THURSDAY, APRIL 18, 1872

## *THE SECOND REPORT OF THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE*

THE Commission has just issued its Second Report, dealing with the scientific side of the instruction given in Training Colleges and National Schools, and in the Science Classes at present conducted by the Science and Art Department. The report is so long that it is impossible to give it *in extenso*. It can, however, be easily obtained, and it should be read by all interested in one of the most important questions for England just now. Both with reference to elementary education and the Science Classes the present condition of things is fully stated, and this condition is criticised where, in the opinion of the Commissioners, criticism is necessary. The provisions of the new code we may refer to as a case in point.

The Report concludes with the following recommendations :—

### SCIENTIFIC INSTRUCTION IN TRAINING COLLEGES AND ELEMENTARY DAY SCHOOLS

I. We recommend, as regards the elder children in the elementary schools, that the teaching of such rudiments of physical science as we have previously indicated should receive more substantial encouragement than is given in the regulations of the new code.

II. We recommend, as regards the younger children that Her Majesty's Inspectors should be directed to satisfy themselves that such elementary lessons are given as would prepare these children for the more advanced instruction which will follow.

III. We recommend that the mode of instruction of pupil teachers, the conditions of admission to training colleges, the duration of the course of study in them, and the syllabus of subjects taught, should be so modified as to provide for the instruction of students in the elements of physical science.

### SCIENTIFIC INSTRUCTION IN SCIENCE CLASSES UNDER THE SCIENCE AND ART DEPARTMENT

IV. We recommend that the instruction in Elementary Science Classes under the Science and Art Department, be so arranged as to work in complete harmony with the general system of public elementary education, but, at the same time, we consider it important that the Education Department and the Department charged with Instruction in Science shall continue to be co-ordinate.

V. We recommend that a more efficient inspection of Elementary Science Classes be organised, and that the inspectors should advise the local committees and report on :—

(*a*) The apparatus of instruction.
(*b*) The state of the discipline and methods.
(*c*) The general efficiency of the arrangements.

VI. We recommend that teachers who have already qualified by passing the May examination in either of the advanced classes shall continue to be recognised as qualified to conduct Elementary Science Classes, with the title of Elementary Science Teacher, and to earn the grants awarded by the Department of Science and Art on the results of the examination of their scholars ; but that this qualification and title shall in future only be attainable by passing in the first of the advanced classes.

VII. We recommend that should such arrangements as are hereinafter set forth for conducting the practical instruction of teachers, and for providing for them practical examination at several centres, be adopted, all elementary science teachers shall, after such practical instruction, be admissible to a further examination, which, in all suitable subjects, shall be practical. We recommend that success in this examination shall entitle a teacher to a certificate of Second Grade Science Master.

VIII. We recommend that, as an inducement to teachers to prepare for and pass this further examination, payment for results in the case of a Second Grade Science Master be made at a somewhat higher rate than in that of the Elementary Science Teacher.

IX. We recommend that an examination, both by papers and by practical tests, in any group of allied subjects defined by the Department which the candidate may select, shall be open to all those teachers who have passed in the advanced classes, or who have been otherwise admitted as Science Teachers; and that success in this examination shall entitle the candidate to receive a certificate of First Grade Science Master in that group.

X. We recommend that a greater capitation grant be payable in respect of the scholars of a First Grade Science Master teaching in any group of allied subjects with or without assistance, than in respect of the scholars of a Second Grade Science Master, provided that the Inspector report that the apparatus is sufficient, and that practical instruction has been given in each suitable subject.

XI. We recommend that, with a view of maintaining uniformity of standard in these examinations, they shall be conducted at the several local centres by the staff of Examiners acting under the Science and Art Department.

XII. We recommend that the more systematic training of the teachers of science referred to, be provided for—

(*a*) By the adoption of special arrangements for this purpose in the Science School which has been referred to in our First Report ; and by the recognition by the Department of similar arrangements for the instruction of this class of students in any University or College, and in Science Schools as hereinafter described.

(*b*) By giving to the students of Training Colleges the opportunity of remaining a third year, during which scientific instruction may either form a principal part of the curriculum of such Colleges, or be accessible in some adjacent College or School of Science approved as efficient for that purpose.

XIII. We recommend that the Science and Art Department be at liberty to dispense with the preceding exami-

nations, and to accord the privilege of First and Second Grade Science Masters in consideration of University Examinations in Science, or of a satisfactory course of study in colleges in which science is taught, as well as in other cases of obvious scientific qualification.

XIV. We recommend that in schools recognised as Science Schools, as hereinafter set forth, facilities for the employment of assistant teachers be afforded as an experiment on a limited scale, some addition being made to the emoluments of the teacher in consideration of the instruction afforded; provided the Department be satisfied, on the report of an inspector, that such assistant teacher has received practical instruction in subjects in which it is prescribed, and that he has been actively engaged in teaching.

To encourage the more advanced scholars to become assistant teachers under first grade masters in such schools, a small stipend, rising in successive years, might be granted on condition that a like sum was raised locally, subject to such conditions as the Department might deem expedient. The proportion of assistant teachers should not exceed one for every fifteen successful scholars in any science school, and no scholar should be recognised as an assistant teacher until he has passed in the first division of the elementary class in the May examination.

XV. We recommend that, with a view of training First Grade Science Teachers, exhibitions of sufficient value and in sufficient numbers be offered to elementary science teachers and to assistant teachers who have served three years, and passed in the first division of the advanced class in the May examinations; and that such exhibitions should be tenable in any University, College, or Science School recognised in Recommendation XII.

XVI. We recommend that the grants made by the Science and Art Department for buildings be extended, under sufficient guarantees, so as to embrace institutions for scientific instruction, although they may not be built under the Public Libraries Act, or be in connection with a School of Art.

XVII. We recommend that grants similar to those now made for apparatus be given for laboratory and museum fittings under proper guarantees.

XVIII. We recommend that whenever the arrangements for scientific teaching in any institution shall have attained a considerable degree of completeness and efficiency, such institution be recognised as a Science School, and be so organised as to become the centre of a group of Elementary Science Classes; and to provide the assistance of First Grade Science Masters, the loan of apparatus and specimens, and the means of instruction in the laboratories and museums to the more advanced students of the group.

XIX. We recommend that assistance be given for the formation and maintenance of such Science Schools by special grants, the conditions of which shall be determined by regulations to be framed by the Science and Art Department.

XX. We recommend that when laboratories are attached to second grade grammar schools in the schemes issued by the Endowed Schools Commissioners, the trustees of such schools be encouraged and enabled to invite the formation of elementary science classes to be taught therein.

## *AMERICAN WAR-OFFICE REPORTS*

*Report on Barracks and Hospitals*, with Descriptions of Military Posts. War Department, Surgeon-General's Office, Washington, December 5, 1870; pp. 525.

*Approved Plans and Specifications for Post Hospitals.* Surgeon-General's Office, Washington, July 27, 1871; pp. 14.

THESE two documents are intended to fulfil for the United States army the same purpose as the Reports of the Royal Commissions of 1857 and 1863 on the sanitary state of the British and Indian armies, and the Report of the Barrack and Hospital Improvement Commission were intended to fulfil for Her Majesty's troops serving at home and abroad.

The first document contains an excellent general report by Assistant-Surgeon Billings, followed by a digest of reports from the posts of the United States army scattered all over their territory. These reports, besides dealing with the general sanitary condition and diseases of troops, are full of interesting general information regarding local topography, surface geology, hydrography, meteorology, and natural history, having reference to 151 points and districts of the country extending from the lakes to the mouths of the Mississippi, and from the east of Maine to the far west of Oregon and California. The reports are illustrated by topographical plans, showing the outlines of the more important localities, and also by plans and details of barrack and hospital arrangements.

The most common diseases to which troops are liable are malarial fevers, catarrhal affections, diarrhœa, and dysentery. Malaria appears to exist more or less in all the military "departments," while in Arizona it produces results of more importance to efficiency than this pest does in India.

The purely medical details are of more interest to professional readers, but it is evident that most of the officers who have supplied the local information have been fully alive to the importance of scientific questions generally, and hence these reports may be advantageously consulted by persons interested in the physical geography of this division of the American continent. In Mr. Billing's report the general results of these district inquiries are given, and the principles of local improvements are discussed. Those referring to post hospitals are embodied in the "approved plans and specifications," which show simple, efficient, and economical, methods of erecting hospitals of the denomination required. The plans are generally the same as those proposed by the Army Sanitary Committee in this country, but they contain one or two of those ingenious adaptations of principles for which our transatlantic cousins are famous. One of the great difficulties in American climates is to keep apartments sufficiently heated and yet to preserve the air from contamination.

In improved barracks and hospitals at home this has been effected by a peculiar form of fire grate, contrived by Captain Galton, which, while retaining the advantages of the open radiating fire, supplies the room with a large body of fresh air warmed to about 60° F., the chimney draught being used as a means of removing foul air from the room. A modification of this contrivance for burning wood is figured in the report on the Sanitary Improve-

ment of Indian Stations, drawn up by the Army Sanitary Committee.

The American contrivance produces the same result in duplicate by one fire-place intended to be fixed in the centre of the ward. There are two open fires, one facing each way. The fresh air to be warmed is passed under the floor to the space between the backs of the two fires, and is thence admitted in the room. The arrangement is simple, and ought to be effective.

It is evident from the reports generally, that much improvement is required in existing barracks and hospitals in the United States, and that overcrowding, defective ventilation, and other disease causes, still exist there as they used to do with us. It is a great step towards improvement to have an honest statement of defects. We must congratulate the Surgeon-General's department on the production of these reports, and express our hope that the executive authorities may make as good a use of them as the reporters have done of their opportunities of acquiring information regarding the stations.

## *OUR BOOK SHELF*

*Scottish Meteorology*, from 1856 to 1871. Being a continued monthly and annual representation of the more important mean results for the whole country, deduced at the Royal Observatory, Edinburgh, from the schedules of observation by the Observers of the Scottish Meteorological Society, for the purposes of the Registrar-General of Births, Deaths, and Marriages in Scotland. (Edinburgh Astronomical Observations, vol. xiii.)

IN the Introduction to this work, the Astronomer Royal for Scotland tells us that it was undertaken at the request of Government, the application being to deduce from the observations taken under the auspices of the Scottish Meteorological Society, "certain monthly and general results for each and all of the stations, results supposed to be important for medical climatology and its influence on population and national welfare." The ways of statisticians are mysterious; it is difficult to understand what advantage either to medical climatology, to agriculture, or, broadly, to national welfare, is to be derived from the means here printed, means not only of barometric pressure, but of temperature, rain, and hours of sunshine, including as they do the observations at some 55 stations scattered over all Scotland, from the Shetland Islands to Dumfries, from Aberdeen to Islay—places with peculiarities of climate as distinct as could anywhere be found within anything like equal distances. We suppose, however, that there is a use for them; and, that being the case, they could not be put before the reader with more beautiful simplicity and clearness than we here find; but as we reflect on the enormous amount of skilled labour which the reductions must have cost, we cannot help regretting that meteorology can derive no advantage from it. With this report for "the purposes of the Registrar-General" is sewn up one of a very different and highly interesting character, the detailed observations of the storm which passed over the North of Scotland on October 3, 1860. These observations describe very fully a storm of extraordinary intensity, bursting almost with the suddenness of a meteor on the northern coasts; with such suddenness, indeed, that at several of the stations where the barometer was registered only at intervals of twelve hours, the whole fall, amounting, it would seem, to about 1·8 in., and the subsequent rise, passed quite unnoticed. One point which has been often, though not very closely, observed in tropical cyclones, comes out most distinctly—the remarkable rise of the barometer beyond the limits of the storm, before and after it, in Scotland, in England, and France, about the time of its meridian passage. The lowest barometric reading anywhere observed was 28·5; this leads us to remark that, in tabulating the conclusions, the force of the wind has been unintentionally much exaggerated, owing, it appears to us, to a confusion common to all non-nautical minds between the land scale, which numbers from 0 to 6, and the Beaufort, or sea scale, which numbers from 0 to 12; for the one is not to be converted into the other by simply doubling; and the shore 6, far from being the equivalent of the Beaufort 12, is more nearly represented by 9 to 10, or at the outside by 10, which may be considered as corresponding to a velocity of about 80 miles an hour. In the discussion of the observations of this storm, many points of great interest arise: amongst others, the relationship between wind and pressure, the howling of the wind, and the ascensional motion of the air near the centre. The curt, able, cautious, and suggestive treatment of these is such as we might expect from the high standing of Prof. Smyth, and leaves little to be wished for except time for meditation. J. K. L.

*The Deviation of the Compass in Iron Ships considered practically for Sea Use, and for the Board of Trade Examinations.* By W. H. Rosser. (London: Longmans.)

IN this small treatise the Deviation of the Compass in iron ships is professedly dealt with as a matter of observation, and distinct generally from magnetic science and the mathematical investigations based thereon. Mr. Rosser's long experience both as a "teacher" of officers in the mercantile marine, and an adjuster of compasses for the ships of that service, has enabled him to produce a work calculated to give those with whom he has been so long associated good practical information. The articles on the compass equipment of ships and the heeling error are judiciously given, and rightly occupy a prominent place. Whilst, however, thus commending the work, it must be regarded as meeting only a present and passing want; for from the absence of many theoretical, but not necessarily abstruse, details, the subject even as presented from a practical point of view cannot be considered as grasped with that entirety which certainly belongs to it. Those theoretical deductions which have been practically confirmed are further requisite in the advanced examinations instituted by the Board of Trade, and are, moreover, to be found in the several manuals compiled under the Admiralty and Board of Trade auspices.

## *LETTERS TO THE EDITOR*

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

### Error in Humboldt's Cosmos

I BEG to call the attention of geometers to what appears to me to be an inaccuracy in a work, which is, perhaps, the last which one would suspect to be capable of error—the "Cosmos" of Humboldt.

In vol. i. p. 293, he says, "I have found by a laborious investigation, which, from its nature, can only give a maximum limit, that the centre of gravity of the land at present above the level of the ocean is, in Europe, 630; in N. America, 702; in Asia, 1,062; and in S. America, 1,080 French feet (or 671, 748, 1,132, and 1,151 English feet) above the level of the sea." Sir John Herschel in his "Physical Geography" (Encylop. Britt.) quotes these numbers of Humboldt as giving the height of the centre of gravity of these continents; and adds, "whence it follows, that the mean elevation of their *surfaces* (the doubles of these) are respectively 1,342, 1,496, 2,264, and 2,302." Herschel's conclusion is, of course, just, if Humboldt meant what he seems to say. But at the risk of being thought most presumptuous, I submit that Humboldt meant the height of the centre of gravity of the *surface* of the land; in other words, the mean height of

the land; and by thus misleading Sir John Herschel he has by a *coup de plume* doubled all our continents.

1. In the first volume of his "Asie Centrale," p. 165, writing on "la hauteur moyenne des continents," Humboldt says, "en cherchant à évaluer l'élévation moyenne de la hauteur des divers continents, c'est à dire la position du centre de gravité du volume des terres élevées audessus du niveau actuel des eaux. . . ." It thus appears that Humboldt used the words "hauteur moyenne," and "hauteur du centre de gravité du volume," as equivalent expressions, which I submit they are not. Had he said "centre de gravité de la surface," he would have been right, for that height is the mean height.

2. But though inaccurate in expression, Humboldt could never be other than right in principle. Fortunately in the "Asie Centrale" he describes with much detail the process by which he arrives at his so-called "centre de gravité du volume"; and the process legitimately leads to the mean height. He divides the continent into great areas, which I shall call $a_1$, $a_2$, $a_3$ . . . finds the mean height of each $b_1$, $b_2$, $b_3$, . . . by taking the mean of several; and then the mean height is

$$\frac{a_1 b_1 + a_2 b_2 + a_3 b_3 \ . \ . \ .}{a_1 + a_2 + a_3 \ . \ . \ .}$$

A range of mountains he regards as a triangular prism; and to find its mass he multiplies the area of the base by half the mean height, and then computes how much this would raise the whole country if spread over it; and the former number thus increased is, as is plain, the mean height.

3. Arago, in his "Astronomie Populaire," cites the labours of Humboldt with approbation, goes over all the details, adds a vast number more, and deduces numbers approximately the same for the mean height of land. Arago, it is to be observed, invariably uses the phrase "hauteur moyenne." Like Humboldt, he considers that the mean of all the continents lies between 900 and 1,000 feet.

4. Humboldt (Note 360, "Cosmos") apologises for differing from La Place, who, he says, made the mean height of continents *more than three times* too great. Now La Place's estimate was 3,078 feet.

I conclude, therefore, with the greatest deference, that Humboldt's "centre de gravité du volume" is an inaccurate expression, and that he meant "centre de gravité de la surface," or mean height. If this be so, Sir John Herschel has been led into the error of doubling our continents, which he estimates at a mean elevation of 1,800 feet.

