphuretted hydrogen, and the acetic acid removed by evaporation, which leaves the new acid as a crystalline mass resembling spermaceti, melting at 105°. Its composition is found to be $CH_3\,H_2\,PO_3$, and may be called methylphosphinic acid. It forms two series of salts, in which H_1 and H_2 are replaced by metals. The primary silver salt crystallises in beautiful white needles which, in contact with water, are converted into the secondary salt. The lead and barium salts of this acid have also been obtained.

Methylphosphinic acid has the same composition as methylphosphorous acid, but they are two absolutely different bodies. Methylphosphorous acid is an uncrystallisable ephemeral compound, decomposing at a gentle heat into phosphorous acid and methyl alcohol, whilst methylphosphinic acid may be distilled without decomposition.

Dimethylphosphinic acid, obtained in a nearly similar manner to the above, is a white crystalline solid, melting at 76°, and may be distilled without change. Its composition is $(CH_3)_2 H PO_2$; the silver, lead, and barium salts have been obtained, but do not crystallise so well as the salts of the last-named acid.

Phosphoretted hydrogen, on treatment with nitric acid, fixes four atoms of oxygen yielding tribasic orthophosphoric acid, whilst trimethylphosphine fixes only one atom of oxygen yielding trimethylphosphine oxide, a body which is no longer capable of forming saline compounds. We have thus a series of three bodies which may be looked on as derived from orthophosphoric acid by the replacement of hydroxyl by methyl:—$(HO)_3$ PO, orthophosphoric acid; $(CH_3)(HO)_2$. PO, methylphosphinic acid; $(CH_3) HO_2$. PO, dimethylphosphinic acid; $(CH_3)_3$ PO, trimethylphosphine oxide. An analogous series of bodies is known in the arsenic group.

The primary and secondary ethylic derivatives of phosphoretted hydrogen are prepared in a precisely similar manner to the methyl compounds, except that the tubes containing ethyl iodide, phosphonium iodide, and zinc oxide, must be heated to 140°—150° for six hours.

Ethylphosphine $(C_2H_5) H_2$. P, is a transparent mobile liquid, powerfully refractive, lighter than water, and insoluble in it. It boils at 25°, and has an overwhelming odour. Its vapour bleaches like chlorine; caoutchouc placed in it becomes transparent, and loses its elasticity. It is inflamed by chlorine, bromine, and nitric acid. It is isomeric with dimethylphosphine previously described. With acids it forms salts which are crystalline and are decomposed by water.

Diethylphosphine is a colourless transparent liquid, insoluble in water and lighter than it. Its odour is very penetrating and persistent. It boils at 85°, and forms corresponding salts to dimethylphosphine which are not decomposed by water.

The primary and secondary ethyl phosphines, on oxidation by nitric acid, yield precisely corresponding products to the methylphosphines already described.

By the action of benzyl chloride, phosphonium iodide, and zinc oxide at 160°, the author has succeeded in obtaining the benzyl phosphine in a similar manner as before described.

Benzyl phosphine, $(C_7H_7) H_2$ P, is a liquid boiling at 180°, attracting oxygen with great avidity; it forms a beautifully crystalline iodhydrate, and also other salts corresponding to those obtained from methylphosphine.

Dibenzylphosphine, $(C_7H_7)_2$ H P, is a crystalline body melting at 205°, which does not oxidise in the air, nor does it form salts with acids like the corresponding dimethyl and diethylphosphines.

The author has likewise obtained the phosphorus compounds in the propyl, butyl, and amyl series, the details of which will be shortly communicated.

