THURSDAY, JULY 13, 1882

THE GEOLOGY OF CHINA

China: Ergebnisse eigener Reisen und darauf gegründeter Studien. Von F. Freiherrn von Richthofen. Zweiter Band. (Berlin: Reimer, 1882.)

THE second volume of Baron Ferdinand von Richthofen's great work on China has just appeared. Five years have elapsed since the publication of the first volume, and two additional volumes are promised to complete the work, which when its maps and full index have been supplied, will be a great storehouse of observations in almost every department of Geology. Few geologists have enjoyed such opportunities of extended travel as have fallen to the Baron's lot. Already familiar with the rocks of a large part of Central Europe, he carried his knowledge and experience to the far west of North America, and did admirable service there as a pioneer to those who have come after him. Subsequently he set himself to explore the geological structure of the Chinese Empire, and he is now laboriously collecting and arranging the vast materials which he amassed in his wanderings through the almost unknown geological formations of that wide region.

His chapters are arranged in the chronological order of his journeys, and bristle with local details, which, however, are illustrated and made more readily intelligible by numerous sections interspersed through the text, as well as by sheets of coloured profiles. One of the most valuable features of the book for general readers consists in the clear summaries of geological data which for each great district are given in larger type. From these the salient points in the geological structure of the different provinces and their bearing on systematic geology may be gathered by those who have not time to read the voluminous narrative of details. The author confers a further and most welcome boon upon students by appending to his volume a final chapter of "Geological Results," wherein he gives a succinct but clear and interesting outline of what he conceives to have been the leading events in the geological history of China. As this outline is accompanied throughout by references to the pages where each subject will be found treated in ample detail, the reader sees at once where to turn for fuller information.

Baron von Richthofen divides the story of the geological evolution of China into three chief periods. (1) That of the formation and plication of the Archæan rocks; (2) that of the Palæozoic rocks to the end of the Carboniferous epoch; and (3) a vast continental period lasting from Palæozoic time up to the present day. The Archæan gneiss, in highly inclined beds with a persistent N.N.W. strike, is separated from all younger formations by a great abrasion and discordance. It is succeeded by a younger gneiss and by mica-schist, hornblende-schist, quartzite, marble, coarse conglomerate, sandstone, and green slates, some of which can be seen to lie unconformably upon it. These various crystalline masses underwent enormous plication and subsequent denudation before the deposition of the Palæozoic series upon them. They are succeeded by a vast mass of sedimentary material (12,000 to 20,000 feet thick) constituting the "Sinesian Series," in which arenaceous rocks predominate in the lower and calcareous in the upper portions. The occurrence of some forms of *Dikellocephalus* and *Conocephalus* and numerous brachiopods at the top of this series indicates that in part it represents the period of the Primordial Fauna of Europe, and the Potsdam Sandstone of North America. These interesting and important fossils will be fully described in a future volume of the work. It would appear that the denudation of the elevated area of crystalline rocks continued through the Silurian and Devonian periods. In the latter period, or at its close, considerable terrestrial disturbance took place, whereby a general upheaval of the whole area was effected, with plication and fracture in certain tracts. Next came the deposit of the Carboniferous Limestone and of the coal-bearing sandstones shales and marine calcareous bands (with *Productus semireticulatus*) which overlie the limestone. The existence of coal in China was known many years ago, and English steamboats have been in the habit of coaling in Chinese ports from the produce of native workings. But the vast extent and geological relations of the coal-fields have first been made known by our author. One of his maps gives a graphic representation of the enormous area of undisturbed country over which the nearly horizontal coal-bearing measures extend. There are at least two series of coals, one belonging to the true Carboniferous and the other to the Jurassic system.

The close of the Carboniferous period was marked by an equable uprise of the land towards the north and plication in the south, with the outbreak of volcanic eruptions. The result of these movements was the final and persistent transformation of the greater part of China into land. Among the oldest deposits of that ancient terrestrial area are the coal-bearing beds in the northern tracts of Chili and Shansi, which contain land-plants referable to the age of the Upper Jurassic rocks of Europe, and the coal-basin of Ta-tung-fu, the flora of which appears to be of Lower Jurassic age. Among the events of Mesozoic time was the outburst of porphyritic eruptive rocks, with which are associated masses of breccia and tuff.

Some of the most generally interesting portions of the volume are those that deal with the origin of the present surface-features and superficial deposits of China. The author traces the history of the vast depression forming the great plain or basin of China, and of the volcanic activity which took place there and in other parts of the empire during Tertiary and Post-Tertiary time. Those who have seen his first volume will be prepared to find that he ascribes much of the existing configuration of the Chinese Empire to prolonged denudation since the Post-Carboniferous elevation of the region into dry land. He distinguishes three great climatic periods during which the denudation proceeded:—(1) The period of Erosion, in which the existing contours of the firm surface under the Loess were carved out; (2) the period of the Steppes, when the peculiar conditions of the Central Asiatic steppes spread over Northern China; and (3) the period of the Loess, or the duration of the existing meteorological conditions, whereby the former steppe-land is desiccated and converted into loess-land. He is disposed to regard the steppe-period as contemporaneous with the Ice-Age in Europe; but no traces of glaciation occur in Northern China. He reiterates his well-known views regarding the origin of the Loess, and cites a number of authors who have elsewhere been led to the same conclusion, that the deposit is essentially a subaërial one, formed by long-continued wind-drift with the help of vegetation. That this conclusion is true for the high arid regions of Asia and Western America cannot be doubted by any attentive observer who has watched what is now daily going on in either of these regions. In his first volume the Loess was spoken of as "subaërial"—a term altered in the present volume into "æolian," which the author noticed for the first time employed geologically in Mr. Clarence King's Report on the "Exploration of the Fortieth Parallel." It is a very good term, but of much older date than the Baron supposes, for he will find it in Captain Nelson's suggestive paper on the Bahamas, published as far back as 1852.

In a section "Upon Abrasion and Transgression," the author insists upon the paramount influence of the sea as an agent in planing down the surface of the land. "Regional abrasion," he affirms, "can only be accomplished by the advance of the breakers." This used to be also the opinion of geologists in Britain, who from their insular position and stormy climate had exceptional advantages in studying marine denudation. But there is now a wide-spread conviction among them that the part played by the sea in the levelling of land has been much exaggerated. For the production of a plain of erosion the co-operation of the sea is no doubt necessary. But the abrasion of the land down to the level of the sea is the work of the subaërial agents, and only the final touches are given by the breakers. A "plain of marine denudation" is the surface down to which a terrestrial area has been reduced. Its position and form were mainly determined by the lower limit of breaker action. But by far the greatest amount of abrasion was done by wind, rain, frost, rivers, glaciers, and other subaërial forces, which in fact reduce the land to the level at which breaker action could take effect. Oscillations of level might doubtless assist the sea, but any such help would be of comparatively trifling value.