It is a matter of some importance; for Sir Charles Lyell computes that the continent of N. America will be utterly washed away into the ocean by the ordinary processes of degradation in four and a half millions of years. If, indeed, this period is to be doubled, we can take a more cheerful view of the future of that continent. But I greatly fear with Sir Charles that it is limited to four and a half millions of years, unless some upheaval of the land shall protect its short span of existence.

JOHN CARRICK MOORE

113, Eaton Square, March 28

## Conscious Mimicry

THE idea of mimicry in animals being induced through the sense of sight appears to me to deserve more than a passing notice of M. G. Pouchet's statement that changes of colour in prawns, to accommodate them to the colour of surrounding objects, are prevented by removing the eyes of the prawns.

In 1869 I expressed my belief that such was the case, and endeavoured to embrace a large class of phenomena, as well as mimicry, within the same instrumentality. I allude to the asserted cases of the human or other fœtus being affected through the sense of sight of the mother. But on ascertaining the views of many able medical men, as well as of scientific naturalists, I found opinions so divided on the matter that I did not think it desirable to pursue further inquiries, nor publish my memoranda made at the time. I could not bring myself to see that natural selection alone could produce mimicry. If it were of rare occurrence it would be called a remarkable coincidence, and might reasonably be due to selection, but what is really very general becomes a law, and must be traced to some far more "regular" influence than natural selection.

In basing the idea of mimicry in general upon the supposed act of the fœtus being susceptible through the mother's sense of sight, one is aware of the critical nature of the ground adopted, and that possibly nine-tenths of the cases recorded must be put aside as worthless; but I have strong reasons for believing the one-tenth at least to have been true.

On the other hand, the experiments of Mr. Leslie on the caterpillars of *Pontia Rapæ*, which when enclosed, some in black and others in white boxes, produced chrysalises respectively modified to suit the colour of the box (*Sc. Gossip*, 1867, p. 261), appear to support my view, as also do those of Mr. Robert Holland (*Ib.* p. 279), in which the cocoons of the Emperor moth spun in white paper were white, while those on soil or in dead grass were brown.

G. HENSLOW

## The Adamites

MR. C. STANILAND WAKE objects to my remarks on his paper on the "Adamites," which paper he protests is "written at least in a truly scientific spirit." This, I venture to say, is just Mr. Wake's error. He does not seem to be aware that comparative philology has a scientific method, and that words have to be compared by sound and structure according to fixed and even strict principles. Mr. Wake comes upon a Sanscrit word *pita*, father, and finds in it a primitive root *ta*, which he compares with another syllable *ta* got by cutting in two in the same way an Arabic verb, *'ata*. Had he looked into the structure of Sanscrit, he would have found that *pita* is the nominative case, and precisely the one that does not show the real crude-form of the word, which is *pitar*, the *tar* being a suffix. If it is lawful to compare languages by cutting words up anyhow and finding resemblances among the bits, of course connections may be found between any languages whatsoever. In the same easy way Mr. Wake finds a relation in Polynesian mythology between a divine being called *Taata* (by the way, he should have taken the name in one of its fuller forms, such as *Tamata* or *Tangata*), and another divine being called *Tiki*. But these are two different gods with different attributes, why should their names be altered to make them into one?

Mr. Wake thinks it nonsense for me to have set up an imaginary derivation for *Paddy* and *Taffy*, as commemorating the same ancestor *Ad* or *Ta*, from whom he traces *Akkad* and *Taata*. But of all ways of testing methods, one of the most useful is to try whether they can be made to prove transparent nonsense. If they can, it is evident that the method wants correction. As for my communication to you being anonymous, it was so for much the same reason that Mr. Wake's name was not mentioned in it, viz., that it is best to keep the personal element in the background in such matters, and the paper itself is the thing to be judged by.

M. A. I.

IF your correspondent, "M. A. I.," instead of endeavouring to negative the conclusions of Mr. Wake's paper "by such nonsense as the reference to Paddy and Taffy," as the author of the paper justly observes, had brought forward the word *Adam* itself, and shown that, by dividing it into *Ad* and *am*, and prefixing its consonant in each case, we obtain *Dad* and *Mam*, *father* and *mother*, he might have been held to have been critical, as well as satirical.

I believe, however, that Mr. Wake is wholly wrong in his conclusions, simply because his premisses are wholly wrong.

The word *Adam* has nothing of the meaning of *father* in it. The *Ad*, which Mr. Wake has so ingeniously made so much of, should for his argument be the Hebrew *Ab*, Arabic *Aba*, *a father*. To suppose that the word *Adam* has anything of the meaning of *father* in it shows a complete disregard of its root-meaning. In Hebrew the verb *adam* means *he was red* or *brown*, and the substantive *Adam* means *a red* or *a brown man*. The word *Edom* is from the same root, and means the *Red land*, probably because Red Sandstone constitutes its principal geological formation, and even *adamah*, the *ground*, is so called because of its *reddish* or *dark brown* colour. The Scripture narrative of the origin of man is that the Creator formed "the *Adam* (or man) of the dust of the *adamah* (or ground)."

If Mr. Wake's object had been to show that the *Adamites* were derived from the earth or *earth*-born, he would have found little difficulty both by internal and external evidence; he might have instanced the autochthones of the Greeks, the homines (*humus*, the ground), of the Latins, the yellow-earth men of the Chinese, and the red-clay men of the North American Indians.

April 15 B. G. JENKINS

## On the Colour of a Hydrogen Flame

ACCEPTING, for the time being, the experiments of Mr. Barrett as sufficient proof that a pure hydrogen flame does not exhibit a blue colour, my "elaborate theory" must, I suppose, seek refuge under the actinic power of the electric light.

Mr. Murphy refers this actinism to the fact "that the electric light is *bluer* than solar light," the blue rays of the sun's light having been abstracted by absorption. This is a bare fact, and deals solely with the relative proportions of the different coloured rays which reach us from the two sources—it conveys no clue to the reason *why* the blue rays have an entity in the first instance.

I would not have it understood that I consider *all* the high refrangible rays to be due to secondary waves; but I think it possible that some, at least, of those emitted from sources of a very high temperature may owe their existence to this cause. Considering for the moment the electric light, we have a centre of the most intense commotion sending off waves in all directions—a condition necessary, and at the same time eminently favourable, for the production of secondary waves.

With respect to Mr. Barrett's experiments, I intend to repeat them as soon as I can command the time. The absence of the higher refrangible rays in a hydrogen flame does not, however, affect the mechanical possibility of the existence of secondary waves; although it would be reasonable to expect their presence in a pure oxy-hydrogen flame, the amplitude of the disturbed particles being necessarily very great. A. G. MEEZE

Hartley Institution, Southampton, April 15.

## Another Aurora

A MAGNIFICENT aurora, scarcely inferior to that of February 4, was observed here on the evening of the 10th inst., between $8^h\ 30^m$ and $9^h\ 30^m$.

The display was at its greatest beauty about $9^h\ 0^m$, when the creamy-white streamers attained an altitude of at least 60° above the N. horizon, and formed a fine contrast with a pale rose-pink background. The streamers appeared to proceed from behind a dense mass of stratus cloud which, although a moderate breeze was blowing from the S.W., remained almost stationary and unaltered during the display. The N. horizon was lighted up with a glow as intense as the early twilight on an evening in June.

With a small direct-vision spectroscope by Browning, I could see the line in the green near F, but no others. It was remarkably bright and sharply defined.

Bedford, April 12 THOS. GWYN E. ELGER

## Brilliant Meteor

YESTERDAY afternoon, whilst standing on the lawn of the Observatory with my back to the sun, which was brightly shining, I saw a splendid meteor fall in the south-east. The sky at the time was of an intense blue and cloudless, with the exception of a few cirri in the north and north-west, and the meteor as seen against it presented the appearance of polished silver. The flight of the meteor was almost vertical at an altitude of about 30°, its extent was about 10°, and the trail which seemed to hang in the air and fade away like the trail of a rocket, was at the instant of explosion probably 3° in length. There was no report accompanying its disruption, or it would certainly have been heard, the neighbourhood being very still at the time.

Immediately on its disappearance I looked at my watch, it was $4^h\ 36^s$ P.M. G.M.T.

Had the fall occurred after dark I have no doubt but that the meteor would have exhibited a magnificent spectacle, for its brilliancy far exceeded that of the moon as seen by daylight.

During the aurora on the evening of the 10th I observed at 9.16 P.M. a peculiar well-defined patch or short band of bright red light, the position of which, as seen from here, was N.N.E. altitude 40° to 45°. Perhaps other observers may have noticed it, and their observations will give data which may serve to assist in determining the true height of the auroral discharge.

The magnetic disturbance on the 10th commenced abruptly at 2 P.M., and was greatest during the hours of daylight, so it is extremely probable, the sky being but partially clouded, that if the aurora was visible before night, some observers may have seen it. I cannot say I have ever seen it myself in the daytime, although I have repeatedly seen cirrus clouds assuming a form very similar to auroral streamers. However, on looking at the magnets and finding them undisturbed at the time, I have concluded that no aurora was taking place.

Kew Observatory, April 13 G. MATHUS WHIPPLE

## Tide Gauges

THE subject of the tides is now one in which much interest is taken by the committee of the British Association, and it would be a great boon to many who are in a position to give attention to it, if some of your readers would supply a description of a self-registering gauge for recording the heights, which should do its work effectively and not very expensively. Many plans are suggested; the difficulty is to know which is the best.

Vicarage, Fleetwood, April 11 JAMES PEARSON

## *NOTES ON THE RAINFALL OF* 1871

THE following are a few particulars of the rainfall of the past year, deduced from daily observations with Glaisher's (Hall's improved) rain gauge* at Fulwell,† near Twickenham, Middlesex, the place of observation being in lat. 51° 26′ 0″ N. long. 0° 20′ 53″ W.

The orifice, or receiving surface of the gauge, which is placed horizontally, is 8·00 inches in diameter (50·26 in area), the height of the same above the ground being one foot, and, as determined by spirit levelling from Ordnance B.M., 47 feet above mean sea-level.

The results of the observations have been calculated in the imperial system, and metric equivalents are placed in brackets, the use of which (brackets), for the sake of distinction, has been avoided in all other formulæ; they have, in each instance, been calculated to two or three places of decimals, but are here given, so far as is practicable, in whole numbers; the nearest integer, in each instance, having been taken; *they have further been calculated upon the hypothesis that the rainfall was equally distributed.*

In the following table:—

$\alpha$ = depth of rainfall in inches } Total fall
$\beta$ = depth in centimetres } per month.
$\gamma$ = number of gallons } Equivalents
$\delta$ = number of hectolitres } per acre.

| | $\alpha$ | $\beta$ | $\gamma$ | $\delta$ |
|---|---|---|---|---|
| January | 2·03 | 5·156 | 45,675 | 2,074 |
| February | 1·00 | 2·540 | 22,500 | 1,022 |
| March | 1·08 | 2·743 | 24,300 | 1,103 |
| April | 3·52 | 8 941 | 79,200 | 3,596 |
| May | 0·62 | 1·575 | 13,950 | 633 |
| June | 3·21 | 8·153 | 72,225 | 3,279 |
| July | 3·00 | 7·620 | 67,500 | 3,065 |
| August | 0·93 | 2·362 | 20,925 | 950 |
| September | 4·20 | 10·668 | 94,500 | 4,291 |
| October | 1·10 | 2·794 | 24,750 | 1,124 |
| November | 0·54 | 1·372 | 12,150 | 552 |
| December | 1·19 | 3·023 | 26,775 | 1,216 |

The total depth during the year was 22·42 in., or 56·947 centimetres.

The rainfall on a square mile during the year was $22{,}500 \times 640 \times 22{\cdot}42 = 322{,}848{,}000$ gallons ($\div 22{\cdot}024 = 14{,}658{,}918$ hectolitres), or $640 \times 4840 \times 9 \times 22{\cdot}42 \div 12 = 52{,}086{,}144$ cubic feet ($\div 35{\cdot}31658 = 1{,}474{,}835$ cubic metres).

A cubic inch of distilled water at a temperature of 62° Fahr. (16·66 C.) is a standard of weight; this quantity has been determined to weigh 252·458 grains, of which 437·5 make one ounce Av.;‡ therefore, a cubic foot weighs

* Vide *Scientific Opinion*, Vol. iii., pp. 429, 449 (May 18, 1870).

† Although the observations refer especially to this locality, they will probably be scarcely the less interesting.

‡ *Practical Meteorology*, by John Drew, Ph.D., sec. 127, p. 190.

$\frac{252{\cdot}458 \times 1728}{437{\cdot}5} = 997{\cdot}137$ oz. Av.; hence we may assume that the entire weight of water which fell on one square mile was $\frac{52{,}086{,}144 \times 997{\cdot}137}{35{,}840} = 1{,}449{,}136$ tons, (÷ ·984 = 1,472,699 milliers). Some idea of this enormous quantity will be afforded by the following illustrations.

The Thames at London Bridge is, at low water, nearly 700 feet wide,* and from 12 to 13 (say 12·5) feet deep. We will, for the sake of argument, assume the sectional area throughout to be 700 × 12 5 = 8,750 square feet. The amount of rainfall on a square mile was equivalent to a volume of water corresponding in sectional area to the Thames at London Bridge, and extending $\frac{52.086,144}{8750 \times 5280} =$ 1·127 miles in length; in other words, it would extend from London Bridge, past Cannon Street (Railway), Southwark and Blackfriars (Railway and Road) Bridges, to about Somerset House, or nearly to Waterloo Bridge.

The same quantity of water would equal the contents of a river or canal having an uniform width of 20 feet, and depth of 5 feet—the sectional area being 100 feet—extending nearly 99 miles, or 159 kilometres in length.

The cubic contents of a sphere are $\frac{2}{3}$ of that of a cylinder of the same diameter and altitude. But the altitude being equal to the diameter, and $\frac{2}{3}$ of ·7854 being ·5236, the contents may be expressed as I have arranged it in the following formula. Calling $\triangle$ the diameter, and $x$ the cubic contents required, we have

$$\triangle^3 \times {\cdot}5236 = x,$$

or the reverse, calling C the cubic contents and $x$ the diameter required.

$$\sqrt[3]{\frac{C}{{\cdot}5236}} = x.$$

By these formulæ I have determined that the rainfall on a square mile—under the conditions mentioned in paragraph 3—was equivalent to a globe of water 463 ft. in diameter (approximate), a height exceeding that of the top of the cross surmounting the dome above the pavement of the churchyard of St. Paul's Cathedral (370 ft.†) by 93 ft.

The same quantity of water was equivalent to the following:—

A circular column of water 144 ft. in diameter (corresponding to that of the dome of St. Paul's Cathedral—interior surface‡), rising to a height of 3,198 ft.; in other words, it would be upwards of 8½ times the height of the cross before-mentioned.

Or, with regard to specific gravity:—

A circular column of lead (cast)§ of the same diameter (144 ft.—a cubic foot being taken as 710 lbs., or 11,360 oz.) containing 4,571,921 cubic ft., and rising to a height of 278 ft.

A circular column of granite (Aberdeen) of the same diameter, a cubic foot being taken as 2,690 oz.,‖ containing 19,307,443 cubic feet, and rising to a height of 1,184 ft.

But perhaps the most remarkable illustration will be afforded by comparing the weight of this quantity of water to a corresponding weight contained in, say, a number of railway coal waggons. Railway coal waggons are constructed to carry, on an average, from eight to ten tons. Let us assume it as the former of the two, and the average length of a number of waggons as 16 feet each from buffer to buffer. It would require no less than 181,142 such waggons to carry a corresponding weight of coal (or 3,623 heavy trains of fifty waggons each) which would, when close coupled, *i.e.*, buffer to buffer, extend over a distance of nearly 549 miles (883 kilometres) represented very nearly by the distance from London (Euston Station) to Aberdeen *viâ* Rugby, Stafford, Crewe, Carlisle, Glasgow, and Perth (London and North Western and Caledonian Railways). An express train, travelling at an uniform speed of sixty miles per hour, would take upwards of nine hours to run this distance, in other words, to pass this number of waggons; or, if I may indulge in another illustration, this number of waggons would, if travelling at an uniform rate of twenty-five miles per hour—which is about the average rate of goods trains—be nearly twenty-two hours in passing any given point, such, for instance, as a station. (Aberdeen is upwards of 130 miles N.N.E. of Edinburgh by the Caledonian Railway—Eastern route from London.)

Such a means of illustration as the one I have here set forth may not be considered in all respects strictly scientific; it has nevertheless this advantage, it enables us to comprehend something of the truth and magnitude of the subject—although dealing with hypotheses—where mere abstract figures would fail to produce anything like a similar result.

JOHN JAMES HALL

* I quote this from a paper "On the Rainfall of Devonshire," by W. Pengelly, Esq., F.R.S., *Scientific Opinion*, Vol. i. p. 137. (From the Transactions of the Devonshire Association for the Advancement of Science, 1868.) The depth is confirmed in the *Encyclopædia Brittanica*, Vol. xxi p. 163.

† *Encyclopædia Brittanica*, vol. xiii. p. 670.