Geological Society, March 20—"On the Wealden as a Fluvio-lacustrine Formation, and on the relation of the so-called 'Punfield Formation' to the Wealden and Neocomian." By C. J. A. Meyer. In this paper the author questioned the correctness of assigning the Wealden beds of the south-east of England to the delta of a single river; he considered it more probable that they are a fluvio-lacustrine rather than a fluvio-marine deposit, and attributed their accumulation to the combined action of several rivers flowing into a wide but shallow lake or inland sea. The evidence adduced in favour of these views was mainly as follows:—The quiet deposition of most of the sedimentary strata, the almost total absence of shingle, the prevalence of such species of mollusca as delight in nearly quiet waters, the comparative absence of broken shells such as usually abound in tidal rivers, and the total absence of drift-wood perforated by mollusca in either the Purbeck or Wealden strata. This Wealden lacustrine area the author supposed to have originated in the slow and comparatively local subsidence of a portion of a land-surface just previously elevated. He considered that during the Purbeck and later portion of the Wealden era the waters of such lacustrine area had no direct communication with the ocean. The changes from freshwater to purely marine conditions, which are twice apparent in the Purbeck beds, and the final change from Wealden to Neocomian conditions at the close of the Wealden, were attributed to the sudden intrusion of oceanic waters into an area below sea-level. The author then pointed to the traces o terrestrial vegetation in the Lower Greensand as evidence of the continuance of river-action after the close of the Wealden period. In the concluding portion of his paper the author referred to the relation of the Punfield beds of Mr. Judd to the Neocomian and Wealden strata of the south-east of England. From the sequence of the strata, no less than on palæontological evidence, he considered the whole of the so-called "Punfield formation" of the Isle of Purbeck to be referable to the Lower Greensand of the Atherfield section. Mr. Godwin-Austen did not agree with Mr. Judd in calling the bed at Punfield the Punfield "formation;" it was merely a bed intercalated between beds of a different character below and above. Prof. Ramsay thought that the Purbeck strata were connected with lagoons in contiguity with a large river rather than with inland lakes. These, from time to time, owing to the oscillations of level, were covered with marine deposits. He did not think that the absence of gravelly deposits offered any serious difficulty in regarding the Wealden strata as marine. It seemed to him more probable, however, that the sands and clays of the Wealden were due to some ancient rivers on a large scale, and deposited at their mouths, though in some spots the beds were subject to the action of fresh and salt water alternately. He regarded the Neocomian as, to some extent, a marine representative of the Wealden, though of later date. Mr. Etheridge recalled the fact that Mr. Judd had correlated the Punfield fossils with those of the north of Spain, twenty-two species found in each being absolutely identical. He argued from this that the extent of the beds may have been far larger than might be supposed. Prof. T. Rupert Jones remarked that the Purbeck-Wealden lake theory had not only been intimated by several previous writers, but had been illustrated by maps by Messrs. Godwin-Austen and Searles Wood, Jun. The Chairman, alluding to the pseudomorphs of salt mentioned by the author, stated that they had been somewhat compressed, and thus modified in form. They had also been found in other beds in the Wealden. He commented on the extension of the Wealden strata even to the south of Moscow. In the Oxford and Buckinghamshire area there was evidence of great denudation of the Purbeck and Wealden beds prior to the deposit of the Neocomian, so that great changes would seem to have taken place, giving rise to a great amount of denudation towards the close of the Wealden period. Mr. Meyer agreed with Mr. Godwin-Austen and other speakers as to there having been a certain amount of denudation of the Upper Wealden beds prior to the deposit of others upon them, but this he regarded as merely local. It was the absence of shingle rather than of gravel to which he had alluded in his paper. He thought that there was a distinction to be traced between the Neocomian of the north of England and that of the south, and that the middle beds of one were equivalent to the lower beds of the other.