In a final section the author gives a sketch of the coal-fields of Northern China, and analyses of sixty varieties of coal which will be found of some economic interest. He must be congratulated on the appearance of this second volume. The task he has undertaken is a most laborious one; but the method he follows is well suited to combine scrupulous attention to details and general intelligibility and interest. Without ample details his work would be of comparatively little value to those who shall hereafter travel over the same ground to verify, modify, or extend his observations. On the other hand, mere details would repel ordinary readers; but Baron von Richthofen skilfully caters for them in his large print summaries, where they find the points so well put before them as to induce probably not a few to attack the voluminous detail. It is to be hoped that the Baron may find leisure enough to enable him soon to complete the work.

ARCH. GEIKIE

OLD ENGLISH PLANT-NAMES

Sinonoma Bartholomei. A Glossary from a Fourteenth Century Manuscript in the Library of Pembroke College, Oxford. Edited by J. L. G. Mowat, M.A. (Oxford: Clarendon Press, 1882.)

IT is announced that "under the general title of 'Anecdota Oxoniensia,' it is proposed to publish materials, chiefly inedited, taken directly from MSS., those preserved in the Bodleian and other Oxford Libraries to have the first claim to publication." The materials will be issued in four series—(1) Classical, (2) Semitic, (3) Aryan, (4) Mediæval and Modern; and the work named at the head of this notice is the first of the fourth series.

Of the general value of these mediæval glossaries it is of course unnecessary to speak. The "Promptorium Parvulorum" (c. 1440), issued by the Camden Society in 1865, and the Early English Text Society's "Manipulus Vocabulorum" (1570) and "Catholicon Anglicum" (1483)—the latter one of the most recent as it is one of the most useful of their publications—may well be styled priceless records of the English language. Our only regret is that the whole work from which the "Sinonoma" is taken has not been made accessible, as Mr. Mowat's brief preface renders it abundantly evident that it contains much which would be useful, and probably also amusing—if we may judge from the few sample extracts which he gives, one of which refers to the "pulvis pro instrumento illo bellico sive diabolico quod vulgaliter dicitur *gunne*."

The editor tells us that "it was in the plant-names chiefly that [his] interest lay"; and this is easily accounted for when we see how large a proportion words of that class bear to the whole glossary. We have lately had from Prof. Earle an interesting little volume on "English Plant-Names from the Tenth to the Fifteenth Century"; while the "Dictionary of English Plant-Names" by Mr. Holland and myself, of which the third and last part is nearly ready for issue by the English Dialect Society, is, I hope, fairly complete for such names from the days of William Turner downwards. Some day it will, I trust, be found practicable to combine these two, adding to them the names found in "Promptorium Parvulorum" and in other early glossaries, both published and unpublished; and the "Sinonoma" will form a useful adjunct to such a work. There can be no doubt that Mr. Earle's book and the "Dictionary of English Plant-Names" will be found to supplement one another to an extent hardly suspected by Mr. Mowat, who, in spite of his interest in plant-names, does not seem to have consulted the latter work. For instance, he gives "Allium agreste, *i.* crawegarlek," and adds in a footnote "probably meadow-saffron." A *meadow* plant would hardly be termed *agreste;* and a reference to the "Dictionary" would have identified the crowgarlic with *Allium vineale*, which is so called by Turner ("Names of Hebes"), and is, or was, sometimes—*fide* Lisle's "Husbandry" (1757)—as troublesome a weed among corn in England as it is in the continental vineyard from which it took its specific name. Later on (p. 38) we find Mr. Mowat saying of "Allium sylveste" [sylvestre] that it "can be no other than meadow saffron." Here again the designation *sylvestre* should have put the editor on his guard; the reference to Fuchs which he gives shows clearly that some *Allium* was intended, and tracing the synonymy through Bauhin to Linnæus, we find that *A. vineale* is the species meant. Even apart from this evidence, it is obvious that the "sellers of simples" who substituted another herb for *Teucrium Scordium* would have selected one that had a similar smell, and not one like the *Colchicum*, which has no such odour. Mr. Mowat rightly identifies the "gosegresse" of the "Sinonoma" (p. 41) with *Potentilla Anserina;* but it is hardly accurate to say that it is "generally cleavers" (*Galium Aparine*). The "Dictionary of English Plant-Names" shows that the *Potentilla* is at least as frequently called goosegrass nowadays; and it is the "Gosgres" of the Old English Medical MS. printed in Archæologia, vol. xxx. (p. 408)—a glossary containing many plant-names which have been too little noticed. "Caputpurgium, *i.* stafisagria," is not *Pedicularis*, as glossed by Mr. Mowat—a plant supposed to favour the growth of lice—but the Stavesacre, which has been used for destroying them since the days of Pliny. Similarly "Calendula, *i.* solsequium," is not Caltha, but the Marigold, *Calendula officinalis;* this is made quite clear by the description under Kalendula, which may be cited as an example of the capital diagnoses which the glossary contains. "Kalendula est herba crescens in hortis portans florem rubeum vel croceum de quibus floribus faciunt sibi juvenculæ coronas, solsequium idem."

To make a glossary of this kind useful to other than English-speaking students, the plants should be identified with their Latin as well as by their English names. Even in America, the mention of the cowslip would suggest, not *Primula veris* but *Caltha palustris*. Mr. Mowat says (quite correctly) that "pigle, pagle, paigle seems to be the regular old name for cowslip"; and he seems to imply that the entry "pigle, *i.* stichewort," may also refer to *Primula veris*. But a previous entry, "Lingua avis, *i.* stichewort, *i.* pigle," is quite sufficient to confirm the natural conclusion that by stitchwort *Stellaria Holostea* (which is still commonly so called) was intended; and this plant is called pigle by Gerard in his appendix of "names gathered out of ancient written and printed copies, and from the mouthes of plaine and simple countrie people." Under "Serpillum" we find the name "pelestre," which Mr. Mowat queries "palustre?" but this is a form of Pellitory, already given on p. 34—"Piretrum, pelestre idem"—the name "Piretrum" showing that *Anacyclus Pyrethrum*, not *Parietaria*, was intended; the Anacyclus also figures in the Glossary under the name of "Dentaria," in allusion to its former use in toothache. An instance of the insufficiency of English names is given in the gloss of "Umbilicus veneris, *i.* penigresse," as "penny-grass, pennywort"; it is of course *Cotyledon*, not *Hydrocotyle*, which is here meant, though the vernacular names are common to the two plants.

In most cases, however, where Mr. Mowat has given a modern synonym, it is correct; but I do not quite understand why only comparatively few plants are identified, as the identifications are by no means confined to cases of special difficulty. Some very obvious explanations are duly set forward, while in more doubtful cases help is often not forthcoming.