‡ From the Cathedral authorities.

§ "Sprague's Pocket Tables (Architects and Surveyors)," p. 9.

‖ Ibid.

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## *ON CERTAIN PHENOMENA ASSOCIATED WITH A HYDROGEN FLAME*

PHENOMENA of much interest and possibly of future usefulness are associated with the combustion of ordinary hydrogen.

I. To study these phenomena free from disturbing causes three things should be attended to, although the effects to be described can be obtained without any special precaution.

(*a*) The gas must be stored and purified in the ordinary way, namely, by passing into a gas-holder through a solution of potash, and then through a solution of perchloride of mercury or nitrate of silver.

(*b*) From the holder the gas must be led through red or black india-rubber tubing to a platinum, or better, a steatite jet.

(*c*) And then the gas should be burnt in a perfectly dark room, and amid calm and dustless air.

II. In this way the flame gives a faint reddish brown colour, invisible in bright daylight. Issuing from a narrow jet in a dark room, a stream of luminosity, more than six times the length of the flame, is seen to stretch upward from the burning hydrogen. This weird appearance is probably caused by the swifter flow of the particles of gas in the centre of the tube. The central particles as they shoot upward are protected awhile by their neighbours; metaphorically, they are hindered from entering the fiery ordeal which dooms them finally to a watery grave. Dr. Tyndall has shown that the radiation from burning hydogen is hugely ultra-red, and moreover, that it has not the quality of the radiation from an elementary body like hydrogen, but practically is found to be the radiation from molecules of incandescent steam. So that, except at its base, a hydrogen flame is a hollow stream of glowing water raised to a prodigious heat.

III. Bringing the flame into contact with solid bodies, in many cases *phosphorescent* effects are produced. Thus allowing the flame to play for a moment on sand paper and then promptly extinguishing the gas, a vivid green, phosphorescence remains for some seconds. The appearance is a beautiful one, as a luminous and perfect section of the hollow flame is depicted. Similar phosphorescence is produced by the flame on white writing paper,

or on marble, or chalk, or granite, or gypsum, &c. But no such effect is produced by coal gas, or olefiant or marsh gas. It is evidently a question of temperature, as oxygen given through coal gas shows the phosphorescence well.

IV. Far exceeding in generality the effect just noticed is a really magnificent *blue image of the flame* that starts up on almost every substance with which the flame is brought into contact. I have already drawn attention to this effect in the Phil. Mag. for November 1865, and in my letter of last week pointed out how the same effect has more recently formed the subject of a memoir, presented through M. Wurtz to the Paris Academy of Sciences, the author of that paper evidently being unaware that the subject had already been investigated by myself.

The appearance is as follows: When the hydrogen flame is brought either vertically or sideways, say, upon a white plate or a block of marble, there instantly appears a deep blue and glowing impression of the exact size and shape of the hollow flame. The moment the gas is extinguished, or the flame removed to the slightest distance from the solid, the effect as instantly ceases. If the flame be brought successively to the same spot on the solid, the effect grows fainter and finally vanishes, but instantly reappears upon an adjoining portion.

Other combustible gases, such as carbonic oxide, or marsh gas, or olefiant, or coal gas, do not yield this effect, nor does any lamp flame, luminous or otherwise; nor is it obtained in the oxidising flame of an ordinary blowpipe; but it is imperfectly produced in the reducing flame when coal gas is used; it is not seen when oxygen is driven through coal gas, unless the latter be in excess, and it is poorer and vanishes more quickly with the oxyhydrogen flame than with hydrogen alone. This blue luminosity is, therefore, not a question of heat, but some property depending either on ($\alpha$) the chemical nature of hydrogen, or on ($\beta$) the physical effect of its radiation. At first I thought it was the latter, and that it was a new form of fluorescence, so closely did it resemble those phenomena. But after a week's incessant experimenting, the true cause was hunted down, and found to be dependent on the former effect ($\alpha$), and in every case ultimately due to the presence of *sulphur*. A chemically clean body, or a freshly broken surface, did not show the blue coloration; but after exposure for a short time to the air of London, the substance invariably yielded the blueness; this, however, was not the case when the clean surface was covered by a shade, or exposed to the air of the open country. The combustion of coal gas and coal fires yields sulphate of ammonia, a body often deposited in acicular crystals in the glass tubes in a laboratory. Sulphate of ammonia is decomposed by a hydrogen flame, and when that salt is brought into contact with burning hydrogen, it permanently yields the blue colorescence. Hence this body is probably the main source of the blueness seen whenever a hydrogen flame comes into contact with glass tubes or a dirty surface. This effect must repeatedly have been seen by every one who has experimented on singing flames.

When the blueness, as is so often the case, is seen tinging the flame itself, without contact with any body, the sulphur is derived either from the vulcanised tubing, the dust of which is taken up by the passing gas; or if the hydrogen be burnt from the bottle generating it, the blueness is due to the decomposition of the sulphuric acid spray, as will be shown further on.

As a chemical re-agent for detecting sulphur, the delicacy of a hydrogen flame is extraordinary. This fact was estimated as follows:—Pure precipitated silica yields no blueness with the flame; 500 grains of silica were intimately mingled with one grain of milk of sulphur. Less than a $\frac{1}{100}$th of a grain of this mixture was thrown on the surface of pure water or placed upon chemically clean platinum foil. The water is best, but in either case the blue colour (absent before) now shot forth on bringing the hydrogen flame down. Tried again and again with fresh portions, the effect was very evident, but quickly vanished. The sulphur in a similar portion of the mixture could not be detected chemically by nitro-prusside of sodium. The wonderful sensitiveness of the flame may be still better seen in another way. Immediately after washing, the fingers show no colour when brought for a moment into the flame, but if a white india-rubber tube be touched ever so lightly, the fingers not only show a vivid blueness, but for some time any clean object touched by them, such as platinum foil, shows traces of sulphur by the appearance of the blue coloration with the flame. A block of melting ice continually weeps itself free from dust, and thus presents an excellent surface upon which to try the foregoing experiment. Or a plate of platinum, after heating to redness, may be written over with a stick of sulphur. If kept covered, the invisible letters may long after be traced out by sweeping the hydrogen flame over the surface of the platinum.

Examined through a prism, the blueness derived from any source shows blue and green bands, similar to the spectrum of sulphur, but I have noticed also a red band. This mode of obtaining a sulphur spectrum suggests further inquiry. White marble smeared over with a bit of sulphur, or with vulcanised rubber tubing, is a convenient source for obtaining the effect at pleasure.

Some sulphates and sulphides show the blueness with the flame, and are evidently decomposed by the hydrogen. Thus sulphate of soda gives no blue appearance, whilst sulphate of ammonia, or alum, does.

V. Various liquids were tried in contact with the flame. Sulphuric acid was very notable. Here a magnificent blue effect was observed. For persistence and brilliancy of the colour, this experiment leaves nothing to be desired; the spectrum is very fine. If the liquid is in a glass dish when the flame is brought vertically down, the blueness lights up the glass in a lovely manner.*

VI. But the presence of sulphur is by no means the only body that a hydrogen flame reveals. The least trace of *phosphorus* is detected by the production of a vivid green light. It is striking to notice the wonderful subdivision of matter in these experiments, and how an immeasurable trace of an element can evoke pronounced and apparently disproportionate effects.

Might not this ready detection of minute quantities of sulphur and phosphorus be of use in the manufacture of iron; and might not hydrogen introduced into the molten metal be employed for the removal of these great enemies of the iron worker? I speak ignorantly.

VII. Among the range of substances I have tried, *tin* was found to yield the most conspicuous effect, after the bodies named. A fine scarlet colour is almost instantly produced when the hydrogen flame is brought into contact with tin or any alloy of tin. Tin is somewhat volatile, and its spectrum is rich in red rays. The tin must be clean; or the sulphur blue, which is much brighter, will mask the effect. A charming experiment may be made by partially scraping a soiled surface of tin; the blue and the scarlet colours mingle, and a lovely purple is the result. When a trace of phosphorus is present there may be obtained a green belt encircling a rich blue, then a purple zone, and finally a glowing scarlet at the root of the flame. These colours, it must be remembered, are not imparted to the flame, but reside on the surface of the body which the flame touches. And where the combustion of the hydrogen is complete, as in the upper part of the flame, or in the luminous stream referred to (II.), these effects are not produced, they are best developed at the root of the flame.

VIII. Passing from liquids and solids, I next tried *gases* in contact with the flame of hydrogen. Many gases imparted a colour to the flame, but here the effect was

* With all liquids, but best with mercury, a fine musical note can be obtained by causing the jet to dip just below the surface of the liquid.

different to that previously noticed. The whole flame was tinged with the colour imparted to it. A mere trace of hydrochloric acid gas imparts a reddish brown to the flame; ammonia gas gives a yellow, and burns freely. It is striking to note the combustion of ammonia gas rising from an unstopped bottle that contains the usual solution and which is placed below the flame.

But carbonic acid gas yields the most striking result in contact with the flame. A pale lilac tinge is instantly produced by a stream of this gas. This, I imagine, is due to the decomposition of the carbonic acid by the hydrogen, and the production and combustion of carbonic oxide. For it is at the lower part of the flame that the effect is most marked. One per cent. of pure carbonic acid admitted to a jar of air, can be detected on holding the jar over the flame. The breath, of course, shows the effect most strikingly.

IX. Here then is an eminently practical method of noting the presence of vitiated air in rooms or public buildings. A continuous hydrogen apparatus might be employed with a wash bulb attached. The flame might be burnt from a brass burner or lava jet, placed within a blackened tin cylinder. Opposite the flame a hole might be pierced in the cylinder, and closed by a lens for better viewing the flame within. As soon as the atmosphere in a room becomes unpleasantly vitiated the flame would indicate the fact by its changed colour. A similar apparatus might likewise be employed by miners: in metal mines as a warning against impure air, and in coal mines as a detector of fire damp. In this latter case the ends of the cylinder could be covered with wire gauze.

To this practical aspect of the question I am now giving such little leisure as I possess.

The results thus briefly described demonstrate—

1. That the combustion of hydrogen exhibits some physical peculiarities, and produces phosphorescence on many substances with which it comes in contact.

2. That the blueness so often seen in a hydrogen flame is due to the presence of sulphur, derived either from the vulcanised rubber tubing, or from atmospheric dust, or from the decomposition of the sulphuric acid spray from the generator.

3. That a flame of hydrogen forms an exceeedingly delicate re-agent for the detection of sulphur or phosphorus, and possibly also of tin.

4. That many sulphates, and also carbonic acid, are apparently decomposed by a hydrogen flame.

5. That a hydrogen flame is further a test for the presence of some gases, notably carbonic acid.

6. That these results are capable of practical application.

W. F. BARRETT

International College, Spring Grove, W.

## *THE INHABITANTS OF THE MAMMOTH CAVE OF KENTUCKY*

### CRUSTACEANS AND INSECTS

(*Concluded from page* 448)

NEXT to the blind fish, the blind crawfish attracts the attention of visitors to the cave. This is the *Cambarus pellucidus* (Fig. 10, p. 486, from Hagen's monograph of the North American Astacidæ) first described by Dr. Tellkampf. He remarks that "the eyes are rudimentary in the adults, but are larger in the young." We might add that this is an evidence that the embryo develops like those of the other species; and that the inheritance of the blind condition is probably due to causes first acting on the adults and transmitted to their young, until the production of offspring that become blind becomes a habit. This is a partial proof at least that the characters separating the genera and species of animals are those inherited from adults, modified by their physical surroundings and adaptations to changing conditions of life, inducing certain alterations in parts which have been transmitted with more or less rapidity, and become finally fixed and habitual. Prof. Hagen has seen a female of *Cambarus Bartonii* from Mammoth Cave, "with the eyes well developed," and a specimen was also found by Mr. Cooke. Prof. Hagen remarks that "*C. pellucidus* is the most aberrant species of the genus. The eyes are atrophied, smaller at the base, conical, instead of cylindrical and elongated, as in the other species. The cornea exists, but is small, circular, and not faceted; the optic fibres and the dark-coloured pigments surrounding them in all other species are not developed." It seems difficult for one to imagine that our blind crawfish was created suddenly, without the intervention of secondary laws, for there are the eyes *more perfect in the young than the adult*, thus pointing back to ancestors unlike the species now existing. We can now understand, why embryologists are anxiously studying the embryology of animals to see what organs or characteristics are inherited, and what originate *de novo*, thus building up genealogies, and forming almost a new department of science,—comparative embryology in its truest and widest sense.

Of all the animals found in caves, either in this country or Europe, perhaps the most strange and unexpected is the little creature of which we now speak. It is an Isopod crustacean, of which the pill bugs or sow bugs are examples. A true species of pill bug (*Titanethes albus* Schiödte) inhabits the caves of Carniolia, and it is easy to believe that one of the numerous species of this group may have become isolated in these caves and modified into its present form. So also with the blind *Niphargus stygius* of Europe, allied to the fresh water Gammarus so abundant in pools of fresh water. We can also imagine how a species of Asellus, a fresh water Isopod, could represent the Idoteidæ in our caves, and one may yet be found; but how the present form became a cave dweller is difficult of explanation, as its nearest allies are certain species of Idotea which are all marine, with the exception of two species: *I. entomon*, living in the sea and also in the depths of the Swedish lakes, as discovered by Loven, the distinguished Swedish naturalist, while a species representing this has been detected by Dr. Stimpson at the bottom of Lake Michigan. Our cave dweller is nearly allied to Idotea, but differs in being blind, and in other particulars, and may be called *Cæcidotea stygia.** (Fig. 11 side view, enlarged; Fig. 12 dorsal view; *b*, inner antenna; *c*, 1st leg.) It was found creeping over the fine sandy bottom, in company with the Campodea, in a shallow pool of water four or five miles from the mouth of the cave.

This closes our list of known articulates from this and other caves in this country, the result of slight explorations by a few individuals. The number will doubtless be increased by future research. It is to be hoped that our western naturalists will thoroughly explore all the sinks and holes in the cave country of the western and middle states. The subject is one of the highest interest in a zoological point of view, and from the light it throws on

* Generic characters. Head large, much thicker than the body, and as long as broad; subcylindrical, rounded in front. No eyes. First antennæ slender, 8-jointed (2nd antennæ broken off). Abdominal segments consolidated into one piece. Differs chiefly from Idotea, to which it is otherwise closely allied, by the 8-jointed (instead of 4-jointed 1st (inner) antennæ, the very large head, and by the absence of any traces of the three basal segments of the abdomen usually present in Idotea. Specific characters. Body smooth, pure white; tegument thin, the viscera appearing through. Head as wide as succeeding segment, and a little more than twice as long. Inner antennæ minute, slender, the four basal joints of nearly equal length, though the fourth is a little smaller than the basal three, remaining four joints much smaller than others, being one-half as thick and two-thirds as long as either of the four basal joints; ends of last four joints a little swollen, giving rise to two or three hairs; terminal joint ending in a more distinct knob, and bearing five hairs. Segment of thorax very distinct, sutures deeply incised: edges of segments pilose; abdomen flat above, rounded behind, with a very slight median projection; the entire pair of gills do not reach to the end of the abdomen, and the inner edges diverge posteriorly. Legs long and slender, 1st pair shorter, but no smaller than the second. Length ·25 inch.

the doctrine of evolution. Prof. Schiödte, the eminent Danish zoologist, has given us the most extended account of the cave fauna of Europe, which has been translated from the Danish into the Transactions of the Entomological Society of London (new series, vol. i., 1851).

A pertinent question arises as to the time of the formation of these caves and when they became inhabitable. As previously stated, the caves of the western and middle States are in lower Carboniferous limestone rocks, though the Port Kennedy cave explored by Wheatley and Cope * is in the Potsdam limestone. They could not have been formed under water, but when the land was drained by large rivers. This could not have occurred previous to the Triassic period. Prof. Dana in his "Manual of Geology" shows that the Triassic continent spread westward from the Atlantic coast "to Kansas, and southward to Alabama; for through this great area there are no rocks more recent than the Palæozoic." "Through the Mesozoic period (comprising the Triassic, Jurassic, and Cretaceous periods) North America was in general dry land, and on the east it stood a large part of the time above its present level." Though at the close of these periods there was a general extinction of life, yet this was not probably a sudden (one of months and even years), but rather a secular extinction, and there may be plants and animals now living on dry land, which are the lineal descendants of Mesozoic and more remotely of Carboniferous forms of life. So our cave animals may possibly be the survivors of Mesozoic forms of life, just as we find now living at great depths in the sea remnants of Cretaceous life. But from the recent explorations in the caves of Europe and this country, especially the Port Kennedy cave, with its remarkable assemblage of vertebrates and insects, we are led to believe from the array of facts presented by Prof. Cope that our true subterranean fauna probably does not date farther back than the beginning of the Quaternary, or post-Pliocene, period. We quote his "general observations" in his article on the Port Kennedy fauna:—

"The origin of the caves which so abound in the limestones of the Alleghany and Mississippi valley regions, is a subject of much interest. Their galleries measure many thousands of miles, and their number is legion. The writer has examined twenty-five, in more or less detail, in Virginia and Tennessee, and can add his testimony to the belief that they have been formed by currents of running water. They generally extend in a direction parallel to the strike of the strata, and have their greatest diameter in the direction of the dip. Their depth is determined in some measure by the softness of the stratum whose removal has given them existence, but in thinly stratified or soft material, the roofs or large masses of rocks fall in, which interrupt the passage below. Caves, however, exist when the strata are horizontal. Their course is changed by joints or faults, into which the excavating waters have found their way.