Zoological Society, March 19.—John Gould, F.R.S., vice-president, in the chair. The secretary read a report on the additions that had been made to the Society's collection during the month of February 1872, amongst which were specimens of the Sumatran rhinoceros, two-wattled cassowary, and other rare animals.—Mr. R. B. Sharpe exhibited some specimens of blue rock thrushes from Europe and Eastern Asia. After tracing the different plumages through which *Petrocossyphus cyanus* passed, he came to the conclusion that the Eastern blue rock thrush, *P. solitarius*, eventually becomes entirely blue like the European species, and that the birds usually called *P. manillensis* and *P. affinis* are merely stages of plumage of *P. solitarius*.—Major Godwin-Austen exhibited a skin of *Ceriornis blythii*, which had been obtained by Mr. Roberts, of the Indian Topographical Survey, in the Naga Hills.—Mr. Sclater exhibited and made remarks upon a specimen of the American yellow-billed cuckoo (*Coccyzus americanus*) which had been obtained near Buenos Ayres.—A communication was read from Prof. A. Macalister, of the University of Dublin, containing notes on a specimen of the broad-headed wombat (*Phazcolomys latifrons*).—A communication was read from Mr. W. E. Brooks, of Etawah, India, containing remarks on the Imperial eagles of India, *Aquila crassipes* and *A. bifasciata*.—A paper by Dr. J. E. Gray, F.R.S., was read, containing observations on the genus *Chelymys*, and its allies, from Australia.—Sir Victor Brooke, Bart., read a paper on *Hydropotes inermis* and its cranial characters, as compared with those of *Moschus moschiferus* and other Cervine forms.—Major Godwin-Austen read descriptions of new land and freshwater shells which he had recently met with in the Khási, North Cachar and Nágá Hills of N.E. Bengal.—Mr. Howard Saunders read some notes on the introduction of *Anser albatus* of Cassin into the European avifauna, and exhibited two examples of that species lately shot near Wexford in Ireland.

Chemical Society, March 21.—Dr. Odling, F.R.S., vice-president, in the chair.—The chairman announced that the

Faraday lecture would be delivered by Prof. Cannissaro on Thursday, May 30.—A communication from M. Maumerie, of Paris, was then read by the secretary, in which he denied the existence of the hyponitrous acid recently discovered by Dr. Divers (Proceedings of the Royal Society, xix. 425), on purely theoretical grounds, unsupported by any experiments or analyses. Dr. Divers, who was present, explained M. Maumerie's theory. —An interesting discussion took place on theoretical points connected with some remarks made by Dr. Debus, in which he stated that no organic compound existed, in which the number of atoms of hydroxyl, HO, was greater than the number of carbon atoms.

March 30.—The President delivered the annual address, in the course of which he commented upon the comparatively small number of papers communicated to the Society. The apathy and lethargy from which chemical science in this country is at present suffering, he believed to be due to a great extent to our system of university education. After the officers and council for the ensuing year had been elected, and the usual votes of thanks proposed, the meeting was adjourned.

April 4.—Dr. Frankland, F.R.S., president, in the chair.—Dr. Schorlemmer, F.R.S., delivered a very interesting lecture "On the Chemistry of the Hydro-carbons," defining organic chemistry as the chemistry of hydro-carbons and their derivatives. The characteristic properties of the paraffin, olefine, and acetyline series, and their relations one to another, were discussed, also those of the great aromatic group, the speaker pointing out the great assistance derived from the atomic theory in determining both the constitution of isomeric compounds, and also the relations existing between the various members of the aromatic series.

Entomological Society, March 18, 1872.—Mr. F. Smith, vice-president, in the chair.—R. Meldola was elected a member. —Mr. Higgins exhibited beautiful species of *Cetoniidæ* from Java, including some apparently new.—Mr. Bond exhibited a dimorphic example of *Acronycta leporina*, one side of which was coloured and marked as in typical examples, the other side as in the variety *bradyporina*, the two forms having at one time been considered distinct species.—Mr. Smith said that the remarks on Siberian insects at the last meeting had induced him to make a minute examination of specimens of the hornet (*Vespa crabro*) from Europe, Siberia, and North America, and he found that individuals from these districts presented no appreciable variation. The Asiatic *V. orientalis* was, however, quite distinct.—Mr. Müller read notes on *Serropalpus striatus*, which beetle he considered to be a wood-feeder, and especially attached to firwood; hence its occurrence in a hose-warehouse at Leicester could only be considered as accidental.—The Secretary read a long account of the ravages of locusts in South Australia in December 1871, as related in the *South Australian Register* for January 2, 1872. The insects were described as coming in swarms that darkened the air, eating every morsel of vegetation. It was found that those individuals that had partaken of leaves of the castor-oil plant were immediately killed thereby, and larkspur seemed also inimical to them.—Mr. Horne related his experiences of locusts in India. The castor-oil plant had certainly no injurious effects upon Indian species, though they were affected by the leaves of the tamarind-tree.