In the volume of Plant-Names which I hope to prepare for the Early English Text Society, I shall try to identify as far as possible all the plant-names, both English and Latin, with their modern scientific equivalents. This will be a tedious work, and one in which mistakes are certain to occur; but a foundation will then have been laid for the future production of a comprehensive work on English plant-names which shall take in all, from the earliest to the most recent. When such a work comes to be done, the great value of collections like this of Mr. Mowat will become apparent. JAMES BRITTEN

LETTERS TO THE EDITOR

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

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

The Analysis of the Tuning Fork

MR. HERMANN SMITH, in a letter in NATURE last week, commenting upon my paper read before the Physical Society on June 10, of which you gave a short report, offers some very cogent experiments in support of the evidence I have endeavoured to give, that the tuning-fork does not communicate its sonorous vibrations to a sounding-board through a *ventroid*, as we find generally accepted upon the theory of Chladni. In remarks upon my paper at the Physical Society, Lord Rayleigh suggested that this matter could be demonstrated by cutting a tuning-fork out in both ends of a long steel bar in the manner I had done, for an experiment, in one end only; we might then observe if sonorous vibrations would be communicated through either of the prongs of the double fork, at the opposite end to that set in vibration. In the following week I constructed such a fork, and I found that either of the non-vibrating prongs, when the opposite ones were set in vibration, would form a perfect stem to the fork, and communicate sonorous vibrations just as well as a single stem. In this case it will be seen that the prongs, which may be considered to form the stem, lead directly to the places on the fork pointed out as its nodes by Chladni. It appears, therefore, evident that a node may communicate sonorous vibration to a sounding-board.

After reading my paper Dr. Stone told me in conversation that he had constructed a tuning-fork with a rod projecting at right angles to the open space between the prongs, and directly from its stem, and that this rod communicated sonorous vibrations from the fork to a sounding-board nearly as perfectly as the direct stem. This modified form of fork I also made by screwing a stem into my experimental fork, which was made in the end of a flat steel bar. I found it to act as Dr. Stone had stated. These experiments appear further to show that sonorous vibrations are communicated through nodes to sounding-boards. If we may apply this principle to stringed instruments, we must look rather to the bridge than the transverse motion of the string, as the communicator of the sonorous vibrations which produces the note. I may say that the discussion of Chladni's theory was not the object of my paper, the purpose of which was to show that the sonorous vibrations forming a note are possibly compounded of vibrations of much smaller amplitude than generally assumed, which was perhaps better demonstrated by other experiments.

W. F. STANLEY

The Mount Pisgah (U.S.) Stone Carvings

THE number of NATURE dated June 15 (p. 160) contains some statements relating to the curious stone carvings discovered by Mr. M. S. Valentine in the neighbourhood of Mount Pisgah, North Carolina, and now exhibited by him in Europe. Before leaving the United States, Mr. Valentine brought his specimens to Washington, in order to have them examined by Prof. Baird, the Director of the United States National Museum, and by myself. I am therefore enabled to express an opinion concerning them. Having been for many years in charge of the largest existing collection of North American antiquities, I can safely assert that they are totally abnormal in character, that is, unlike any pre-Columbian stone carvings thus far found in the United States. They neither show the characteristics of the stone sculptures discovered in mounds, nor do they resemble the well-known specimens of modern Indian art. In short, they are not typical at all, unless, indeed, we deem them sufficiently important to form a type for themselves. Such an importance, however, I cannot concede to them, believing that they originated in comparatively modern, certainly in post-Columbian, times, and were made by a few individuals of the Indian, or, perhaps, even of the Caucasian, race. The rude attempts at imitating animals of the Old World are conclusive evidences that the makers either had seen such animals, or knew at least that they existed.

The carvings, it should further be taken into account, are executed in soft potstone, a material easily yielding to the effects of exposure, and hence a short lapse of time would have sufficed to give them the appearance of real antiquities. In fine, I consider these carvings as a modern intrusion, and would deem it an extremely hazardous attempt to make them the basis for speculations bearing on the ethnology of North America.

CHARLES RAU,
Curator Department of Antiquities,
U.S. National Museum
Smithsonian Institution, Washington, D.C., June 27

The Influence of Light on the Development of Bacteria

IN NATURE for July 12, 1877, there appeared a short communication from Messrs. Downes and Blunt summarising the conclusions at which they had arrived as the result of investigations on the influence of light on the development of lower organisms. The experiments were described in detail in the *Proceedings* of the Royal Society for 1877 (vol. xxvi. p. 488), and were considered by them to show that light is inimical to the development of bacteria in Pasteur's solution; but that for the full effect direct insolation is needed. Exposure to the sun's rays, according to them, may simply retard development, or it may completely sterilise the solution, by killing bacteria or their germs contained in it. In a second paper read before the Royal Society (*Proceedings*, vol. xxviii. p. 199), some further experiments were detailed, which, however, did not, I venture to think, do much towards settling the difficulties of the question. In the same volume of the *Proceedings* (p. 212) Prof. Tyndall supplied observations of his own, which confirmed the conclusions of Messrs. Downes and Blunt, in so far as the retardation of development was concerned, but differed on the point of sterilisation by bacterial destruction being attainable by insolation. At the last meeting of the British Association, Prof. Tyndall returned to the subject (NATURE, September 15, 1881), and related some further experiments confirming what he had previously stated.

I have recently made a considerable series of experiments, with the hope that under our bright Australian sun I might get results decisive on the point of difference between these inquirers and also confirming or negativing the result on which they were agreed. I made use of Cohn's solution as the cultivation fluid and common one-ounce phials as the vessels. The solution was inoculated with a small quantity of fluid swarming with bacteria (*B. termo*), the bottles plugged with cotton wadding and exposed fully to the sun. Some of the experiments were made in the hottest weather of February and March, and the later in April. To begin with, I simply placed the bottles on the outside of a window-sill, on which the sun shone during the greater part of the day, a temperature of 124° F. being noted on one occasion, and that probably not the highest reached. My first results seemed fully to confirm the conclusions of Messrs. Downes and Blunt, complete sterilisation apparently being sometimes attained, at least as far as bacterial growth was concerned, the destruction of mould spores, as also noted by them, not being so easily accomplished. Suspecting at last that the effect might possibly be due as much to elevation of temperature as to any special chemical or other action of the sun's rays, I varied my procedure. I was led to do this in part by the circumstance that I had not seen diffused light check in any way the bacterial growth, when the solution exposed to it was kept at the same temperature approximately as that in other bottles closely wrapped in brown paper. It did happen, indeed, that the exposed solution became opalescent *sooner* than that which had been guarded. The method ultimately adopted was, to suspend the bottle outside of a window, and the particulars of one experiment will make clear what resulted, and show the general method. On April 6, at 2 p.m., the weather being bright but cool, these bottles, containing each two drachms of inoculated solution, were suspended outside of a window. The 7th was cloudy, the 8th bright and cool; and on the 9th, which was bright and warm, all were still found transparent, and, at 9 a.m., one was brought in out of the sun. On the 10th, which was also bright, another was taken in at 9 a.m., the one which was left out showing, at that time, faint signs of cloudiness. A thermometer hung up beside it marked a temperature of 98° F. Next day, the 11th, at 9 a.m., the exposed solution was quite milky, the others just beginning to show traces of opalescence, the one removed on the 9th being least advanced. This experiment, even by itself, was almost decisive. It established the fact that insolation by itself does not prevent the growth of bacteria in a perfectly transparent medium, and does not even retard it, relatively to the time needed in solution less exposed, but kept at a rather lower temperature. In another experiment I found two bottles continuously exposed to the sun during two bright days, become milky, the bacterial growth, in fact, only beginning then, no trace of cloudiness having shown itself during five previous days which were dark and cold.