"That these caves were formed prior to the post-Pliocene fauna is evident from the fact that they contain its remains. That they were not in existence prior to the drift is probable, from the fact that they contain no remains of life of any earlier period so far as known, though in only two cases, in Virginia and Pennsylvania, have they been examined to the bottom. No agency is at hand to account for their excavation, comparable in potency and efficiency to the floods supposed to have marked the close of the glacial epoch, and which Prof. Dana ascribes to the Champlain epoch. An extraordinary number of rapidly flowing waters must have operated over a great part of the Southern States, some of them at an elevation of fifteen hundred feet and over (perhaps two thousand) above the present level of the sea. A cave in the Gap Mountain, on the Kanawha river, which I explored for three miles, has at least that elevation.

"That a territory experiencing such conditions was suitable for the occupation of such a fauna as the deposits contained in these caves reveal, is not probable. The material in which the bones occur in the south is an impure limestone, being mixed with and coloured by the red soil which covers the surface of the ground. It is rather soft but hardens on exposure to the air.

"The question then remains so far unanswered as to whether a submergence occurred subsequent to the development of the post-pliocene mammalian fauna. That some important change took place is rendered probable by the fact that nearly all the neotropical types of the animals have been banished from our territory, and the greater part of the species of all types have become extinct. Two facts have come under my observation which indicate a subsequent submergence. A series of caves or portions of a single cave once existing on the south-east side of a range of low hills among the Alleghany mountains in Wythe Co., Virginia, was found to have been removed by denudation, fragments of the bottom deposit only remaining in fissures and concavities, separated by various intervals from each other. These fragments yielded the remains of twenty species of post-Pliocene mammalia.* This denudation can be ascribed to local causes, following a subsidence of uncertain extent. In a cave examined in Tennessee the ossiferous deposit was in part attached to the *roof* of the chamber. Identical fossils were taken from the floor. This might, however, be accounted for on local grounds. The islands of the eastern part of the West Indies appear to have been separated by submergence of larger areas, at the close of the period during which they were inhabited by post-Pliocene mammalia and shells. The caves of Anguilla include remains of twelve vertebrates,† of which seven are mammalia of extinct species, and several of them are of large size. These are associated with two recent species of molluscs, *Turbo pica* and a *Tudora* near *pupæformis*.‡ As these large animals no doubt required a more extended territory for their support than that represented by the small island Anguilla, there is every probability that the separation of these islands took place at a late period of time and probably subsequent to the spread of the post-Pliocene fauna over North America."

I think the reader will conclude from the facts Prof. Cope so clearly presents, that the subterranean fauna of this country does not date back beyond the Quaternary period. These species must have been created and taken up their abode in these caves (Mammoth Cave and those of Montgomery County, Virginia) after the breccia flooring their bottoms and containing the bones of Quaternary animals had been deposited; or else migrated from Tertiary caves farther south, which is not probable, as it has been previously shown that those blind animals inhabiting wells immediately die on being exposed to the light. (British Sessile-eyed Crustacea, i. p. 313. Though this is true of the Gammandæ, Mr. Putnam tells me that a blind crawfish lived several days in a bottle of water exposed to the light, and is thus as hardy as any crustacean.)

* A notice of the animals found in this cave will be found in the Proc. Amer. Phil. Soc., April 1871. The insects there enumerated would probably not come under the head of cave insects.

* See Proceed. Amer. Phil. Soc., 1869, 171.

† Loc cit. 1869, 183; 1870, 608. A fourth species of gigantic Chinchillid has been found by Dr. Rijgersma, which may be called *Loxomylus quadrans* Cope. It is represented by portions of jaws and teeth of three individuals. It is one of the largest species, equalling the *L. latidens*, and has several marked characters. Thus the roots of the molars are very short, and the triturating surface oblique to the shaft. The roots of the second and fourth are longer than those of the first and third. The last molar has four dental columns instead of three as in the other *Loxomyli*, and is triangular or quadrant-shaped in section; the third is quadrangular in section, and has three columns. The second is the smallest, being only ·6 the length of the subtriangular, first. Length of dental series m. ·063 or 2·5 inches. Palate narrow and deeply concave. There is but little or no lateral constriction in the outlines of the teeth; the shanks are entirely straight. In its additional dentinal column, this species approaches the genus *Amblyrhiza*. The large Chinchillas of Anguilla are as follows, *Loxomylus longidens*, *L latidens*, *L. quadrans*, and *Amblyrhiza inundata*.

‡ See Bland, Proceed. Amer. Phil. Soc., 1871, 58.

Assuming, on the principles of evolution, that the cave animals were derived from other species changed by migration from the outer world to the new and strange regions of total darkness, it seems evident that geologically speaking, the species were suddenly formed, though the changes may not have been wrought until after several thousand generations. According to the doctrine of natural selection, by which animal species pass from one into another by a great number of minute variations, this time was not sufficient for the production of even a species, to say nothing of a genus. But the comparatively sudden creation of these cave animals affords, it seems to us, a very strong argument for the theory of Cope and Hyatt, of

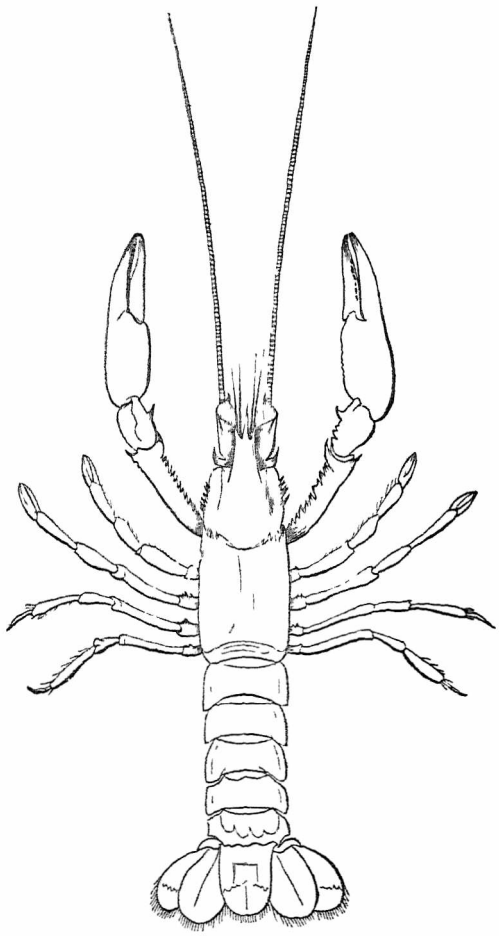

FIG. 10.—*Cambarus pellucidus*.

creation by acceleration and retardation. The strongly marked characters which separate these animals from their allies in the sunlight, are just those fitting them for their cave life, and those which we would imagine would be the first to be acquired by them on being removed from their normal habitat.

On introducing the wingless locust, *Ceuthophilus maculatus* into a cave, where it must live, not under stones, but by clinging to the walls, its legs would tend to grow longer, its antennæ and palpi would elongate and become more delicate organs of hearing as well as touch,* and the body would bleach partially out, as we find to be the case in *Hadenœcus subterranetus* and *stygius*. The Carabid beetle, Anopthalmus, extending farther into the cave, would lose its wings (all cave insects except the Diptera have no wings, elytra excepted) and eyes, but as nearly all the family are retiring in their habits, the species hiding under stones, its form would not undergo further striking modification. So with the blind Campodea, which does not differ from its blind congeners which live more or less in the twilight, except in its antennæ becoming longer. The blind Adelops, but with rudiments of eyes, does not greatly depart in habits from Catops, while on the other hand the remarkable Stagobius of the Illyrian caves, which according to Schiödte spends its life in crawling ten to twenty feet above the floors over the columns formed by the stalactites

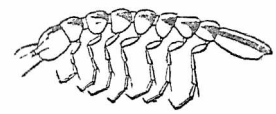

FIG. 11.—*Cæcidotea stygia* (side view).

to which unique mode of life it is throughout perfectly adapted, is remarkably different from other Silphids. Its legs are very long and inserted far apart (the prothorax being remarkably long), with surprisingly long claws, while the antennæ, again, are of great length and densely clothed with hairs, making them most delicate sense organs.* So also are the limbs of the false scorpion, and the spider and pill bug (Titanethes) of remarkable length.

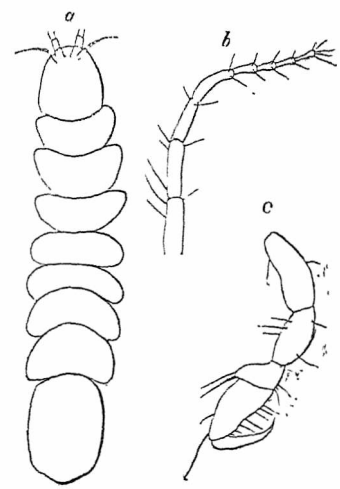


FIG. 12.—*Cæcidotea stygia* (dorsal view).

But the modifications in the body of the Spirostrephon are such that many might deem its aberrant characters as of generic importance. It loses its eyes, which its nearest allies in other, but smaller, caves possess, and instead gains in the delicate hairs on its back, which evidently form tactile organs of great delicacy; the feet are remark-

* After writing this article, and without the knowledge of his views, we turned to Darwin's "Origin of Species" to learn what he had to say on the origin of cave animals. He attributes their loss of sight to disuse, and remarks.—"By the time an animal has reached, after numberless generations, the deepest recesses, disuse will on this view have more or less perfectly obliterated its eyes, and natural selection will often have effected other changes, such as an increase in the length of the antennæ or palpi, as a compensation for blindness." (5th Amer. Edit., p. 143.) We are glad to find our views as to the increase in the length of the antennæ and palpi compensating for the loss of eyesight, confirmed by Mr. Darwin.

* Schiodte remarks that "it is difficult to understand the mode of life of *Stagobius troglodytes*, or how this slow and defenceless animal can escape being devoured by the rapid, piratical Arachnidans, or find adequate support on columns, for inhabiting which it is so manifestly constructed. We are led in this respect to consider the antennæ. Whatever significance we attach to those enigmatical organs, we must admit that they are organs of sense, in which view an animal having them so much developed as Stagobius, must possess a great advantage over its enemies, if these be only Arachnidans. Its cautious and slow progress, and its timid reconnoitring demeanour, fully indicate that it is conscious of life being in perpetual danger, and that it endeavours to the utmost to avoid that danger. Darkness, which always favours the pursued more than the pursuer, comes to its aid, especially on the uneven excavated surface of the columns."

ably long, as also the antennæ. These are not new formations, but simply modifications apparently, by use or disuse of organs present in the other species. The aberrant myriopod and Stagobius are paralleled by the blind fish, an animal so difficult to classify, and so evidently adapted for its abode in endless darkness. And as an additional proof of the view here taken that these cave animals are modified from more or less allied species existing outside of the caves, we have the case of the crawfish, whose eyes (like those of the mole), are larger in the young than in the adult, indicating its descent from a species endowed with the faculty of sight, while in the adult the appendages are modified as tactile organs so as to make up for its loss of eyesight, in order that it may still take its prey.

We thus see that these cave animals are modified in various ways, some being blind, others very hairy, others with long appendages. All are not modified in the same way in homologous organs ; another argument in proof of their descent from ancestors whose habits varied as those of their out-of-door allies do at present. Had they been specially created for subterranean life, we should have expected a much greater uniformity in the organs adapting them to a cave life than we actually find to be the case.

Another fact of interest in this connection is the circumstance that these cave species breed slowly, being remarkably poor in individuals ; they are nearly all, except the wingless grasshoppers, extremely rare. Did they breed as numerously as their allies in the outer world, the whole race would probably starve, as the supply of food even for those which do live is wonderfully limited.

It is now known that animals inhabiting the abysses of the sea are often highly coloured: light must penetrate there, for we know that were the darkness total they would be colourless like the cave insects.

In view of the many important questions which arise in relation to cave animals, and which have been too imperfectly discussed here, we trust naturalists the world over will be led to explore caves with new zeal, and record their discoveries with minuteness, and the greatest possible regard to exactness. The caves of the West Indian Islands should first of all be carefully explored. Also those of Brazil, those of the East Indies, and of Africa, while fresh and more extended explorations of our own Mammoth Cave should be made, perhaps by a commission acting under Government or State authority, in order that the most ample facilities may be afforded by the parties owning the cave. A. S. PACKARD

## *PROPOSED GRAND AQUARIUM FOR MANCHESTER*

THE *Manchester Examiner and Times* of April 2 gives a long account of a Grand Marine Aquarium which it is proposed to build at Manchester, and which shows the interest which is felt in scientific studies in the northern capital. From this article we have made the following extracts, as showing the complete scale upon which everything is proposed to be carried out.

The funds are to be raised by a company started under the superintendence of a number of gentlemen resident in the city who are interested in marine zoology, and desire to promote scientific education in all its branches. The building will contain all the recent improvements shown to be necessary at the Crystal Palace and Brighton Aquaria, and will be rectangular in shape, 120 ft. long and 70 ft. wide. This space will be divided into two side galleries, each 120 ft. long and 15 ft. wide, separated from the central saloon by a light screen. Running along one side of each of these galleries will be a series of tanks, about eighty in number, forty in each gallery, varying in capacity from 300 to 3,000 gallons, and the roofs will be so arranged that the light will pass through the water at an angle of about forty-five degrees to the spectators, thus rendering distinctly visible the living inhabitants and plants contained in the grotto-like tanks. The grand saloon will be also 120 ft. long by 40 ft. wide, supporting on light iron columns an open panelled roof. All the windows will be so arranged as to admit only the exact quantity of light required, as it is found that an excess of light acts upon the higher marine plants and animals in a manner directly contrary to its action upon terrestrial life. It blanches them in a similar manner as ordinary plants are blanched by being earthed up. The most brilliant coloured marine plants are those which live in comparative darkness. The grand saloon will contain two tanks—the largest that have yet been constructed—one at each end of the room, 30 ft. long, 10 ft. wide, and 8 ft. deep, capable of containing each 15,000 gallons of water, and in which the largest specimens of fish found in the British seas will find ample room to display themselves. These tanks will have also a polished plate-glass frontage of great strength, through which the animals can be well seen.

In order to accommodate the inhabitants of what is called the littoral zone round our coasts, a series of shallow tanks, varying in capacity from 20 to 200 gallons, will be erected, in which the animals can be seen either from the surface of the water or through the transparent fronts, and by an ingenious contrivance the supply of water will be so regulated as to afford in every respect tidal currents. Besides these there will be other tanks at the back of the exhibition tanks for reserve stocks, and in the basement cisterns to hold a reserve supply of 60,000 gallons of sea water.

Such are the contemplated arrangements for marine, animal, and vegetable life ; but in addition to these the inhabitants of our brooks, ponds, &c., will not be forgotten, and a series of table aquaria will be provided : while the larger inhabitants of our rivers and lakes will swim in an ever-flowing river and pond supplied by fountains, and placed in the centre of the grand saloon. Such is a brief description of the proposed Manchester Grand Aquarium, which, it is hoped, will both be a success in a scientific, as well as a pecuniary point of view. Mr. B. Hooper, a well-known naturalist, has been engaged as curator of the Aquarium. A site for the Aquarium has been obtained in the vicinity of the Alexandra Park, and it is proposed to open it on Saturdays and Mondays at an admission fee of *1d.* ; on Tuesdays, Wednesdays, and Thursdays, at *6d.* ; and on Friday, which will be a students' day, at *1s.*

## *NOTES*

THE following lectures in Natural Sciences will be delivered in Trinity, St. John's, and Sidney Sussex Colleges, Cambridge, during Easter Term, 1872 :—"On Light and Heat" (for the natural sciences tripos), by Mr. Trotter, Trinity College ; Mondays, Wednesdays, and Fridays, at 10, commencing Wednesday, April 17. "On Heat" (for the special examination for the ordinary degree), by Mr. Trotter, Trinity College ; Tuesdays, Thursdays, Saturdays, at 11, commencing Tuesday, April 16. "On Chemistry," by Mr. Main, St. John's College ; Mondays, Wednesdays, Fridays, at 12, in St. John's College Laboratory, commencing Friday, April 19. Instruction in Practical Chemistry will also be given. Attendance on these lectures is recognised by the University for the certificate required by medical students previous to admission for the examination for the degree of M.B. "On Palæontology" (the Mollusca), by Mr. Bonney, St. John's College ; Wednesdays and Fridays, at 9, commencing Friday, April 19. "On Geology" (for the natural sciences tripos. Stratigraphical Geology), by Mr. Bonney, St. John's College ; Tuesdays, Thursdays, and Saturdays, at 10, commencing Thursday, April 18. There will be excursions every Saturday. "Elementary Geology" (for the special examination) ; Wednesdays

and Fridays, at 11, commencing Friday, April 19. "On Botany," by Mr. Hicks, Sidney College; Mondays, Wednesdays at 1 P.M., and Fridays, at 12, beginning Monday, April 15. The lectures this term will be chiefly on Cryptogamic Botany, the movements of plants, and the principles of classification. "On Embryology," the Trinity Prælector in Physiology (Dr. M. Foster) will deliver a short course at the new museums, beginning Monday, April 22, at 11 o'clock. The Physiological Laboratory is open for practical instruction in Physiology to all those who have gone through the elementary course.