April 1.—Professor Westwood, president, in the chair.—Dr. A. S. Packard, Jun., of Salem, United States, was present as a visitor.—Professor Westwood exhibited a large spongy oak-gall found on the ground under an oak, which Mr. Muller considered to be the work of *Cynips radicis*. He further alluded to the differences existing in the genital apparatus of various species of the genus *Cynips*, and exhibited drawings illustrating his remarks. Also, he alluded to the different structure existing in the antennæ of various species of fleas, and maintained that these insects formed a distinct order, *Aphaniptera*. Finally he produced drawings, sent to him by a correspondent, of a minute Hymenopterous insect of the genus *Coccophagus*, parasitic upon the common *Coccus* of the orange; and he remarked that now is the best time for finding the males of *Coccus*, and especially of that infesting espalier pear trees.—Mr. Müller read notes on the larvæ of *Anaspis maculata*, which he had obtained from the excrescences or outgrowths on a trunk of birch. —Mr. Butler read additional remarks on the *Pericopides*, especially referring to species recently described by Dr. Boisduval.—Mr. McLachlan read a paper on the external sexual apparatus of the males of the genus *Acentropus* and exhibited drawings of this apparatus made from microscopic examination of individuals from various parts of England and the Continent. Although there were minute differences, he could find nothing to indicate, on these characters alone, that more than one species existed.

Geologists' Association, March 1.—Prof. Morris, vice-president, in the chair. "On the Geology of Hampstead, Middlesex," by Mr. Caleb Evans. The author described the deposits which had been exposed from time to time during the last few years in and near Hampstead. The principal excavations noticed were the several drainage works near Child's Hill, on Hampstead Heath, and in Frognal Lane, and the tunnel on the Midland Railway under Haverstock Hill. It appeared from these sections that the Lower Bagshot Sand which caps the hill passes downwards into a dark sandy clay about 50 feet thick abounding with fossils, especially *Voluta nodosa* and *Pectunculus decussatus*. The *Pectunculus* bed passes down into the London Clay of ordinary character, which forms the lower part of Hampstead Hill. The author noticed the great changes in physical geography which must have taken place during the time that intervened between the deposition of the Woolwich series and that of the Lower Bagshot Sand. He considered that remains of the glacial deposits probably exist on the north side of the hill. The position of these deposits on an eroded surface of the London Clay showed the large amount of denudation that had taken place prior to the Glacial epoch. The author, in conclusion, directed attention to the existing valleys around and to the north of Hampstead, which he considered had been formed by means of the springs issuing from the water-bearing Eocene sand and the glacial gravels. Mr. A. Bell thought the leaf-beds of the Middle Eocene indicated freshwater conditions. Mr. H. Woodward considered the presence of *Zanthopsis* in these beds evidence of Marine or Estuarine origin. He pointed out the great value of the maps and sections exhibited by Mr. Evans. Prof. Morris spoke of the foreign equivalents of the London Eocenes, during the deposition of which great changes of level took place. Though there are no traces of the Woolwich beds in the Belgian area, these deposits are represented near Epernay in France, while the London Clay forms a considerable area in Belgium. The patches of London clay on Salisbury Plain indicate the extension of the Lower Eocene sea over that area, and Bracklesham species are found at Chertsey. With respect to the Glacial deposits the Professor considered their importance in Middlesex very considerable, and thought it not improbable that the towns of Barnet, Hendon, and Finchley owed their origin to the presence of these deposits. The physical features of the country north of Hampstead are different from those south of that place, and this difference is due to the glacial deposits. Though the valleys of the district have been formed as we now see them by the rivers, their formation commenced during the rise of the land from the sea.—"On a recently exposed section at Battersea," by Mr. John A. Coombs. This was a brief description of a section exposed at the works of the London Gas Company now in progress near Battersea. The Thames Valley gravels are cut through and several feet of the London Clay is exposed. The gravels, which show much false bedding, yield mammalian remains, but the *Cyrena fluminalis* has not been found. Several species of Mollusca have been found in the clay, but the most abundant fossil is a species of Echinodermata, the *Pentacrinus sub-basaltiformis*. Mr. Hudleston noticed that at the Law Courts site in the Strand the gravels were much more ferruginous than those at Battersea, and the clay immediately underlying the gravels was altered in colour and character to a much greater depth at the former than at the latter locality.—Mr. A. Bell thought the *Cyrena fluminalis* would never be found in these beds at Battersea, as it belongs he considered to beds of a different age.