The conclusion I came to of necessity was, that the bacterial development was mainly, if not wholly, dependent on temperature. On referring to a paper by Dr. Ed. Eidam, in Cohn's *Beiträge zur Biologie der Pflanzen*, Heft iii., I found that he had proved that the *bacterium termo* passes into a torpid condition (Wärmestarre), when exposed to a temperature of between 40° and 45° C. (104°–113° F.); is killed by seven days exposure at 45° C., by fourteen hours at 47° C. (116° 3 F.), by three to four hours at 50°–52° C. (122°–125·6° F.), and by one hour at 60° C. (140° F.). In this country there need be no difficulty in getting a heat in the sun, greater than even the highest of these; and I should think it possible enough in England, on a hot summer day, to get a temperature in exposed situations considerably over 104° F., sufficient to paralyse the bacteria, or even to kill them, if the exposure was long enough continued. Any explanation of the difference between the results of Messrs. Downes and Blunt, and those of Prof. Tyndall, on the point of complete sterilisation, is simply that, while they used small test-tubes, his solutions were contained in flasks, and that the larger body of fluid less easily reached the highest temperature attainable under the conditions. The different results, with very small and larger tubes, observed by the former, and to them evidently inexplicable, if not simply accidental, is best explained on the same principle.

It is true that Prof. Tyndall agrees with the other inquirers in disclaiming the notion that the apparently inimical influence of light can be ascribed to difference of temperature; but it is evident that it had not occurred to them, that any possible elevation of temperature could act otherwise than by favouring bacterial growth and multiplication. This is plain, from the words used by Messrs. Downes and Blunt (*Proceedings*, vol. xxvi. p. 491), when, trying to account for some anomaly, they remark that "external conditions—notably temperature—may retard or counteract the preservative quality of the solar rays. It must be understood, however, that the putrefactive tendency of warmth does not, in our experience, with this solution at least, override what we termed the preservative quality of light; for, provided that there was the full amount of sunlight, we have preserved tubes exposed *continuously* from day to day as readily in hot weather as in cool." Prof. Tyndall, in his recent paper, speaks of his flasks having been exposed to strong sunshine for a whole summer's day; and, with reference to the more rapid occurrence of turbidity in those which had been shaded, adds: "This result is not due to mere difference of temperature between the infusions. On many occasions the temperature of the exposed flasks was far more favourable to the development of life than that of the shaded ones."

I feel the boldness of criticising the conclusions aimed at by such a famous investigator as Tyndall, and all the more when these are in accord, in the main, with those of other inquirers, the joint results having hitherto, to all appearance, been accepted as unimpeachable. I do so only after careful observation and consideration, and with the hope that further investigations, made with due precautions, will establish the correctness of what I have here stated. My researches in detail will be brought before the Royal Society of Victoria at the next meeting, and I will take the liberty of forwarding you a copy of the paper when printed, and of distributing a few others. It contains an account of experiments for the purpose of testing the action of sun and air on dried bacteria, which have some interest, but which the fear of trespassing unduly on your space prevents me from entering on here. JAMES JAMIESON

Melbourne, May 22

Fireballs observed in the Netherlands

IN the well-known "Meteoric Astronomy" of Dr. D. Kirkman, p. 67, is to be found the following note, on the occasion of the interesting shower of dust and aërolites in Calabria on the 13th and 14th of March, 1813. "The date of this remarkable occurrence is worthy of note, as a probable aërolite epoch. From the 12th to the 15th of March we have the following falls of meteoric stones. . . ." &c. (7 cases).

In reference to this note it may interest your readers that on the night of 12-13 March last two great meteors were observed in two different places in the Netherlands. The first observation, made near the village of Haren (four and a half kilom. S. of Groningen), by the schoolmaster, Mr. H. Bos, at 1 a.m., refers to a bright fireball, shining with a splendid "bluish red" light, illuminating the night, leaving a violet train, which lasted some moments. The path seems to have been from a point not far beneath the zenith, in an azimuth of 115° to another at 108° azimuth, and had a length of 45°, which was traversed by the phenomenon in 4 or 5 seconds. After 85 seconds—measured afterwards by means of a watch and by the distance of the objects which the observer had passed, going with a known velocity—a full detonation, like a distant cannon-shot, was heard in the same direction.

On the same night, and at the same hour, another fireball was seen near the village of Bergen, in North Holland. The schoolmaster, J. Francken, gives me the following indications of its path, found by him after having interviewed the observer. It went from N.E. in altitude of 50° to S.E. in an altitude of a little less than 40° It is therefore impossible that this phenomenon should be the same as the former, the direction of the course being opposite. A second observer gave nearly the same direction.

It is worthy of remark that another violet meteor had been seen near Haren on March 12 at 8 p.m. in the S.W.[1]

A fourth meteor of the greatest size, described as being as great as the full moon, was seen by three policemen, from whom I have received tolerably harmonising records, though they were standing in different positions in the town. The time of appearance was May 1, at 4 a.m. precisely, or perhaps three minutes afterwards, and the direction of the course was S.S.E. to N.N.E. It was described by one of the observers as beginning like a shooting star (though already lightening the sky), falling downwards and rising again in a curve from S.S.E. to N.N.E., increasing in the meanwhile to a great ball of a splendid purple light, and showing a train of a silvery colour. The phenomenon lasted 50 seconds (?) measured by a watch. No sound was heard. The disappearance was instantaneous. It is uncertain if an explosion was really observed. The altitude seems to have been at the beginning, and at the end point perhaps 10°, somewhat higher in the middle, as I have attempted to determine *in loco*. The second observer estimated the duration of the phenomenon to be 13 seconds. Even when this is accepted, the body must have been very distant, and of a great volume, though increased apparently by irradiation.

The same morning, at 3h. 45m. a.m. there was also seen a great meteor, going from W. to E. near Enumatil (8 kilom. W.), and at Assen (S. from Groningen). It seems not to be identical with the former. At Assen there was heard a buzzing sound. The Enumatil observers compare the phenomenon, whose colour was white with a red train, to a drum-major's staff. The Assen observers speak of a bluish train or tail, which seemed to be smoke. The same was seen by the sluice-keeper, G. Mulder, at Veenhuizen (W. of Assen), who heard also the buzzing sound, and gives also the direction, W.—E. The ball passed S. of the zenith (Assen).

Still another great fireball was observed at Bourtange (S.E. of Groningen) at 5h. 12m. (local time) a.m. on the same morning. It had a quick motion from S.W. to E. It gave the impression of being very near the earth, only some meters above the houses. It seems to me uncertain whether it was a globulous lightning or a true fireball. The phenomenon showed a fiery tail and exploded without any sound.