WE have to record this week the death of *facile princeps* the most eminent of vegetable physiologists, Prof. Hugo von Mohl, which took place on April 1 at Tübingen. Von Mohl was born at Stuttgart in 1805, and in 1835 was appointed Professor of Botany and director of the Botanic Garden at Tübingen, a position he has held ever since. Conjointly with Schlechtendal, and since his death with Prof. de Bary, formerly one of his pupils, he has been editor of the weekly "Botanische Zeitung" since its commencement in 1843. He was one of the foreign members of the Linnean Society, having been elected as long ago as 1837. Von Mohl has been a copious and most accurate writer on subjects connected with vegetable anatomy and physiology, of which he may be said to have laid the secure foundation in his early investigations of the true relations of cell-membrane and contents. Among his original observations we may especially mention his essay on the Structure of Endogens, published by von Martius in his "Historia Palmarum," and on the Stem-structure of Cycads in the "Vegetable Cell," which appeared in Rudolph Wagner's "Handwörterbuch;" on the Origin and Structure of Stomates; on Cuticle; on the Structure of Cell-membrane; on the Structure and Anatomical relations of Chlorophyll; on the Multiplication of Plant-cells by division, and numerous other essays collected in his "Vermischte Schriften."

ASTRONOMY has sustained a heavy loss in the death of M. P. A. E. Laugier, which took place at Paris on the 5th inst., in the 50th year of his age. M. Laugier was a member of the French Academy and of the "Bureau des Longitudes," and examiner to the naval school at Brest. He was a pupil of Arago, and the following account of his various researches is furnished to the *Révue Scientifique* by M. G. Rayet:—In 1841 he presented a memoir to the Academy on Solar Spots, and was the first to determine their proper motion. The discovery and calculation of a telescopic comet in 1842 won for the young astronomer the Lalande gold medal. At the request of Humboldt he was engaged for some years in the improvement of the construction of astronomical clocks. In 1853 he made an exact determination of the latitude of the Paris Observatory, estimating it at 48° 50′ 11″·19, differing considerably from the earlier determination of Arago and Mathieu. In 1857 he published a catalogue of the declination of 140 stars, having previously issued one of 53 nebulæ. M. Laugier was associated with Arago in a number of his researches on the physics of the globe, and in his magnetic and photometric labours; and has for long made the observations on the declination and inclination of the magnet for the "Bureau des Longitudes." M. Rayet speaks of his death as a source of great grief to the Academy, which had formerly elected him president, and to his colleagues, by whom he was beloved for the moderation of his character, and his affable manners.

AT the meeting of the French Academy of Sciences on the 1st inst. the Abbé David and M. Ledieu were elected correspondents of the Section of Geography and Navigation, in the room of M. d'Abbadie, who has been elected a member of the Academy, and of the late Prince Demidoff.

THE Museums and Lecture Room Syndicate have presented their sixth Annual Report to the Senate of the University of Cambridge. It includes separate reports from Mr. J. W. Clark, superintendent of the Museum of Zoology and Comparative Anatomy, and from Profs. Humphry, Newton, Babington, Miller, Challis, Liveing, and Sedgwick. In response to an appeal from the venerable Prof. Sedgwick, the Woodwardian Museum has acquired during the past year (the purchase money having been raised by subscription) the very valuable collection of fossils made by Mr. Leckenby of Scarborough. Prof. Sedgwick considers the present geological collection of the University to be one of the noblest collections, as far as regards British geology, that exists in England, and for study and practical use, to be inferior to none existing in the island. In order to supply facilities for the practical study of Comparative Anatomy, and to supplement the lectures of Prof. Newton, Mr. J. W. Clark has commenced a class for practical work, for which, however, no sufficient accommodation is at present provided by the University. Mr. G. R. Crotch has been engaged for nearly the last twelvemonth in determining and arranging the extensive collections of insects, both British and exotic, contained in the Museum. The collection includes long series of those insects which were peculiar to certain localities in Cambridgeshire and the adjoining counties, and which, from increase of drainage in the fens and other causes, are either extinct or likely to become so in a few years.

THE discovery of two new planets is recorded. The elements of the first, No. 119, discovered by M. Paul Henry at Paris, are:—

April 9, $11^h$, Paris M.T. R.A. = $13^h\ 18^m\ 59^s$. D. $\doteq -8°\ 40'\ 23''$

The first position is approximate only. The horary movement is $-1^s{\cdot}75$ R.A., $+25''$ declination. It is of the 11th magnitude.

The second was discovered by M. Borelly, and has the following elements:—

April 10, $12^h\ 16^m\ 32^s$, Marseilles M.T. R.A. $12^h\ 0^m\ 55^s{\cdot}38$. Polar distance, $95°\ 2'\ 44''{\cdot}9$.

April 10, $13^h\ 14^m\ 36^s$, Marseilles M.T. R.A. $12^h\ 0^m\ 53^s{\cdot}63$. Polar distance, $95°\ 2'\ 41''{\cdot}4$.

It is between the 11th and 12th magnitude.

THE next lecture to the Crystal Palace School of Science will be delivered this evening by Dr. W. B. Carpenter on "Researches in the Deep Sea."

DR. LIEBREICH will deliver his lecture on "Turner and Mulready" at the London Institution, Finsbury Circus, on Thursday evening next, the 25th inst., at 7.30 P.M.

THE following paragraph, copied *verbatim et literatim* from an evening contemporary, is a striking comment on our remarks last week on "Newspaper Science:"—"M. Agassiz has been finding out some more curious creatures in the deep-sea dredgings near Rio. It would really seem that if we only go deep enough we shall eventually reach the beginning of all things. Dr. Carpenter found living at the bottom of the Atlantic crustaceans of the same kind as those whose bodies now lie in our chalk hills, only seeming slightly degenerated, as if the family had once 'seen better days.' And now Prof. Agassiz tells his friend Prof. Peircei, of Harvard, in a long letter published in the American papers, how at 500 fathoms down he has fished pectens, and also other creatures, who are henceforth to bear the fearful but doubtless honourable appellation of Tomocaris Peircei, which resemble nothing living, only fossils of some of the earliest formations. The Tomocaris, in particular, is strongly suspected of being—we blush to name it—no better than a Trilobite! We shall not disturb our readers by quoting all the array of terrible words—maxillipeds, pygidiums, phyllopods, and the like—with which Prof. Agassiz's letter bristles; nor his interesting controversy with Prof. Milne Edwards concerning the Simulus, which

animal's 'cephalo thorax' is so remarkable that 'the function of chewing is devolved upon the legs.' We only advise our friends who may be intensely anxious about these points to consult his letter *in extenso*." Is the author of "What is a Joule?" the special scientific correspondent of all the daily papers?

WE learn from the *Journal of the Society of Arts* that King Victor Emmanuel has presented to the Geological Museum of the University of Rome a collection of Peruvian antiquities—silver vases, curious musical instruments, a coloured garment made from the bark of trees, and arrows and lances. The articles were discovered in a guano bed, and are antiques. The lances are notched, ornamented with feathers, and have wooden heads, showing that they were made before iron was used.

A REPORT of the meeting of delegates of the French departmental learned societies, held on the 4th inst., under the presidency of M. Jules Simon, is given in *Les Mondes*. The following medals were awarded:—Gold: to Grenier, of Besançon, botanical researches; Grandidier, scientific travels in Madagascar; Houzeau, of Rouen, researches in ozone. Silver: to Boussinesq, of Gap, mathematical mechanics; Tourdes, of Strasbourg, legal medicine; Faivre, of Lyons, vegetable physiology; Fromontel, of Gray, palæontology; Reboul, of Besançon, chemistry; Cailletet, of Châtillon-sur-Seine, agricultural and industrial chemistry; Mazure, of Bar-le-Duc, agriculture; Chautard, of Nancy, meteorology; Coquelin, of Beaufícel, meteorology; Crova, of Montpellier, physics; Raoult, of Grenoble, physics; Mussy, of Montluçon, a geological map of Ariége.

PROF. HAYDEN has applied to the Congress of the United States for a grant of 75,000 dols. for the purpose of continuing for another year his most important geological survey of the territories of the United States. He proposes making a thorough series of astronomical, topographical, meteorological, geological, and chemical observations, which cannot but be of the utmost value in developing the material resources of the country. The application has the cordial support of the Secretary of the Interior.

## *SCIENTIFIC INTELLIGENCE FROM AMERICA**

MAJOR POWELL has returned from the cañons of the Colorado, having left his party in the field in charge of Prof. Thompson. Since the party started in April last, it has passed through the cañons of Green River and the cañons of the Colorado to the mouth of the Paria, at the head of Marble Cañon. Here the Major left his boats for the winter, and he expects to return as soon as there is a favourable stage of water, and embark for the second trip through the Grand Cañon. On the way down the party explored the region to the west of the Green and Colorado, tracing the courses of the larger streams emptying into the two great rivers to their sources in the Wasatch Mountains and Sevier Plateau, and examined the geology of the great mesas and cliffs. Early in the winter a base-line 47,000 feet in length was measured on a meridian running south from Kanab, and the party is now engaged in extending a system of triangles along the cliffs and peaks among lateral cañons of the Colorado. During the past season the party has discovered many more ruins of the communal houses once occupied by the prehistoric people of that land. Many of these houses stood upon the cliffs overhanging the cañons, and many more are found in the valleys among the mountains to the west. Stone implements, pottery, basket-ware, and other articles were found buried in some of the ruins. The Major found a tribe of Utes on the Kaibab Plateau who still make stone arrow-heads and other stone implements, and he had an opportunity to observe the process of manufacturing such tools.—Mr. Joseph Sullivant, of Columbus, Ohio, a well-known naturalist, publishes an account in the *Ohio State Journal* of the capture of the *Bassaris astuta*, or ring-tailed cat of the Rio Grande region. It was taken in Fairfield County, Ohio, and was said to be accompanied by a second specimen. The occurrence of this animal so far north is very remarkable, and it may be a question whether it had not been brought from Mexico or California, and escaped from confinement. It is an animal very much sought after as a pet, being clean in its habits, and readily becoming very tame and affectionate; indeed, it would seem to be quite a desirable animal to domesticate and keep about the house as a protection against rats and mice. Some years ago a specimen of this same animal was brought into the Smithsonian Institution, having been captured in a hen-coop near the city. It was in capital condition and in full fur; but it had evidently escaped from captivity, as shown by the marks of the rubbing of a collar round the neck.—The greatest depth between the west end of Cuba and the coast of Yucatan found by the Coast Survey steamer *Bibb* is 1,164 fathoms, as reported to Prof. Peirce by Captain Robert Platt, commanding the surveying vessel. The lowest temperature observed is 39·5° F. at the bottom; surface, 81°; strongest current, two knots; direction, north. Dr. Stimpson reports the bottom from Cape San Antonio to Yucatan very barren of animal life. A few rare shells were found.—In a paper by Prof. Cope upon the *Pythonomorpha*, or Python-like fossil saurians of the cretaceous formation of Kansas, presented to the Academy of the American Philosophical Society of Philadelphia, he shows that America is the home of this group, four species only having been described from Europe. Forty-two North American species are already known, of which fifteen belong to the Greensand formation of New Jersey, seven to the Limestone region of Alabama, seventeen to the Chalk of Kansas, and three to other localities. Of the Kansas species six are described as new by Prof. Cope in the paper referred to.—A new fossil reptile, from the cretaceous strata of Kansas, has just been described by Prof Cope under the name of *Cynocercus incisus*. The peculiarity of this reptile consists in having the articular faces of the vertebræ deeply excavated above and below, so as to give them a transverse character. A new crocodilian from the same region was also described, under the name of *Hyposaurus webbii*.—Prof. Cope has shown, in a paper read to the American Philosophical Society, that the greater number of the fossil fishes of the cretaceous strata of Kansas belong to three families, namely, the *Saurodontidæ*, the *Pachyrhizodontidæ*, and the *Stratodontidæ*. Of the first family four genera and ten species are described in his paper, some of them (as those of the genus *Portheus*) being among the most formidable of marine fishes. Of the second family one genus and four species are introduced, and three genera and seven species of the third. The *Stratodus*, a genus of the *Stratodontidæ*, is provided with multitudes of minute shovel-headed teeth. He finds a great resemblance between this Kansas fauna and that of the English Chalk, no less than six of the eight Kansas genera having been found in the latter.—Some of our readers may remember the letter written by Prof. Agassiz to Prof. Peirce in December 1871, just before starting upon the Hassler expedition, in which he announced beforehand the general nature of the discoveries that he expected to make. His ability to make these predictions with any degree of certainty was much questioned by those who were not familiar with the method of research in natural history, and of the almost mathematical nature of the inferences to be derived from certain given premises. We now have a second letter addressed to Prof. Peirce, written at Pernambuco on Jan. 16, giving an account of experiences up to that date, which go far toward showing that the Professor really knew of what he was speaking in the first instance. Owing to various adverse influences, among them the necessity of hastening with all possible despatch to reach the Straits of Magellan at the earliest possible date, only four hauls of the dredge were made in water of any great depth, those being at depths of from 75 to 120 fathoms off Barbadoes. The results of these were in the highest degree satisfactory, however, "the extent and variety of material obtained being enough to occupy," in the Professor's words, "half a dozen competent zoologists for a whole year, if the specimens could be kept fresh for that length of time." As anticipated by the Professor in the letter referred to, the most interesting discoveries were certain forms of animals, the allies of which had previously been known in greater part or entirely as fossils of older formations. Among these may be mentioned a remarkable sponge, a crinoid very much like *Rhizocrinus*, a living *Pleurotomaria*, only three having been previously known, although a great many are described as fossil, &c. The crinoid, especially, is one of the very few living representatives of what was originally the prevailing character of

* Communicated by the Scientific Editor of *Harper's Weekly*.

the marine fauna of the silurian and other epochs ; and while now they occur only in the very deepest water, they were formerly found crowded in the shallower seas. The inquiry, therefore, suggested itself to the Professor as to the reason of this difference, and he makes the suggestion that in the progress of the earth's growth we may look to such displacement of conditions favourable to maintaining certain low types as may recall most fully the adaptation to former ages, and that the deeper waters of the present constitution of our globe possibly approximate the conditions of animal life in the shallow seas of former ages as nearly as anything can in the present order of things on the earth. The depth of the ocean alone, he thinks, can place animals under the high pressure which the heavier atmosphere of the earlier period afforded. But as such pressure cannot be a favourable condition for the development of life, it is to be expected that the lower forms only will occur in the deep seas. Other causes acting in the same direction are the decrease of light in the greater depths, the smaller amount of free oxygen, the reduced amount and smaller variety of nutritive substances, &c. He does not think, however, that facts warrant the conclusion that any of the animals now living are lineal descendants of those of the earlier ages, nor that we may justly assume that the cretaceons formation is still extant, notwithstanding the similarity of forms. It would be just as true to nature to say that the tertiary period is exhibited in the tropics, on account of the similarity of the Miocene mammalia and those of the torrid zone.—The ninth number of the illustrated work on the butterflies of North America, in course of publication by Mr. William H. Edwards, has just made its appearance, and we are informed that the tenth number, to appear very shortly, will conclude the first volume. This number, like its predecessors, is accompanied by a great many quarto plates in the highest style of pictorial excellence, depicting some extremely beautiful species and varieties of butterflies. Among these are three varieties of *Papilio Ajax*, namely, *Walshii*, *telamonides*, and *Marcellus*. Mr. Edwards, in his paper, makes some judicious remarks upon the uncertainty that exists in regard to the true character of many butterflies which some naturalists consider as perfectly distinct species, and others as mere varieties. He takes the ground that the only way of coming to a satisfactory conclusion is to breed them, and ascertain whether the eggs from the same female develop similar larvæ or not, and whether these, even if different, produce the same perfect insects or different ones. The attempt at discriminating from the perfect insect alone he considers extremely unsatisfactory.

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

By J. Prestwich, F.R.S., President

(*Concluded from p.* 472.)