Victoria Institute, February 4.—Mr. C. Brooke, F.R.S., in the chair. "Prehistoric Monotheism, considered in relation to Man as an Aboriginal Savage," being a reply to certain statements made by Sir John Lubbock in his work on Primitive Man. The paper combated the statements made by that writer, that man in his original state was a savage and without religious knowledge, from the results of investigations into the present condition of savages, from the earliest authentic records to be found in various countries, and from the writings of Aristotle, Herodotus, and others. Mr. Prichard stated that so far as his inquiries had extended, they confirmed the view taken in the paper, and the Rev. G. Percy Badger, who gave similar testimony, in alluding to an apology made by the author of the paper, for not quoting Scripture as an authority, stated that it was perhaps judicious, as it enabled him to refute Sir John Lubbock's statement on his own ground, though it seemed strange that the latter should prefer the authority of such as Herodotus, whose writings betrayed ignorance on several points, for instance, where he refuses to believe in snow existing in a land so hot that the inhabitants were black,—to the writings of Moses, which, as writings even, were of a much higher order.

PARIS

Academy of Sciences, March 25.—M. Serret presented a note by M. A. Mannheim, containing geometrical investigations upon the contact of the third order of two surfaces.—General Morin read a memoir on the simultaneous employment of electrical induction apparatus and apparatus of deformation of solids, for the study of the laws of the movement of projectiles, and of the variation of pressures in the bore of guns.—A memoir was also read by M. V. Albenque, relating to the theory of rifled artillery, and treating of the effects of the resistance of the air upon a solid of revolution animated by a simultaneous movement of rotation.—M. Phillips presented a note by M. Bresse on the determination of brachistochrones.—A note from Father Secchi was read, giving an account of injury done at Alatri by lightning striking a lightning-conductor, and passing from it to large water pipes.—A note by M. G. Volpicelli, on the use of the proof-plane in the investigation of electrical conditions, was read.—M. Wurtz communicated a note by M. G. Salet, on the absorption spectrum of the vapour of sulphur, in which the author claimed to be the first describer of this spectrum, which was noticed by M. Gernez at the meeting of the Academy on March 18. He stated that the most perceptible dark lines coincide with the luminous bands in the spectrum of sulphur in the flame of hydrogen.—A letter from M. Donati to M. Delaunay, on auroras and their cosmical origin, was read. The author considers these phenomena to depend on an exchange of electricity between the sun and the planets.—M. Delaunay announced the discovery at Bilk by M. Luther on the night of March 15-16 of a new planet of the eleventh magnitude. The discoverer proposes to name it *Peitho*.—The miserable dispute as to the priority of the invention of the preservation of wines by heat was continued by MM. Vergnette-Lamotte, Pasteur, and Thenard.—M. Wurtz presented a note on a new class of compounds of dulcite with the hydracids by M. Bouchardat. These compounds are crystallisable, but rather unstable.—M. Fremy presented a note by M. Prinvault on the action of bromine upon protochloride of phosphorus, by which he has obtained some curious and unexpected compounds.—A note by M. E. Jannetaz on a new type of idiocyclophanous crystals was presented by M. Delafosse.—M. C. Robin communicated a note by M. V. Feltz on the properties of the bones, in which the author stated that matters injected into the spongy tissues of the bones in the living subject are absorbed as rapidly as if they were introduced directly into the veins, from which he inferred that this spongy tissue is in direct connection with the veins, and must be regarded as forming a system of sinuses.—M. Champouillon, in a note presented by M. Larrey, stated that putrefaction is much more rapid in the dead bodies of alcoholised subjects than in those of comparatively sober individuals.—M. C. Robin presented a note by MM. Legros and Onimus containing an account of some experiments on spontaneous generation, in which the authors describe the production of fermentation within an egg penetrated with sugar by endosmotic action, and afterwards immersed in a fermenting solution of sugar.—A note by M. A. Gris containing general considerations upon the structure of the bark in the Ericineæ was communicated by M. Brongniart.—M. A. Baudrimont read a paper on the existence of mineral matter in plants, which contains some interesting results as to the amount of solid matter in fleshy plants.—M. Roulin presented a note by M. Triana on the *Gonolobus cundurango*, a South American plant, reputed to furnish a remedy for cancer.—A paper by M. L. Vaillant on the fossil Crocodiles of Saint-Gérand-le-Puy was communicated by M. Milne-Edwards. The author described three species, two belonging to the subgenus *Diplocynodon* (*D. Ratelli* Pomel, and *D. gracilis* n. sp.), and a true Crocodile allied to the African species (*Croc. æduinus* n. sp.)