Recapitulating, there seems to have been observed the following fireballs of great size:—

March 12,	8 p.m.	(Groningen M.T.)	at	Haren.	
,, 13,	1 a.m.	,,	,,	,,	
,, 13,	,,	,,		Bergen (N. Holland).	
May 1,	3.45 ,,	,,	,,	Enumatil.	
,,	,,	,,	,,	Assen	} Probably
,,	,,	,,	,,	Veenhuizen	} the same.
,, 4,	,,	,,	,,	Groningen.	

Finally a fireball or a globulous lightning.

May 1, 3 45 a.m. (Groningen M.T.) at Bourtange.

Groningen, June 19 H. J. H. GRONEMAN

[1] In the German journal, *Sirius*, edited by Dr. H. J. Klein, Bd. x. (1882), p. 40, is mentioned likewise a fireball of the full moon size, from March 13, 1875, by Mr. T. Köhl.

Aluminium for Movable Coils

AT the Oxford meeting of the Physical Society, after Dr. W. H. Stone's interesting description of an electrodynamometer designed for medical purposes with the movable coil, made of aluminium wire for the sake of lightness, I took the liberty to remark that about eight years ago Dr. Werner Siemens had made use of aluminium wire for the movable bobbin of his *dynamo-relay*.

I was then under the impression that this fact was probably not known in this country; a friend has, however, since called my attention to a short paragraph in the *Telegraphic Journal* of 1878, p. 53, in which it is already mentioned.

One of these dynamo-relays was shown working at the Paris Electrical Exhibition, and Messrs. Siemens and Halske have made use of the same principle in their so-called *soot-recorder* (see *Telegraphic Journal*, 1878, p. 90), an instrument well suited for the registration of currents of varying direction and strength.

At the meeting I further said that in some of the coils made of very thin aluminium wire, I had found an increase of resistance after the lapse of some time, and that this increase was proved to exist at the place where two lengths of wire had been joined by twisting them round each other.

Some experiments were afterwards made to coat the ends of the wire with an electrolytic deposit of copper, and then solder them together; but the best and most natural way to overcome the difficulty is to make the coil all of one length of wire, and thereby dispense with all internal joints.

A similar increase of resistance at the place of contact between aluminium wire and mercury I had already observed several years previously; the cause of it seems to be the formation of a very thin film of aluminium oxide on the surface of the wire.

I have been led to make the above remarks after perusing the closing paragraph of Dr. Stone's article in NATURE, vol. xxvi. p. 201. EUGENE OBACH

Woolwich, July 3

The Recent Weather

THE article published in NATURE, vol. xxv. p. 225, entitled "Recent Weather," attracted attention from meteorologists in China from the fact that the extraordinary character of the season therein discussed was observable in China also In my Report on the Health of Wenchau, I referred to the unprecedentedly high reading of the barometer in this part of the world, at the same time that a like phenomenon was observed in Western Europe.

NATURE records that November last showed the highest thermometrical range that has been known since thermometers came into use. On referring to the tables of Dr. Zrightsche (director of the Belgian Observatory at Peking), I find that the mean temperature at Shanghai of that month for a period of twelve years falls considerably below that of the record for November last; and finally we learn from NATURE that the winter of 1881–82 in Western Europe was an "open one," which was the case in Eastern Asia; the port of Tientsin, for example, having been closed by ice later, and opened to navigation earlier than usual. When the meteorological reports are all gathered in, it will be found that the abnormalities which characterised last winter were coincident with like phenomena in this part of the world. D. J. MACGOWAN

Wenchau, May 17

"Megaceros Hibernicus" in Peat

MY friend, Dr. Leith Adams, has given it as his opinion that the Irish elk is only found in the clay or marl under the peat, while I contended that some of them occur in the peat, this opinion being formed from reports of finds in the counties of Limerick, Carlow, and Wexford, also from the colour and appearance of the bones; still I could not be positive, as I had not myself seen the bones raised out of the peat. Last week, however, I heard from Capt. Woodrift, Kilowen Inch, Co. Wexford, that he had found an elk's head in the peat, and I went to see it. It was lying on its back altogether in the peat, except some of the points of the horns. The portions in the clay under the peat were quite hard, while those in the peat were soft, but became quite hard a short time after they were taken out.

The "Elk Hole" at Kilowen is a very remarkable place, because, although very small, not 200 yards in diameter, yet at the present time the remains of over ten skeletons of elks have been taken out of it; while in the undisturbed portion of the bog there are probably other skeletons. A few miles to the south-west of Kilowen there is the small bog of Axe, in which the remains of the *C. megaceros* has also been found.

Ovoca, July 8 G. H. KINAHAN

Perception of Colour

HAPPENING to be reading out of doors, while the sun was shining on my book, I noticed that patches of weed on the lawn appeared peculiarly conspicuous in their difference of tint from the grass. The same patches of weed close-cropped to the level of the grass were ordinarily scarcely observable from difference of colour. Now, as I looked up from my book—my eyes dazzled with the glare—they appeared to me to have a strong blue tint. My attention thus being drawn to the point, I extended my observations, with the following results, which, if new, will doubtless prove interesting to some of your readers. I found that if the eye was exposed for two or three minutes to the action of a very strong light, *by looking at a sheet of white paper*, while bright sunshine fell on it, the capacity of the eye for perception of colour was curiously modified, under certain conditions. For example: if, on the instant after the exposure of the eye to strong light, as described—solarisation I will call it—flowers of various colours, placed in a shady part of a room were examined, a pink rose appeared the colour of lavender; dark crimson Sweet William, almost black; magenta Snapdragon, indigo; scarlet Poppy, orange; the eye was, in fact, red-blind. After a minute or two, the eye recovered its normal sensibility to red, and the flowers assumed their natural colour.

In order to ascertain that the mal-perception of colour, under the conditions described, was due to the action of strong light on the eye, and not to any other circumstance, I repeated the experiment, allowing the solarisation to take place on one eye only, the other eye being kept shut until the moment of making the observation. I then found, as before, that the solarised eye was red-blind to objects in a subdued light for a minute or two after solarisation, but sensitive to blue, and in less degree to yellow, while the non-solarised eye was perfectly normal in its perception of all the colours. By alternately closing and opening the solarised and non-solarised eye, the difference in colours perceived by the two eyes was extremely striking—the rose was, as seen by one eye, pink, by the other eye, blue. It must be remembered that the effects described were produced when the flowers were observed in a room not strongly lighted.

When a corresponding experiment was made with the flowers *in the sunshine* instead of in the shade, it was found that a reverse effect was produced—that every colour, and red particular, was intenser to the solarised eye than to the non-solarised eye—as was readily seen by alternately shutting and opening them. To the solarised eye a red rose-bud was deep red, to the other eye light red. The red of the poppy was deeper and more vivid to the solarised eye. A calceolaria was orange chrome to the solarised eye, lemon chrome to the non-solarised eye. A viola was dark violet to the solarised eye, a colder tone of blue to the non-solarised eye.