It has been urged as a fatal objection to the discovery of coal in the south-east of England, that the Coal Measures become unproductive and thin out under the Chalk, as they range from Valenciennes towards Calais, and, therefore, that the coal-trough or basins end there. It is perfectly true that the Coal Measures do thin out between Bethune and Calais, but not in the sense of their dying out owing to their deposition near the edge of a basin. In that case, each seam, each stratum, would gradually become thinner and disappear; but such is not the fact. None of the beds of the Belgian coal-field are thick. The average does not exceed 2¼ feet. At Valenciennes it is the same; whereas M. Burat states the mean thickness of the beds actually increases westward of Bethune to more than 2½ feet. With respect also to the extreme end of this basin, the lower beds there brought up correspond with the bottom beds of the Hainault basin, where the lower 650 feet consist of unproductive measures. The thinning-out is, in fact, due to denudation, just as the Bristol coal-field thins out at Cromhall to resume in the Forest of Dean, or the coal-field of Liége thins out at Nameche to resume at Namur in the great field of Charleroi and Mons.

The deterioration of the coal in the small coal-field of Hardinghen, near Boulogne, has also been adduced against the occurrence of workable coal in South-Eastern England, but Mr. Godwin-Austen has shown that this Hardinghen coal-field is one of those small local developments of coal-bearing strata intercalated in the Mountain Limestone, and is of older date than the great Belgian coal-field. It has, therefore, no bearing on this part of the question.

Another objection to which much weight has been attached is that the coal-field of Bath and Bristol forms an independent basin, cut off both on the east and on the west by ridges of Millstone Grit and Mountain Limestone, so that there is an end of the eastern extension of the Coal Measures. This is quite correct as far as regards the western edge, and is probably the case on the eastern, although as the edge of the basin is there covered by Secondary rocks, some uncertainty still exists about the disposition of the Palæozoic rocks under them. Admitting, however, the basin to be complete and isolated, that is no proof that the older Palæozoic rocks prevail exclusively to the east; for the Coal Measures of the Somerset basin maintain their full development to the edge of the basin, and are there cut off by denudation, and are not brought to an end by thinning out. They form really part of a more extended mass, of which we have there one fragment; while on the west another portion exists in the Welsh basin, and another in the newly discovered small basin of the Severn valley.

This last basin is entirely covered by the New Red Sandstone; and as the Welsh basin is bounded on the east and the Bristol basin on the west by Mountain Limestone, the same argument as the one above might have been used to show the impossibility of coal occurring in this intermediate area.

But the fact is, it is the very nature of this great line of disturbance to have minor rolls and flexures of the strata at, or nearly at, right angles to it, and so causing breaks in the coal-trough, which would otherwise flank it without interruption; thus the Aix-la-Chapelle coal-field is separated by older rocks from that of Liége, which is again separated by a ridge of Mountain Limestone from that of Hainaut. So in the case of south-western England, we have the several basins of South Wales, Severn Valley, and Bristol, separated by tracts of Mountain Limestone and Old Red Sandstone, the extremes of the intervening belts of older rocks being two miles at Nameche and eighteen miles in Wales. These barriers are clearly only local, and the division of the Coal Measures into separate basins appears to be their ordinary condition along this great line of disturbance. The length of the two known portions of the axis included between Pembrokeshire and Frome, and between Calais and Westphalia, is 472 miles, and in this distance we find eight separate and distinct coal-fields. The combined length of these eight coal-fields is about 350 miles, leaving about 122 miles occupied by intervening tracts of older rocks; so that nearly three-quarters of the whole length is occupied by coal-strata. I consider that a structure which is constant (so far as the axis of disturbance can be traced above ground) is, in all probability, continued under ground in connection with the range of the same line of disturbance; and I see no reason why the coal-strata should not occupy as great a proportionate length and breadth in the under-ground and unknown, as in the above-ground and explored area.

With respect to the possibility of denudation having removed the intervening Coal Measures, enormous as the extent of denudation must have been previous to the deposition of the Permian strata, we cannot admit its exceptional action in this case. Denudation has removed from the crest of the Mendips a mass of strata possibly equal to two miles or more in height, and from that of the Ardennes as much as three or four miles, and it has also worn extensive channels between many of our coal-fields, so that the power of such an agent cannot be denied. But it is a power of planing down exposed surfaces rather than of excavating very deep troughs. Notwithstanding its immense planing-down action on the Mendips and Ardennes, deep troughs of Coal Measures are left flanking their northern slopes. These troughs descend to more than a mile beneath the level of the sea; and I do not think it probable that those underground intermediate portions of the trough where the axis is lower, would have suffered more than those on the higher levels, unless it were to the extent caused by the later denudation which preceded the Cretaceous period. But this would not affect the main bulk of the Coal Measures. The Belgian coal-field, which was exposed to the action of both these denudations, still retains vast proportions.

I may remark that the pre-Cretaceous denudation was very irregular in its action. At one place near Mons the Chalk and Tertiary strata are above 900 feet thick; whilst at another, on about the same level, and at but a short distance, they are not 100 feet thick—an old under-ground hill of highly inclined

Coal Measures causing this difference, and rising in the midst of the unconformable newer strata. This shows that in the English Chalk area we may possibly find irregular old surfaces of this kind, so that the Coal Measures may exist at places nearer the surface than we have estimated.

We have alluded before to the great length and narrow width of the Belgian coal-fields. That of Liége is forty-five miles long, with a mean width of less than four miles, whilst that of Hainaut and Valenciennes is 119 miles long, with a width scarcely greater. The presence of lower Carboniferous rocks under Harwich, and the wider range north and south of the Bristol coal-field, renders it possible that the trough in the intermediate area may have a greater expansion than in Belgium; but we have nothing else to guide us, unless it be that the lateral pressure in the intermediate ground was probably less than in the Ardennes and the Mendips, where it has exercised its maximum elevatory force. In that case the coal-trough in this intermediate area would be less compressed and more expanded; so we might consequently here look to find larger coal-basins than either those of Somerset or Liége. The position of these basins I am disposed, for reasons given in my Report, to place farther north than Mr. Godwin-Austen, and should therefore look for them not in the valley of the Thames, or on the line of the North Downs, but under South Essex, Middlesex or Hertfordshire, Oxfordshire, and North Wiltshire.

The strata on the south side of the Liége coal-field rise abruptly against highly inclined and faulted Devonian rocks, and the north side they rise at a less angle beneath Cretaceous or Tertiary strata. In the Hainaut coal-field the overlying have a greater extension. Under these strata the Coal Measures are succeeded by the Mountain Limestone, and then by Devonian or Silurian strata; but with one or two limited exceptions their outcrop is hidden by the newer strata which stretch uninterruptedly northward over the rest of Belgium. The Palæozoic strata have, however, been met with near Brussels, under Tertiary strata, at a depth of about 600 feet, and at Ostend at a depth of 985 feet, of which 682 consisted of lower Tertiary strata, 210 feet of Chalk, and 93 of coloured marls. It appears, therefore, not improbable, that the Tertiary and Cretaceous strata of all Belgium may repose directly on a floor of Palæozoic rocks; and as there is reason to suppose that all these rocks have a strike parallel with that of the Ardennes, folds in the strata may bring in some under-ground coal-basin or basins in parallel lines to the north, in the same way that small troughs of Coal Measures are brought in again in the Ardennes to the south of the great coal-trough. On the other hand, the great Palæozoic axis of the Ardennes, consisting of Silurian and Devonian rocks, Mountain Limestone, and Coal Measures, passes westward under the Chalk of the north of France, and has been followed under ground as far as to Calais, where it lies at a depth of 1,032 feet; while in the direction of Boulogne it keeps nearer the surface, outcrops from beneath the Chalk downs surrounding the Boulonnais, and disappears westward under an unconformable series of Jurassic and Wealden strata.

We may, I think, look for a prolongation of this old Palæozoic surface of highly inclined, contorted, and faulted rocks at no very great depth under the same Wealden, Chalk, and Tertiary area of the south of England. For, although the old Palæozoic surface descends rapidly from about 300 feet above the sea-level in the Boulonnais to 1030 feet below it at Calais, it rises at Ostend 47 higher than at Calais, and crossing the Channel, it is found at Harwich within a few feet of the same depth as at Calais, from which it is eighty miles distant in a northerly direction. Passing westward from Calais, we find the Palæozoic rocks under London 105 miles distant, and 102 feet higher than under Calais, and 106 feet higher than at Harwich. Allowing for irregularities of the old surface as evinced by the well at Crossness, near Plumstead, which was still in the Gault at a depth of 944 feet, or some 14 feet below the level of the Palæozoic rocks at Kentish Town, we may still consider that in the area between these three points, and possibly throughout the south-east of England, the Palæozoic rocks will probably be found not to be more than from 1,000 to 1,200 feet beneath the sea-level.

Projecting the line another 100 miles westward, we reach the neighbourhood of Bath and Frome, where the Coal Measures are, as before mentioned, lost at a depth of about 450 feet, beneath Liassic and Jurassic strata. In the intermediate area between that place and London no trial-pits and no wells have been carried to a depth of anything like 1,000 feet beneath the sea-level. The deepest well with which I am acquainted is one near Chobham, in Surrey, through Tertiary strata and Chalk to a depth of about 800 feet, or of 550 feet beneath the sea-level.

There are, however, in all this area certain indications of the proximity of old land and of pre-Cretaceous denudation, in the presence of quartz and Lydian pebble-stones, accompanied by Secondary rock fossils in the Lower Greensands of Surrey, and in the like old rock pebbles, with the addition of slate pebbles, in that formation in North Wiltshire; while the banks of shingle, Bryozoa, and sponges of the same age at Farringdon, point to still and sheltered waters, probably of no great depth, and to adjacent dry land. Again, on the north of London, we have in the Lower Greensand of Buckinghamshire and Bedfordshire shingle beds consisting almost entirely of fossils derived from Jurassic strata, with a remarkable collection of larger quartz, quartzite, and other rock-pebbles, derived probably from the old Palæozoic axis.

On the south also of the great Mendip and Ardennes axis coal strata may possibly be found just as they are found on both sides of the Pennine chain; for in either case the measures are cut off and broken through by these chains of hills. In South Wales certain folds of the older strata seem to render it probable that the Coal Measures may pass under the Bristol Channel, forming a trough which prolonged eastward would pass along the south side of the Mendips. Trials in the latter area, have, however, shown that the New Red Sandstone, Lias, and Oolitic series attain an infinitely greater thickness than on the north flank of that range, so that it is not likely that the Coal Measures would lie at a less depth than from 1,500 to 2,000 feet.

On further consideration of the subject, it seems to me a question whether we should not take a still broader view of this great east and west axis, and assign to it a width varying from thirty to eighty miles or more, looking at the Mendips and Exmoor hills as the bounding flexures north and south of the same line of disturbance in South-western England, while the ridges of the Ardennes, the Eifel, and the Hundsruck (in part?) are exhibitions of the same parallel series of anticlinals. In that case the great coal-basins of South Wales and Somerset would represent the synclinal trough on one side of the axis of disturbance, and on the other side we should have the Lower Carboniferous or Coal Measures of Devon; while on the Continent the deep, narrow synclinal trough of the Liége and Aix-la-Chapelle basin may be considered as lying on one side of the arch, and the great coal-basin of Saarbruck on the other. This important coal-basin has already been followed under the New Red Sandstones of the Vosges for a distance of from twenty-four to thirty miles in the direction of Metz, still on the strike of the Ardennes. Further westward, a trial for coal near Doncherry led to the discovery of Palæozoic rocks, at a depth of 1,090 feet under that thickness of Lias and Infralias; but the line of the coal-trough should, I think, pass a few miles to the south of this spot. Thence this underground coal-trough would range in an irregular east and west line, keeping parallel, or nearly parallel, with the Mons and Valenciennes troughs, under the north of Champagne, Normandy, the Channel, between the Isle of Wight and Cherbourg, Dorset, and cropping out again in North Devon. The only deep sections that I know of on this line are those furnished by a well sunk many years since, nine miles east of Dieppe, to a depth of 1,092 feet in the Kimmeridge clay and other strata; and another by a boring at Sotteville, near Rouen, through a thin capping of Cretaceous strata, to a depth of 1,050 feet in the same Kimmeridge clay—in either case without reaching the Palæozoic rocks. At Paris no Palæozoic rocks have been reached at a depth of 2,000 feet.

In this country the newer strata, overlying the Palæozoic rocks on our presumed anticlinal line, have been sunk through, without result, in the lowest beds of the Wealden at Hastings to a depth of 486 feet, in the upper beds at Earlswood, near Reigate, to a depth of about 900 feet, and, on the presumed synclinal line of Carboniferous rocks, through Chalk at Chichester, to a depth of 945 feet, and at Southampton, through Tertiary strata and Chalk to a depth of 1,317 feet.

To the south of all the area we have now described, there existed during the Carboniferous period, the ranges of the older Palæozoic strata of the Hunsdruck and Vosges—of the old crystalline rocks of Central France, fringed on the east and north with small outlying coal basins of the old Palæozoic rocks of Brittany—and of the Silurian rocks of South Cornwall—forming the old land-surface, fringed by the great coal-growths subtended northwards through Northern France, Western Prussia, Belgium, and

England, to the Silurian uplands of Central Scotland on the north, and those of the Welsh and Cumbrian highlands on the west, and possibly to those of the Scandinavian hills on the north-east. After the formation and consolidation of the Coal-strata, the southern area of this great Carboniferous basin was then subjected to that remarkable disturbance which, for a distance of above 800 miles, exercised that excessive lateral pressure by which the older underlying strata were squeezed and forced up into the series of sharp anticlinals forming the axis of the Mendips and Ardennes, while portions only of the Carboniferous series were preserved from the denudation which followed, in deep synclinal troughs flanking the main axis.

The central and northern portions of the great Carboniferous basin, which were not raised by this disturbance, were then overspread by strata of the Permian series; after which the northern section of the original coal area was traversed by that other great disturbance at nearly right angles to the former one, by which fresh portions of the Coal Measures were brought up in our central and northern counties, still leaving other deeper-seated portions to be afterwards covered by Triassic and Jurassic strata.

At a much later period the emerged southern area of Palæozoic rocks, including the westward prolongation of the great coal-trough of Belgium, or portions thereof, was submerged and covered over by the several formations of the Greensands, Chalk, and Lower Tertiaries now forming the surface of the south-east of England.

The trials to discover these possibly productive coal-basins must necessarily be attended with considerable uncertainty. We shall have to feel our way. Of our hope of their ultimate success I have given you the reasons. Nor could such trials near London scarcely fail of some important results; for, even if we did not hit at first upon the Coal Measures, it is probable that the Lower Greensand would at some spots be reached, so that the inestimable additional benefit of a large and steady supply of pure water might also be obtained, and, with proper care to prevent undue interference, might be maintained for all time.

And now, gentlemen, in retiring from the chair, which I have had the honour to occupy during the last two years, allow me to express the sincere satisfaction I have experienced in witnessing the continued prosperity of the Society, and the unanimity and oneness with which its labours are carried on. It was a post I long hesitated to accept, but which your kind forbearance and the friendly co-operation of your officers, has not only rendered easy, but as pleasant as it has been gratifying. I feel assured of the continued prosperity and usefulness of the Society when I resign my trust into the hands of a nobleman so distinguished as a statesman so able as a writer, and so long known amongst us an active and zealous geologist, as the Duke of Argyll.

## SCIENTIFIC SERIALS

*The Lens*, a quarterly journal of microscopy and the allied natural sciences, with the Transactions of the State Microscopical Society of Illinois, edited by S. A. Briggs. No. 1, January 1872. Chicago, U.S. This long-promised journal has at length made its appearance, and we learn from its first number that it was printed and ready for the mail when the great fire occurred. With the exception of a few copies, the whole edition was destroyed, and on recovery from that disaster had to be reprinted. We have cause, therefore, to congratulate the publishing committee on recovering themselves so speedily as to issue their first number with the new year. Amongst its contents we note the following:—"Conspectus of the families and genera of the Diatomaceæ," by Prof. H. L. Smith. This is an artificial key, and like all such efforts has its good and bad sides. As a help such guides are useful, but they are seldom satisfactory. A table of synonyms is promised in the next number.—"The Flora of Chicago and its vicinity," by H. H. Babcock, is hardly such a subject as we should expect to find in a microscopical journal, since the list of Phanerogamic plants, with localities, here commenced, contains no single note of microscopical observation. To the local botanist it will probably make amends for this by its practical utility.—"On the preparation and preservation of sections of soft tissues," by Dr. J. N. Danforth, contains practical observations on the preparation of morbid animal tissues without artificial hardening.—"Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, U.S. Army, is the first portion of a more elaborate treatment of the same subject, which is to be contained in succeeding numbers. Dr. Woodward's reputation on this side the Atlantic as a practical microscopist is a sufficient guarantee for these memoranda.—"A new fossil Echinus," by O. S. Wescott, is named by the author *Oligoporus Groveri*, and found in the limestone region of Hancock County, Illinois.—"The Diatomaceæ of Lake Michigan," by S. A. Briggs, is simply a list of species.—"A New Method of Illuminating Opaque Objects under high powers," by Dr. H. A. Johnson. This new method consists in sending a beam of light down the oblique body of the binocular upon the prism, by means of a plane mirror or rectangular prism; by this arrangement objectives as high as $\frac{1}{25}$ in. have been used successfully by daylight and lamplight.—A reprint from the *Monthly Microscopical Journal* and some notes complete the present number. The losses which the Academy of Sciences of Chicago sustained by the late destructive fire are detailed, in so far as the natural history collections and library are concerned. All British naturalists will sympathise with those of Chicago at their irreparable misfortune in such losses as the Smithsonian collection of crustacea, which filled 10,000 jars, and the invertebrates of the U.S. North Pacific Exploring Expedition, besides the thousands of specimens, zoological, botanical, and mineralogical, in the general collection.