BOOKS RECEIVED

ENGLISH.—On Bone Setting: W. P. Hood (Macmillan and Co.)—The Natural History of the Year: B. B. Woodward (S. W. Partridge).—The Journal of Mental Science, No. 4· (Churchill).

DIARY

THURSDAY, APRIL 11.

ROYAL SOCIETY, at 8 30.—Researches on Solar Physics—Part III.: W. De La Rue, F R S., B Stewart, F.R S, and B. Loewy.—The Action of Oxygen on Copper Nitrate in a State of Tension: Dr. Gladstone, F.R S., and A. Tribe.
SOCIETY OF ANTIQUARIES, at 8.30.—On some of the Stone Remains of Brittany: Sir H. E. L. Dryden, Bart.
MATHEMATICAL SOCIETY, at 8.—On the Mechanical Description of certain Sextic Curves: Prof. Cayley, F.R.S.
ROYAL INSTITUTION, at 3.—Heat and Light: Dr. Tyndall.
LONDON INSTITUTION, at 7.30.—On the Distribution of Coal in the British Islands, and its probable duration: R. Etheridge, F.R.S.

FRIDAY, APRIL 12.

ASTRONOMICAL SOCIETY, at 8.
ROYAL INSTITUTION, at 9—Rousseau's Influence on European Thought: J. Morley.
QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, APRIL 13.

ROYAL INSTITUTION, at 3.—The Star-Depths: R. A. Proctor.
GOVERNMENT SCHOOL OF MINES, at 8.—On Geology: Dr. Cobbold.

SUNDAY, APRIL 14.

SUNDAY LECTURE SOCIETY, at 4.—On Æther: the Evidence for its Existence, and the Phenomena it explains: Prof. W. K. Clifford.

MONDAY, APRIL 15.

VICTORIA INSTITUTE, at 8.—On the Rationality of the Lower Animals: Rev. J. G. Wood.

TUESDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—On Statistics, Social Science, and Political Economy: Dr. Guy.
ZOOLOGICAL SOCIETY, at 9.—On the Mechanism of the Gizzard of Birds: A. H. Garrod—On a supposed New Monkey from the Sunderbunds to the East of Calcutta: Dr. John Anderson.
STATISTICAL SOCIETY, at 7.45.

WEDNESDAY, APRIL 17.

SOCIETY OF ARTS, at 8.—On the Great Central Gas Company's Works: A. Angus Croll.
ROYAL SOCIETY OF LITERATURE, at 8.30—On the Trade of Phœnicia with Ophir, Tarshish, and Britain: W. S. W. Vaux.
METEOROLOGICAL SOCIETY, at 7.

THURSDAY, APRIL 18.

ROYAL SOCIETY, at 8.30.
ROYAL INSTITUTION, at 3—On Heat and Light: Prof. Tyndall, F.R S.
SOCIETY OF ANTIQUARIES, at 8.30.
LINNEAN SOCIETY, at 8.—On *Begoniella*, a new genus of Begoniaceæ: Prof. Oliver.—On three new genera of Malayan plants: Prof. Oliver.—On *Camellia scottiana* and *Ternstrœmia coriacea*: Prof. Dyer.
CHEMICAL SOCIETY, at 8.—Notes from the Laboratory of the Andersonian University; On a Compound of Sodium and Glycerine; and On Benzylisocyanate and Isocyanurate: E. A. Letts.

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NOTICE

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