I found that after the insensibility to dimly lighted red and orange (the effect of solarisation) had worn off, a reverse condition succeeded, for example, venetian red, which was a dirty brown, as seen the instant after solarisation, appeared gradually to change to a full vermillion. I found also that portions of the solarised eye that had escaped the solarising action behaved like the non-solarised eye. I leave the explanation of these slight observations to those within whose special field of study they naturally fall, only remarking that the power of the eye, fatigued by solarisation to perceive blue light, and light of no other colour, under the conditions described, seems to suggest that the eye, like almost all matter sensitive to light, is more sensitive to blue rays than rays of lower refrangibility.

Lancing, July 10 J. W. SWAN

WATER-JET PROPELLERS

VERY early in the history of steam navigation, attempts were made to employ the "hydraulic" or "water-jet" propeller. About 1782 Rumsey began to work in this direction, using a steam-engine to force water out at the stern of a boat, the inlet being at the bow. His experiments are said to have extended over twenty years, but led to no practical result. Another American, named Livingston, applied the same principle of propulsion in a different manner. A horizontal wheel, or turbine, was placed in the bottom of the boat, near the middle of the length, the water was admitted from beneath it, and expelled from the periphery of the wheel through an opening at the after part of the boat. In 1798 a monopoly was granted to Livingston for twenty years by the State of New York, on condition that within a given period he produced a vessel capable of attaining the speed of four miles an hour. This condition was not fulfilled, and, as is well known, the first successful steamers built in this country or abroad were propelled by paddle wheels. This form of propeller alone was employed for nearly forty years, during which period steam-ships increased greatly in numbers, size, and speed, proving themselves well adapted not merely for service on inland and coasting navigation, but also for ocean voyages. Just when the Transatlantic steam service had been successfully commenced by the *Great Western* and *Sirius*, both paddle steamers, the screw-propeller began to threaten the supremacy of the paddle-wheel; and the success of the *Archimedes* in 1840 led to the adoption of the screw in the *Great Britain*, as well as the construction of the screw sloop *Rattler* for the Royal Navy. Soon after came a revival of the water-jet propeller by the Messrs. Ruthven of Edinburgh. In 1843 their first vessel was tried, attaining a speed of about seven miles an hour. Ten years later a fishing-vessel was built on the same principle, and exceeded nine miles an hour. Several other river steamers and small craft were constructed with jet-propellers in the period 1853-65, but they were all comparatively slow, and the plan did not grow into favour either as a substitute for the paddle-wheel or the screw.

There were certain features in the jet-propeller which recommended it to the judgment of many naval officers who had witnessed the trials of vessels so fitted; their influence led the Admiralty in 1865 to order the construction of a small armoured vessel, appropriately named the *Waterwitch*, which was to be fitted with Ruthven's propeller. Admiral Sir George Eliot was one of the principal advocates of a trial of the new system, in which he has always continued to take a great interest. In the German navy, trials of the Ruthven system have also been made on a small vessel named the *Rival*, and experiments of a similar nature have been made in Sweden. At the present time Messrs. Thornycroft are building for the Admiralty a torpedo-boat, to be propelled by water-jets, the trials of which are awaited with interest, since they will furnish another comparison between the performances of the hydraulic propeller and the screw.

The Ruthven system agrees in its main features with the proposal made by Livingston forty years earlier. As an example the arrangements of the *Waterwitch* may be briefly described. Openings are made in the bottom of the ship amidships, to admit the water into a powerful centrifugal pump or turbine, the axis of which is vertical.

The main engines drive the turbine, expelling the water with considerable velocity through curved pipes or passages leading to "nozzles" placed on each side at the level of the water-surface. When the vessel is going ahead the jets are delivered sternwards; if it is desired to move astern the engines are not reversed, but valves are operated in the outlet pipes, and the jets are delivered through the forward ends of the nozzles. These motions of the valves can be made from the deck by an officer in command. If desired, the jet on one side can be delivered ahead, and that on the other side astern, the vessel then turning without headway. This power of control over the movements of the vessel, without reversing the engines, is one of the chief advantages claimed for the system; and it is undoubtedly of value, especially in war-ships. Another advantage claimed for the jet-propeller is the power of turning it on an emergency, into a powerful pump, by which large quantities of water can be discharged from the interior of a ship that has been damaged in action. This latter feature cannot be regarded as of primary importance, however, seeing that modern war-ships are minutely sub-divided into water-tight compartments, and must depend for their flotation upon the integrity of the bulkheads and other partitions, if their skins have been broken through by ramming or torpedo-explosions. A further claim on behalf of the jet-propeller for war-ships is based upon the less risk of disablement in action, as compared with screws or paddle-wheels; and this claim may be admitted. On the other side must be set the fact that all the trials made hitherto in vessels fitted on the Ruthven system have shown a less speed for a given amount of engine-power than would have been obtained with the screw-propeller. It may be urged, of course, that the decrease in speed should be accepted, at least in special cases, in order to secure the undoubted benefit of the hydraulic system. But the general feeling of naval architects and marine engineers is in favour of the use of twin-screws rather than water-jets for war-ships, the duplication of machinery and propellers decreasing the risk of disablement, giving great manœuvring power, and securing higher speed than could be obtained with the jet propeller.

Recently further trials have been made with a vessel built in Germany, from the designs of Dr. Fleischer, who claims to have devised a novel and more efficient system of hydraulic propulsion. A brief notice of the invention appeared in NATURE, vol. xxvi., p. 18; fuller details are to be found in two pamphlets published by the inventor: "Der Hydromotor," and "Die Physik des Hydromotors" (Kiel, 1881). The first of these pamphlets contains a general description of the system, as applied in the *Hydromotor* (a vessel of 110 feet in length, and about 100 tons displacement), a summary of her trials, compared with those of earlier vessels engined on Ruthven's system, and an enumeration of the advantages to be obtained by using jet-propellers instead of screws or paddles. The second pamphlet contains a statement of the experimental and mathematical investigations conducted by Dr. Fleischer in working out his system.

Dr. Fleischer dispenses with a turbine, and allows the steam to act directly upon the water in two large vertical cylinders placed amidships. These two cylinders communicate with the ejecting nozzles which are situated on either side of the keel. In each cylinder there is a "float" or piston of nearly the same diameter as the cylinder, with a closed spherical top; when this float is in its extreme upper position, the cylinder is full of water. Steam is then admitted into the upper part of the cylinder above the float, the latter is pressed down, and the water is expelled through the nozzle-pipe with great velocity. At a certain portion of the stroke, the admission of steam is shut off automatically, the remainder of the stroke being performed during the expansion of the steam, and the velocity of ejection of the water gradually diminishing. At the conclusion of the stroke, the exhaust-valve from the steam space to the condenser is opened, the steam rushes out, forming a partial vacuum above the float, and the water enters, pressing the float up. The entry of the water at this stage is partly through the nozzle, and partly from a separate valve communicating with the water-space of the surface condenser. In order to utilise the vacuum as much as possible, and to increase the effective "head" of water during the down stroke, the cylinders are placed as high as convenient in the vessel. Two cylinders acting alternately were used in the *Hydromotor*, for larger or swifter vessels it is proposed to use a greater number of similar cylinders. As in other jet-propelled vessels valves operated from the deck enable the commanding officer to reverse the direction of outflow of either or both jets, making the vessel move ahead or astern, or turn on her centre. The position of the nozzles in the *Hydromotor* is not so favourable to manœuvring power as in the *Waterwitch*, and the difference in behaviour is likely to be appreciable.