*Journal of the Chemical Society*, Jan. 7, 1872.—Dr. Gladstone has continued his experiments on various essential oils; amongst others he has examined four new oils, those of citron, lign aloes, pimento, and vitivert; the author has separated the hydrocarbons contained in most essential oils into three polymeric groups to which the formulæ $C_{10}H_{16}$, $C_{15}H_{24}$, and $C_{20}H_{32}$, have been assigned. The two bodies first mentioned have the vapour density required by theory, the third has not been examined, the three bodies also differ in their solubility in alcohol, and in their expansibility by heat. The physical properties and chemical composition of several oils have been studied in detail, and are here described. Dr. Armstrong contributes a third paper on the nitrochlorphenols, the results obtained, however, are not suitable for useful abstraction. Amongst the abstracts there is one by E. Budde "on the action of light on Chlorine and Bromine." The author has exposed chlorine to the action of various parts of the solar spectrum, he found that when the bulb of gas was exposed to the violet and ultra-violet rays, there was from six to seven times as great expansion as took place in the red and yellow part of the spectrum. An ordinary differential air thermometer and also one charged with carbonic anhydride and ether, placed in the blue and violet parts of the spectrum, showed no increase in temperature. The author is of opinion that the hypothesis which he has advanced in explanation "that the chemically active light actually decomposes the chlorine molecules into chlorine atoms" is not a little supported by the fact that the rays which cause the expansion of chlorine coincide with those which are known to render it chemically active. The author believes that the light causes the separation of the molecules into atoms, and that the isolated atoms combine again with the production of heat, and thus lead to an increase of temperature which would account for the expansion of the gas as observed.

THE articles of most general interest in the *Journal of the Franklin Institute* for January are by Mr. F. A. Genth, on the Mineral Resources of North Carolina; and by Mr. G. W. Baird, U.S.N., on the Absorption of Gases by Water, and on the organic matters contained therein. The latter contains a series of experiments on the volume of different gases capable of being dissolved in a unit volume of water, and on the amount of oxygen necessary to oxidise the organic matter contained in the water.—The editorial notes contain descriptions of a number of novelties in mechanics and physics.—Mr. J. Farrand Henry continues his series of papers on the Flow of Water in Rivers and Canals, and Mr. J. H. Cooper his article on Belting Facts and Figures.—There is also a report by Mr. W. M. Henderson on some experiments on the explosion of steam-boilers, carried out by a committee of the Franklin Institute at the instance of the engineers of some of the American railways.

THE *American Journal of Science and Art* for February is mainly geological. It commences, however, with some observations by Prof. C. A. Young on Encke's comet, at the Dartmouth College Observatory, accompanied by drawings. He identifies the spectrum with that of Comet II. 1868 (Winnecke's comet) described by Mr. Huggins in the Philosophic Transactions for that year.—Prof. J. D. Whitney has a note on the occurrence of the "Primordial Fauna" of Nevada, which he considers indicates most unequivocally the Potsdam period of the Silurian age, and carries

the Primordial Fauna much farther west than it had been found before.—Prof. Dana's notice of the address of Prof. T. Sterry Hunt, before the American Association at Indianapolis has already appeared *in extenso* in our columns.—Prof. Roland Irving on the age of the Quartzites, Schists, and Conglomerates of Sauk Co., Wisconsin, holds them to be unquestionably islands in the Potsdam Sea, furnishing beautiful illustrations of wave action on a rocky coast.—Prof. Hayden gives an extremely interesting account, illustrated by maps, of the hot springs and Geysers of the Yellowstone and Firehole Rivers, the result of the recent Government exploration of that district. Prof. T. Sterry Hunt continues his notes on granite rocks, and Mr. A. S. Verrill his contributions to Zoology from the museum of Yale College.

## *SOCIETIES AND ACADEMIES*

### LONDON

Royal Society, April 11.—"Researches on Solar Physics."—III. By Warren De La Rue, F.R.S., Balfour Stewart, F.R.S., and Benjamin Loewy.

The authors present in this paper the third instalment of the determination of the areas and heliographic positions occupied by the sun-spots observed by the Kew photoheliograph, comprising the years 1867, 1868, and 1869. They announce that the fourth and last instalment is in active progress, and will be preceded by the final discussion of the whole ten-yearly period, during which the photoheliograph has been at work. This final discussion will contain the determination of the astronomical elements of the sun on the basis of photographic observations, and this work they anticipate will not only settle the question of rotation for a considerable time to come, but will also throw light upon many points which have only recently been brought under the consideration of scientific men. The results in general, they believe, will prove the superiority of photographic sun-observations over previous methods. The second question which will be discussed is the distribution of sun-spots over the solar surface. The facts already brought out indicate that the progress of the inquiry may lead to some definite laws which regulate the distribution; there appear to exist centres of great activity on the sun, and the different solar meridians seem to have various but definite intervals of rest and activity. In conclusion the authors point out the necessity of devoting in future greater attention to the study of the faculæ, and express a hope of seeing photographic sun-observations carried on in this country on a more extended system, connecting from day to day solar phenomena with terrestrial meteorology and magnetism.

Correction to Messrs. De La Rue, Stewart, and Loewy's papers "On some recent Researches in Solar Physics, &c."

The erroneous date given in our paper for one of Professor Wolf's maxima has already been corrected by us, and we give in the subjoined little table the corrections of the few numerical data which are necessitated by the error of fixing the date of maximum at 1846·6 instead of 1848·6.

Prof. Wolf's ratio $\frac{A}{B}$ (p. 86).

| Erroneous figures given previously. | | Differences. | Corrected figures. | | Differences. |
|---|---|---|---|---|---|
| I. 1·265 | | —0·728 | 1·265 | | +0·283 |
| II. 2·615 | Mean 2·093 | +0·522 | 1·478 | Mean 1·548 | +0·073 |
| III. 2·400 | | +0·307 | 1·900 | | +0·352 |

The differences derived from our own results are respectively +0·061, and —0·047, that is, they are still much smaller, and agree singly better with the mean, than if Prof. Wolf's ratio were adopted; hence our conclusion is quite unaffected by this correction.

The remark made by us with reference to this maximum will remain in force even with the corrected date. We stated there that this particular maximum showed alone an appreciable difference from the dates fixed by ourselves, for it will be found that Prof. Wolf's date differs still by about three-quarters of a year from ours.

"Contributions to the History of the Opium Alkaloids."—Part V. By Dr. C. R. A. Wright.

"The Action of Oxygen on Copper Nitrate in a state of Tension." By Dr. J. H. Gladstone, F.R.S., and Alfred Tribe, F.C.S.

In our experiments on the action between copper and nitrate of silver in solution, we frequently noticed that the tips of the silver crystals became red, as though coated with a thin layer of metallic copper.

This apparent deposition of a positive on a more negative metal of course raised our curiosity, and led us to look closely into the circumstances under which it occurred. We found that it took place only when the nitrate of silver was exhausted, and only on those silver crystals which remained in metallic connection with the copper. We found, too, that the cupreous coating formed most readily where air had the freest access; and, in fact, that it would not form at all in vessels from which oxygen was excluded, nor on those white crystals which were far below the surface of the liquid, though they might be in immediate contact with the copper plate. When an inverted jar was filled with nitrate of copper solution and silver crystals resting on branches of copper, and the liquid was displaced by oxygen gas, it was found that the tips of the crystals became red, and the solution gradually filled the jar again by the absorption of the gas. In the same way the oxygen was absorbed from air, or from its mixtures with hydrogen or carbonic anhydride. This action was further studied by employing plates of the two metals instead of copper covered with silver crystals. When the two plates, connected by a wire, were partially immersed in an ordinary aqueous solution of copper nitrate, it was found that a slight yellowish deposit made its appearance speedily all over the silver plate, and went on increasing for a day or two, while at the air line there was a thicker deposit, which gradually grew and extended itself a little below the surface. This deposit changed from yellowish to red, and under the microscope presented a distinctly crystalline appearance. Thinking that this slight crust all over the silver plate was due to the air dissolved in the solution itself, we took advantage of the reaction to prepare copper nitrate absolutely free from dissolved oxygen. An ordinary solution of the salt mixed with some silver nitrate was placed in a narrow cylinder, with a long piece of copper foil arranged somewhat spirally so as to retain the deposited silver on its surface, and allowed to rest for twenty-four hours.

The solution thus obtained was exposed to the action of the conjoined copper and silver plates, but even after some hours there was no diminishing of the lustre of the silver plates, except at the air line, which was sharply defined. The same solution shaken for some time in the air produced a yellowish deposit on the white metal in three minutes.

The colour and general appearance of this crust, together with its formation only where oxygen can be absorbed, showed that it was not metallic copper, but the suboxide.

This was further proved by the action of diluted sulphuric acid, which resolves it at once into red metallic copper and copper sulphate. There is also another curious reaction which can only be properly observed under a microscope.

When treated with a solution of silver nitrate, this cupreous deposit does not give the ordinary crystals of the white metal; in fact, it is only slowly acted upon, but presently there shoot forth thin threads of silver which run through the liquid, often twisting at sharp angles, while the yellowish crystals change to black. This also was found to be a property of the suboxide of copper. This deposition of oxide on the silver is accompanied by a corresponding solution of copper from the other plate.

Thus, in an experiment made with nitrate of copper solution that had been exposed to air, and which was allowed to continue for four days, there was found—

Gain of silver plate, 0·016 grm.
Loss of copper plate, 0·015 grm.

The copper necessary for the production of 0·016 grm. of suboxide would be a little above 0·014 grm.

The wire connecting the two plates in this experiment is capable of deflecting a galvanometer. The current takes place from copper through the liquid to silver, that is, in the same direction as if the copper had been dissolved by an acid, and hydrogen evolved on the silver plate.

If the two plates have their sides parallel, the suboxide is deposited not merely on that side of the silver plate which faces the copper, but after about a minute on the other side also, showing that in this, as in other cases, the lines of force curve round.

It became interesting to consider what started this electric current. The original observations convinced us that it was not due to the action of oxygen on the copper; but to make the matter more certain, bright copper and silver plates in conjunc-

tion were immersed, the copper in a pure, *i.e.* deoxygenised, solution of nitrate of copper, the silver in an oxygenised solution; the two liquids communicated through the diaphragm of a divided cell. In half an hour the silver plate was covered with a reddish film, while not a trace of oxidation was perceptible on the copper. On continuing this experiment for three hours, it was found that the copper plate lost 0·003 grm., and the silver plate increased proportionately. On cleaning the plates and reversing their position, the copper was covered with a film of oxide, while the silver remained free from cupreous deposit. We believe, therefore, that through the simultaneous action of the two metals the dissolved salt is put into such a state of tension that oxygen brings about a chemical change which otherwise would be impossible, and that this change is initiated in close proximity to the more negative metal.

Though we have examined only this reaction, we have satisfied ourselves that it is not an isolated fact. Each of the elements concerned may be replaced by others: thus the sulphate may be substituted for the nitrate of copper, or platinum may be used instead of silver. Chlorine may take the place of oxygen with the production of the subchloride instead of the suboxide, and zinc may be employed as the positive metal with zinc chloride as the salt in solution, in which case copper may be taken as the negative metal, and on its surface will form a deposit of oxide of zinc.

Linnean Society, March 21 and April 4.—Mr. Bentham read the continuation and conclusion of his notes on Compositæ, comprising their History and Geographical Distribution. The ancient history of the order is more purely conjectural than that of many other large groups of plants. The geological record is remarkably scanty. The only remains that can be plausibly referred to Compositæ are the impressions of achenes with their pappus figured by Oswald Heer from the upper Miocene deposits of central Europe, which, supposing, as is probably the case, that the identifications are correct, would only show that at that tertiary epoch Compositæ existed in Europe of the same general character as those which are there now to be met with; and that they had thus already attained that highly differentiated character they now possess, and consequently must already have been of an old date. In the absence, therefore, of direct evidence, we are left to judge of the antiquity and origin of Compositæ in general, as well as of the subordinate races they comprise, from their comparative structure and geographical distribution. The paper then proceeds to pass in review in great detail the thirteen tribes of Compositæ, and the several subtribes and principal genera into which they are divided; after which some conjectures are put forward, as derived from the data thus supplied, as to the comparative antiquity of the principal races of Compositæ. Concurring with the arguments which have been brought forward by French and other botanists, to show that the great consolidation and uniform structure of the essential organs of fructification in Compositæ are evidences of their greatest perfection and consequent comparatively recent origin, it is shown that this consolidation and uniformity is least marked in Helianthoideæ, especially in the small subtribe of Petrobieæ, and most so in Cichoraceæ; and this conjecture that the former represent the most ancient, the latter the most recent, races of the order, is confirmed in some measure by the peculiarities of their respective geographical distribution. The study of the various details given would further lead to the supposition that the primitive form of Compositæ had regular gamopetalous flowers with an inferior ovary, the calyx, corolla and uniseriate stamens isomerous and probably pentamerous, the pistil bicarpellary, but the ovary already internally reduced to a single cell with a single erect anatropous ovule, and the seed exalbuminous, enclosed in an indehiscent pericarp, and containing a straight embryo with an inferior radicle; and that it is in the gradual course of subsequent consolidations that the bracts have crowded round the condensed flowers and usurped the functions of the calyx-limb, which has become obliterated or transformed so as to be better adapted to its new duties; the corollas have become contracted, or the outer ones variously developed in forms and colours adapted to assist in the process of cross-fertilisation; the anthers, brought into close contact by the compression of the flowers, have become united, and their styles modified so as to assist them in the discharge of their pollen, and the conversion from hermaphroditism to unisexuality may in various races have variously preceded or followed some or all of these changes, and produced those numerous diversities observed in the order. We might be further led to imagine that several of these changes had taken place at a very early period previously to the disruption of or stoppage of communication between the tropical regions of the globe, that, besides the parent forms above supposed to be represented in some Helianthoideæ, and perhaps a few Cotuleæ, Compositæ then existed, showing several important modifications, such as—(1) the regular and uniform tubular development of the corolla, accompanied by more or less of suppression of the inner bracts, and of the normal calyx-limb, with a substitution of a pappus in the latter case; (2) the reduction of the corolla limb, attended frequently by a sexual dimorphism and occasional oblique development of the outer female flower; and (3) perhaps at a later period, the uniform unilateral development of the whole of the corollas, accompanied usually by a suppression of the inner bracts and conversion of the calyx limb into a pappus. From the first of these modifications would have sprung the Eupatoriaceæ in America, the Vernoniaceæ in the New and the Old World, the Cynaroideæ in the northern, and the Mutisiaceæ in the southern hemisphere. From the second modification would have arisen—first, the more slightly altered Helianthoideæ chiefly in America; secondly, the Helenioideæ in America, and the Anthemideæ in the Old World, with the thinly paleaceous modification or total suppression of the inner bracts and calyx limb; and thirdly, the cosmopolitan Senecioniderc, Asteroideæ, and the majority of Inuloideæ, with an almost universal suppression of the inner bracts and conversion of the calyx limb into a setose pappus. The third general modification, with a very few slight exceptions, has settled down into those Cichoraceæ whose absolute uniformity had been already pointed out. In the third and concluding portion of the paper the present Regions, or chief centres, or areas, of the principal races of Compositæ are passed in review. The position of these great centres is evidently influenced by the prevalent constitution of the order, and the consequent effects of climatological and other physical causes on the gradual migrations of its species. Rarely arborescent and gregarious, still more rarely aquatic, Compositæ are, in a great measure, excluded from the vast forest-clad lowlands of the Amazon region of America, or of eastern tropical Asia, and the species are few in the swampy bogs of the northern hemisphere. Their favourite haunts are treeless or thinly-clad mountain regions, and especially the lower or broken grounds, rocky ridges, or open campos of warm extratropical or subtropical districts. They may be met with, it is true, at the highest altitudes or latitudes which will bear phænogamic vegetation as well as in the warmest tropical deserts, and a few species, as ready colonists, are perfectly ubiquitous in the traces of man; but there are large tracts of open country especially abounding in highly differentiated races of very limited areas, others again where Composite genera and species are as numerous and ill-defined in their subordinate races as wide and vague in their geographical range. These tracts of country severally constitute the centres of differentiation or areas of preservation, of which the definition is attempted as Regions of Compositæ. After alluding to the difficulties arising from the interchange of races across the frontiers of adjoining regions, or from the occasional reappearance of identical genera and species at enormous distances, as well as from our imperfect acquaintance with the Compositæ of certain districts, these regions are severally passed in review, in a series of tables of the genera they contain, either endemic or common to other regions, followed by such general observations as the comparisons may have suggested, commencing with the primary division into the New and the Old World, the former including the Sandwich as well as the more nearly placed Pacific Islands, whilst the Atlantic islands, Australia and New Zealand, are compris d in the Old World. After a general table of the genera of and estimated number of species in each division, a series of tables shows—(1) the connections between the tropical regions of the two divisions, as exemplified by identical genera; (2) the same connections in identical species; (3) the northern, and (4) the southern connections of the New and Old Worlds. Generally Compositæ are nearly equally divided between the two, about 430 genera in the New and 410 in the Old, with at least 4,700 species in the former, 4,400 in the latter; new discoveries being likely to add more to the latter. Of these numbers about 75 genera are common to the two divisions, but the identical species are under 70 out of at least 9,100. These common species are chiefly Arctic, or high northern, the tropical ones being very few and mostly very generally diffused, and ready colonists, such as *Eclipta alba*, *Ageratum conyzoides*, *Adenostemma viscosum*, *Siegesbeckia orientalis*.

In the separate distribution of Compositæ in America and the Old World there is one striking difference in the two divisions with regard to the extratropical or subtropical races which form the great bulk of the order. In America the northern and southern tribes are the same, although in different proportions, and there are a considerable number of identical genera and even species in the north and in the south. In the Old World on the contrary two large northern tribes, Cynaroideæ and Cichoraceæ, are all but absent from the south, whilst the southern Aretotideæ, as well as several subtribes of other tribes, are wanting in the north. The genera common to the Mediterranean and South African regions (except such cosmopolitan genera as *Senecio*) are very few, and the common species scarcely any. This great difference in the two divisions of the globe may be due in a great measure to the direction of the great chain of mountains which in America, running north and south, facilitates or has facilitated means of intercommunication to races of the constitution of Compositæ, to which the east and west mountain ranges plains seas and deserts of the Old World only oppose obstacles. The regions of which the Compositæ are severally tabulated and commented upon are, in America: (1) the Mexican region including California, a portion of Western Texas and Central America north of Veraguas, remarkable for the large number of endemic genera, 135 out of 240, and the small average number of species; (2) the United States region, comprising the general area of North America from the Oregon and Texas eastward and northward, with about 118 genera, out of which only 25 are endemic, or nearly so, but the average number of species more than double that of the Mexican genera; (3) the West Indian region, of which the three principal islands, Cuba, St. Domingo, and Jamaica, have 13 endemic genera of one to three species each; and three South American regions, the Andine, the Brazilian, and the Chilian, not so distinct from each other, nor showing any such remarkable contrasts as the two northern ones. In the Old World six regions are distinguished—(1) the Mediterranean, extending from Spain to Affghanistan, with at least 140 genera, more than half of them endemic, and an average of nearly 10 species to a genus; (2) the great Europæo-Asiatic region, extending from Western Europe to Eastern Asia, with a large number of species, but only 10 endemic genera out of 87; (3) the Tropical African, with 18 endemic genera out of 109; (4) the Tropical Asiatic, with only 9 out of 78 endemic or nearly so; (5) the South African, the smallest in extent but the richest in endemic highly differentiated genera and species, 100 out of 148 genera being limited to that locality, and out of about 1,400 species not above a dozen common to other regions; and, lastly, (6) the Australian region, with 39 out of 83 genera endemic, and, notwithstanding its isolation, nearly 60 species common to other countries, chiefly tropical Asia and New Zealand. The Compositæ of the principal Oceanic islands are also separately tabulated and considered; after which, in the general summary, it is conjectured that Africa, Western America, and possibly Australia may have possessed the order at the earliest recognisable stage, Africa showing the greatest variety of individual isolated remnants of extinct races; Andine America, and some of the scattered Oceanic islands, exhibiting a few of what may be deemed the nearest approach to the previously mentioned conjectural primitive form of the order; that at this early period there must have been some means of reciprocal interchange of races between these regions; that since the disruption of this intercourse between the two great divisions of the globe, there must have been for a time a certain continuity of composite races from north to south across the tropics—a continuity which was probably further prolonged in America than in the Old World; that as Compositæ began to disappear from these tropical regions which thenceforth opposed to them impassable barriers, they became rapidly differentiated to the northward and southward, with greater structural divergences in the Old than in the New World, owing to the isolation being more complete in the former than in the latter; and that those forms, those more or less differentiated races, which had reached and accommodated themselves to high northern latitudes or mountain altitudes, retained some means of communication and interchange between the Old and the New World, long after it was broken off in the warmer parts of the globe. Finally the homes where Compositæ now flourish in the greatest luxuriance of specific variety and individual numbers, appear to be tropical America, exclusive of the great alluvial low grounds and forest regions, the United States, South Africa, the Mediterranean region, West Central Asia, and extra-tropical Australia.

Geologists' Association, April 7.—The Rev. J. Wiltshire, F.G.S., president, in the chair. "On the Excavations at the Site of the New Law Courts," by W. H. Hudleston, F.G.S., and F. G. H. Price. The authors commenced with a general description of the area in question, which faces the Strand for 500 feet, and is in shape a rough square of some seven acres in extent. The floor of the excavation is about 33 feet above ordnance datum line at the south-east corner. Four varieties of beds are recognised. (1) Brick rubbish, &c.; (2) gravels and sands; (3) red clay; (4) blue clay. The nature of the changes which the London clay undergoes in its upper portions was noticed, and the chemical agencies acting upon the clay and its included septaria pointed out. The changes from blue to red were thus summarised:—Conversion of dyad iron, existing partly as carbonate partly as as a basic element of the silicate, into tryad iron, oxidation of the included pyrites, removal to a considerable extent of the resulting sulphuric acid and diminution of the carbonate of lime and magnesia. The several sections carefully examined by the authors showed that on the north side the gravels have a thickness varying from 9 to 13 feet, and thin out and disappear before the Strand is reached. The contour of the London clay is irregular, one line of 30 yards giving a variation of 7 feet in the thickness of the overlying gravels, due to this cause. Deposits of oxide of manganese and sulphide of iron occur in the gravels; the former, it was contended, due to natural causes, while the latter was probably owing to sewage contamination. The bones of *Bos*, *Capra*, and *Equus*, were found in the gravels, and in the underlying clay twenty-three species of mollusca, including *Fusus bifasciatus* and *Pyrula smithii*, characteristic, in the opinion of Mr. C. Evans, of a line of the London clay 130 feet above the base. The gravels belong to the west London block of the Middle Level gravels, the ascertained thickness of which at various points was compared with the thickness of the Lower Level gravels at South Kensington, Battersea, and Westminster. These latter the authors concluded were double the thickness of the western block of the Middle Level gravels. In conclusion the authors drew attention to the results of the operations of the existing river, and several accurate measurements of the bed of the Thames were given in illustration.—Mr. E. Charlesworth brought before the notice of the Association some sharks' teeth from the Red Crag, having certain perforations which, should they be proved to be the result of human agency, would seem to carry the advent of man on the earth back to Pliocene times.

Society of Biblical Archæology, April 2.—Dr. Birch, F.S.A., president, in the chair. "Notice of a Curious Myth respecting the Birth of Sargina, from the Assyrian Tablets containing an account of his Life." By Henry Fox Talbot. In this paper Mr. Talbot showed that Sargina the First was a very ancient king of Babylonia. The date of his reign is uncertain, but it may be roughly estimated at fourteen or fifteen centuries before the Christian era. He was a legislator and a conqueror, and his arms appear to have reached the distant Mediterranean. He fixed his capital at Agani, in Babylonia, a city whose site has not yet been discovered. His history, like that of other ancient conquerors and legislators, has become partially involved in fable. An account of his birth and infancy, preserved on a tablet in the British Museum, offers a great similarity to that of the infancy of Moses, as related in the second chapter of Exodus. This account agrees very closely with the conduct of Sargina's mother as described by the Assyrian tablet. "In a secret place my mother had brought me forth. She placed me in an ark of bulrushes; with bitumen she closed up the door. She threw me into the river, which did not enter into the ark. The river bore me up, and brought me to the dwelling of a kind-hearted fisherman. He saved my life, and brought me up as his own son," &c. The inscription appears to have been a long one, but only a small portion of the beginning has been well preserved.—"On the Rise of Semitic Civilisation, chiefly considered upon Philological Evidence." By the Rev. A. H. Sayce. The author stated that comparative grammar has shown that the Semitic language belongs to a late period in the history of the development of speech, and presupposes a parent-language, possibly connected with the old Egyptian and the sub-Semitic dialects of North Africa. Many objections, however, lie against the biliteral theory, and most of the biliteral roots are probably of foreign origin. This is Accadian, also the source, it would seem, of the early Semitic traditions. Thus two at least of the rivers of Paradise are Babylonian, and the Sisuthrus

of Berosus (the Biblical Noah), is the Accadian Susru or Na (Anu). Like the traditions, a large proportion of the words in the Semitic languages which express the objects of civilised life are borrowed from the Accadian—the ordinary terms for "city," "weighing," "measures," "ciphers," &c., come from this source. We are thus enabled to gauge the primitive civilisation of the Semitic nomads, and to determine that their home had no great rivers or mountains, like the deserts of Northern Arabia.

PARIS.

Academy of Sciences, April 1.—M. Serret presented a continuation of M. A. Mannheim's geometrical researches upon the contact of the third order of two surfaces.—A paper was read by M. C. Decharme on the spontaneous ascensional movement of liquids in capillary tubes. The author here stated as the result of his experiments that each liquid possesses a proper ascensional velocity, which he proposes to call its "capillary velocity," and he indicated the peculiarities presented by certain liquids as regards the relation between this velocity and the length of the column, &c. An aqueous solution of hydrochlorate of ammonia has the greatest capillary velocity, and next to it chloride of lithium; both these have a greater velocity than pure water.—A note by M. de la Rive on the theory of polar auroras was read; the author maintains the atmospheric nature of the phenomenon.—The second part of a paper by M. A. Crova on the phenomena of interference produced by parallel nets was read.—M. Faye gave a long account of an association recently founded in Italy under the title of "Societa dei Spettroscopisti Italiana," and also presented a memoir on the hypothesis of persistent winds on the sun.—In a second communication on the history of fermentation, M. E. Chevreul described in some detail the chemical labours of Stahl, and especially his theories of fermentation and combustion, which the author regarded as physical rather than chemical.—M. Joseph Boussingault presented a note on sorbite, a saccharine material allied to mannite, obtained from the juice of the berries of *Sorbus aucuparia*.—A note was read by M. A. Clermont, on some metallic trichloracetates, and M. Balard presented a note by M. E. Reboul on the identity of the brominated hydrobromate and hydriodate of propylene, with dihydrobromate and iodohydrobromate of allylene, and on the dihydrobromate of acetylene.—A note by M. Duval-Jouve, on the anatomy of the dissepiments presented by the leaves of certain species of *Juncus*, was communicated by M. Duchartre.

April 8.—M. Serret presented a note by M. E. Combescure on a peculiar system of equations with partial differences; and a paper entitled "Investigations upon substitutions," by M. C. Jordan, was read.—M. Le Verrier communicated two notes by M. Diamilla-Müller, one on terrestrial magnetism, the other on the cosmical origin of auroras. In the latter he claimed priority in having put forward the notion of these phenomena being due to solar influences.—M. J. Silbermann read a continuation of his memoir on the laws of atmospheric tides; and M. C. Sainte-Claire Deville communicated a note by M. O. Silvestri, giving a chemical and microscopic analysis of the sand-shower which fell in Sicily on March 9, 10, and 11 in the present year.—M. Chevreul read a second note on the crystallisation of barytic salts, the acids of which originate from the maceration of dead bodies.—A memoir on the alteration of the sulphurous waters of Eau-Bonnes in contact with a limited atmosphere, by the late M. Louis Martin, was read.—M. H. Sainte-Clare Deville presented notes by M. A. Ditte on the apparent volatilisation of selenium and tellurium, and on the dissociation of their hydrogenated compounds; by M. B. Renault, on the reducing properties of hydrogen and vapours of phosphorus, and on their application to the reproduction of drawings; by M. de Tommasi, on a compound of binoxide of chrome and potassic dichromate, kalichromic dichromate $[(CrO^2)^3 (CrO^3)^2 K^2O] H^2O$; and by M. L. Grandeau, on the function of the organic materials of the soil in the nutrition of plants.—M. Cahours presented a note by MM. S. Cloëz and E. Guignet on the chemical composition of the Chinese green (*lokro*).—An interesting note on the polymorphism of *Mucor mucedo*, by MM. P. Van Tieghem and G. Le Meunier, was communicated by M. Decaisne.—M. A. Vulpian read a memoir on the alteration of the muscles produced under the influence of traumatic or analogous lesions of the nerves, and on the trophical action of the nervous centres upon the muscular tissue; and M. Gauthier de Claubry presented some observations on M. Champouillon's recent remarks as to the rapid decomposition of the bodies of alcoholised subjects. He adduces facts which seem to show that the difference in the rate of putrefaction may be otherwise accounted for.—M. A. de Lapparent read a note on the date of the elevation of the district of Bray.

## BOOKS RECEIVED

ENGLISH.—History of the Birds of New Zealand. Part I.: W. L Buller (Van Voorst).—The Teeth, and How to save them: L. P. Meredith (W. Tegg).

FOREIGN.—Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien, Band 21.—Die Grundlagen der Vogelschutzgesetzes (Ritter v. Frauenfeld)—Die Pflege der Jungen bei Thieren (Ritter v. Frauenfeld).—Ueber die Weizenverwüsterin Chlorops tæniopus: Prof. Max Nowicki—La Photographie appliquée aux études géographiques: Jules Girard.—(Through Williams and Norgate.)—Die Metamorphose der Squilliden: Prof. C. Claus.

## DIARY

*THURSDAY*, APRIL 18.

ROYAL SOCIETY, at 8.30.—On the Connection between Explosions in Coal Mines and Weather: R. H. Scott, F.R.S., and W. Galloway.—On the Fossil Mammals of Australia. Part VII. Genus Phascolomys. Species exceeding the existing ones in size: Prof. Owen, F R S.

ROYAL INSTITUTION, at 3.—On Heat and Light: Prof. Tyndall, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30.—Test of Certain Centurial Stones: H. C. Coote.

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 *Ternstræmia coriacea*: Prof. Dyer.

CHEMICAL SOCIETY, at 8.—Notes from the Laboratory of the Andersonian University; On a Compound of Sodium and Glycerine; and On Benzyliso-cyanate and Isocyanurate: E. A. Letts.

*FRIDAY*, APRIL 19.

ROYAL INSTITUTION, at 9.—On the Sulphurous Impurity in Coal Gas and the means of removing it: A. V. Harcourt, F.R.S.

*SATURDAY*, APRIL 20.

ROYAL INSTITUTION, at 3.—The Star-Depths: R. A. Proctor.

GOVERNMENT SCHOOL OF MINES, at 8.—On Geology: Dr. Lobbold.

*SUNDAY*, APRIL 21.

SUNDAY LECTURE SOCIETY, at 4.—On the Hindûs—Ancient and Modern—their Manners, Customs, &c.: Dr. F. J. Mouat.

*MONDAY*, APRIL 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Letter from Dr. Kirk on the Movements of Dr. Livingstone.—On Recent Explorations of the North Polar Regions: Capt. Sherard Osborn, R.N.

ANTHROPOLOGICAL INSTITUTE, at 8.—On the Hair and some other peculiarities of Oceanic Races: Dr. J B. Davis, F.R.S.—On the Hair of a Hindostanee: Dr. H. Blanc.—On the Descent of the Esquimaux: Dr. Rink.—Le Sette Communi: Dr. R. S. Charnock.

*TUESDAY*, APRIL 23.

ROYAL INSTITUTION, at 3.—On Statistics, Social Science, and Political Economy: Dr. Guy.

SOCIETY OF ANTIQUARIES, at 2.—Anniversary Meeting.

*WEDNESDAY*, APRIL 24.

GEOLOGICAL SOCIETY, at 8.—Notes on the Geology of the Colony of Queensland: R. Daintree; with Descriptions of the Fossils, by R. Etheridge, F.R.S.—Notes on Atolls or Lagoon Islands: S. J. Whitnell.

SOCIETY OF ARTS, at 8.—On Nuts; their Produce and Uses: P. L. Simmonds.

ROYAL SOCIETY OF LITERATURE, at 4.30.—Anniversary Meeting.

LONDON INSTITUTION, at 12.—Anniversary Meeting.

*THURSDAY*, APRIL 25.

ROYAL SOCIETY, at 8.30.

ROYAL INSTITUTION, at 3.—On Heat and Light: Prof. Tyndall, F.R.S.

LONDON INSTITUTION, at 7.30.—Turner and Mulready: Dr. Liebreich.

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