Greater interest attaches to the trials of speed than to those of turning. Unfortunately the records are too meagre to enable a decisive opinion to be formed on the merits of the new system as compared with that of Ruthven. Dr. Fleischer claims that the *Hydromotor* attained a speed of 9 knots with 100 indicated horse-power; but the conditions under which this speed was attained may have differed considerably from those under which measured-mile speed trials are conducted in this country. Any exact comparison of the performances of two steamships with either similar or different systems of propulsion, demands as its basis the elimination of all varying conditions, the determination of the true mean speed, and the calculation of the engine-power corresponding to that speed. Dr. Fleischer may have done all this, but it does not clearly appear in his publications whether he has or not. He distinctly claims for his system a very high "efficiency" as compared with that of Ruthven, but it will be shown hereafter that the formula which he uses is not absolutely correct; and what is more important to note is the circumstance that Dr. Fleischer clearly does not possess the experimental data respecting the resistance offered by the water to the motion of the *Hydromotor* when towed at various speeds, which would enable him to express the true efficiency of the propelling apparatus. On this point a few further remarks may be permittted.

Supposing a vessel to be towed at any speed, and her resistance to be ascertained by a dynamometer, the horse-power expended in overcoming that resistance can be calculated, and. in the terminology of the late Mr. Froude, is styled the "effective horse-power." Next let it be supposed that the vessel is driven at the same speed by her own machinery, and that the "indicated horse-power" in the cylinders is ascertained. The ratio of the "effective" to the "indicated" horse-power expresses the true efficiency of the propelling apparatus, excluding from the account, of course, the efficiency of the boilers. Now what has been said above respecting Dr. Fleischer's figures simply amounts to this: he does not appear to have ascertained the effective horse-power of the *Hydromotor*, and consequently cannot express the true efficiency except as an estimate.

The excess of the indicated horse-power over the effective in any steam-ship is to be accounted for by the waste-work of the mechanism, the waste-work of the propellers, and the "augment" of the tow-rope resistance produced by the action of the propellers. In good examples of screw-steamers the effective horse-power at full speed has been found to vary from 40 to 60 per cent. of the indicated power. Dr. Fleischer claims for the *Hydromotor* a corresponding efficiency of about 34 per cent. at full speed; but not, it would seem, with any certainty.

Passing by this comparison with screw-propelled ships, the *Hydromotor* may be compared with the *Waterwitch*. She gains upon the latter obviously in the avoidance of much waste-work in the mechanism In the Ruthven system there is necessarily more waste-work in the engines which drive the turbines, and in the friction of the water in the turbines and passages to the nozzles, than has to be incurred in the Fleischer system. On the other hand, in the latter system, there must be some loss from condensation of steam in the cylinders, and the high mean velocity of ejection must be a disadvantage. The considerable variations in the velocity of ejection at different parts of the stroke must also be a disadvantage, as compared with the uniform velocity of delivery from a turbine. Respecting the condensation it is asserted, as the result of experiment, that the losses are exceedingly small, the cylinders being wood-lined, and a layer of hot water being formed below the float. Experienced engineers were scarcely prepared for this satisfactory result, anticipating that more serious losses would occur from the alternate heating and cooling of the cylinders. Of course, experience in such a matter is the true test; but it is to be observed that the *Hydromotor* appears to have very ample boiler-power in relation to the indicated horse-power assigned to her maximum speed. Losses from condensation cannot be estimated from the statement of indicated horse-power. The indicator diagrams which have been published, show a very good performance.

The varying rate of outflow through the nozzles must be a source of disadvantage in the Fleischer system. For the hydromotor it is stated that the *mean* velocity of outflow was about 66 feet per second when the speed of the vessel was about 15 feet per second. We are not informed what was the maximum velocity of outflow; the minimum velocity is said to have exceeded the speed of the vessel. This varying velocity, of course, carries with it a varying thrust, and the hydromotor in this respect must be less favourable to uniform motion of the ship than the screw or paddle or Ruthven propeller, where the thrust can be kept practically constant. With two cylinders this might be more felt than with four or more cylinders, but in all cases the drawback must exist.

The high mean rate of outflow involved in the Fleischer system is contrary to the generally accepted view as to the condition most favourable to efficiency. For a given speed of ship, neglecting the augment of tow-rope resistance which may be caused by the action of the propeller, there must be a certain thrust developed, which will overcome the resistance of the water to the advance of the ship. This thrust in the jet-propeller is measured by the sternward momentum generated in the jets. No matter how the mechanism may be arranged, what has to be done by it is to impart to water which has entered the ship and acquired her forward velocity, a sternward momentum which shall have a reaction equal and opposite to the fluid resistance. Momentum, it need hardly be explained, involves the consideration both of the weight of the water acted upon and of the velocity imparted to it in each unit of time. Nor is it possible to create this momentum in the water expelled from the nozzles without doing waste-work in overcoming frictional and other resistances. The magnitude of this waste work may vary greatly in different examples, and it is difficult to estimate its value apart from experiment. Hence in theoretical investigations, this waste-work is usually neglected, although in practice it is of great importance.

Leaving out of account for the moment this waste-work, and the possible influence upon the efficiency of the propeller exercised by the disturbance produced in the surrounding water by the passage of the ship, it may be well to explain briefly the accepted theory of the action of jet-propellers. This is done in the following equations:—

Let V = the speed of outflow of the jets from the nozzles in feet per second, v = the speed of advance of the ship, A = the joint sectional area of the nozzles in square feet, w = weight in lbs. of a cubic foot of water. Then—

Cubic feet of water acted upon per second $= A \,.\, V$.

Sternward velocity of jets in relation to still water $= V - v$.

Thrust, or momentum created per second $= \frac{w}{g} \,.\, A \,.\, V \,.\, (V - v)$,

where g is the accelerating force of gravity—say 32 feet per second. For sea-water $w = 64$; so that $w \div g = 2$ (nearly) Hence

$$\text{Thrust (in sea-water)} = 2\,A \,.\, V \,.\, (V - v).$$

Under the foregoing assumptions, we also have

U = Useful work of propeller (in unit of time) = work done in propelling ship.
$=$ Thrust $\times$ speed of ship.
$= 2\,A\,V\,(V - v) \,.\, v$.

W = waste work in race $= \frac{1}{2}$ *vis viva*.
$= A\,V \,.\, (V - v)^2$.

$U + W$ = total work of propeller $= 2\,A\,V\,(V - v)\,v + A\,V\,(V - v)^2$
$= A\,V\,(V^2 - v^2)$.

$$\text{Efficiency} = \frac{U}{U + W} = \frac{2\,v}{V + v}.$$

From the last of these equations it is seen that the more nearly the velocity of outflow V approaches the speed of the ship v, the nearer will the efficiency approach its maximum value, or unity. Moreover, for given values of speed of ship and *thrust*, if the difference $(V - v)$ between the speeds of outflow and advance is diminished, the area of the outlets must be correspondingly increased. That is to say, if the value of $V - v$ is diminished, the *quantity of water* $(A \,.\, V)$ operated upon must be increased. Now, in general, it has been supposed that the inferior performance of jet-propelled vessels, as compared with screw steamers was due to the small quantities of water acted upon, In the *Waterwitch*, for example, about 150 cubic feet of water were expelled per second, whereas in the rival twin-screw vessel *Viper* more than 2000 cubic feet of water were operated upon per second. In the *Waterwitch* $V = 30$ feet per second, and $v = 15{\cdot}7$ feet per second; so that according to the foregoing formula

$$\text{Efficiency} = \frac{2 \times 15{\cdot}7}{15{\cdot}7 + 30} = \frac{31{\cdot}4}{45{\cdot}7} = 68{\cdot}7 \text{ per cent.}$$

In the *Hydromotor* $V = 66$ feet (mean velocity) $v = 15{\cdot}2$.

$$\text{Efficiency} = \frac{2 \times 15{\cdot}2}{15{\cdot}2 + 66} = \frac{30{\cdot}4}{81{\cdot}2} = 37{\cdot}4 \text{ per cent.}$$

Dr. Fleischer adopts the foregoing equations, so far as they relate to *thrust* and *useful work*, but for the *total work* he uses another formula, and it is here that we venture to think he goes wrong. According to his investigation—

Total work $= \frac{1}{2}$ *vis viva* of issuing streams.
$= \frac{1}{2} \times$ Mass of water delivered per second $\times$ (speed of outflow)^2.
$= \frac{1}{2} \times 2\,A\,V \times V^2$.

Hence he writes—

$$\text{Efficiency} = \frac{\text{Useful work}}{\text{Total work}} = \frac{2\,A\,V\,(V - v)}{2\,A\,V \times \frac{1}{2}\,V^2}$$
$$= \frac{2\,V}{v^2}\,(V - v).$$

In thus dealing with the total work, instead of using the expression given above, Dr. Fleischer virtually ignores the fact that the vessel is in motion ahead; and that the streams issuing from the nozzles have the velocity V only relatively to her. It is upon this questionable formula for the efficiency that his estimates above-mentioned are based. For example, in the hydromotor at 9 knots, according to Dr. Fleischer—

$$\text{Efficiency} = \frac{2 \times 15{\cdot}2}{(66)^2}(66 - 15{\cdot}2) = 35{\cdot}4 \text{ per cent.}$$

If the same formula is applied to the *Waterwitch*, at 9·3 knots—

$$\text{Efficiency} = \frac{2 \times 15{\cdot}7}{(30)^2}(30 - 15{\cdot}7) = 49{\cdot}9 \text{ per cent.,}$$

giving about 20 per cent. less efficiency to that vessel, than is given by the accepted formula first stated.

It has been explained that the assumptions upon which the first formula rests are not fairly representative of the conditions of practice. For example, the deduction therefrom (stated above), that it is advantageous to operate upon larger quantities of water, and to reduce the excess in speed of outflow above the speed of the ship requires an important qualification in practice This deduction would be absolutely correct were it not for the waste-work which has to be done in giving the motion to the water; but in actual practice the growth in that waste work may exceed the gain obtained by dealing with larger quantities of water. The parallel case in a screw steamer is that wherein screws of too large diameter or too large surface may involve so much more waste work on frictional or edgewise resistances, that it is preferable to use smaller screws, which operate on smaller quantities of water, but secure a more economical expenditure of power for a given speed, or enable higher speeds to be attained with a given horse-power. In setting aside the commonly received view, and making trial of a system wherein the mean velocity of the outflowing jets is extremely great, while the quantity of water operated on is small, Dr. Fleischer has made an experiment of the greatest interest to all concerned with steam propulsion. If his figures are accepted it is obvious that his system involves much less waste work than the Ruthven system, between the power indicated in the cylinders and the power accounted for in the outflowing jets. On the other hand, as we have endeavoured to explain, this economy of the Fleischer system does not represent the comparative efficiency of the propelling apparatus: because the high and variable velocity of outflow must involve a considerable amount of waste work in the race. A complete comparison could only be made if in the same vessel, or in two vessels of identical form and with identical boiler-power, there were fitted, first, the Fleischer hydromotor; and secondly, the Ruthven arrangement. Then with the same steam-producing power a careful series of trials would settle the matter conclusively. The Swedes did something of this kind in order to compare the efficiencies of twin-screws and water-jets, with the result that the latter were shown to be greatly inferior. Of course it cannot be expected that Dr. Fleischer would undertake such trials unaided; on the other hand, if his system is put forward for adoption in preference to the Ruthven system, it must, at least, be shown to be more efficient, not only in certain intermediate stages in the operations of giving momentum to the jets, but as a whole. This result does not appear to have been attained as yet, so far as can be judged from the published results of trials. The information which is accessible is not complete, and some of the proposed standards of comparison are open to doubt. It is to be hoped, however, that the zeal and ability which have been displayed already by Dr. Fleischer will be still further illustrated in the continued investigation of the capabilities of his novel system of propulsion.

W. H. WHITE

A RAPID-VIEW INSTRUMENT FOR MOMENTARY ATTITUDES

THE wonderful photographs by Muybridge of the horse in motion and those by Maret of the bird on the wing induced me to attempt the construction of apparatus by which the otherwise unassisted eye could verify their results and catch other transient phases of rapid gesture. Its execution has proved unexpectedly easy, and the result is that even the rudest of the instruments I have used is sufficient for the former purpose; it will even show the wheel of a bicycle at full speed as a well-defined and apparently stationary object. This little apparatus may prove to be an important instrument of research in the hands of observers of beasts, birds and insects, and of physicists who investigate such subjects as the behaviour of fluids in motion.

My object was (1) to transmit a brief glimpse of a moving body, (2) to transmit two or more such glimpses separated by very short intervals, and to cause the successive images to appear as simultaneous pictures in separate compartments in the same field of view.

The power of the eye to be impressed by a glimpse of very brief duration has not, I think, been duly recognized. Its sensitivity is vastly superior to that of a so-called "instanteous" photographic plate when exposed in a camera, but it is of a different quality, because the impression induced at each instant of time upon the eye lasts barely for the tenth of a second, whereas that upon a photographic plate is accumulative. There is a continual and rapid leakage of the effect of light upon the eye that wastes the continual supply of stimulus, so that the brightness of the sensorial image at any moment is no more than the sum of a series of infinitesimally short impressions received during the past (say) tenth of a second, of which the most recent is the brightest, the earliest is the faintest, and the intermediate ones have intermediate degrees of strength according to some law, which an apparatus I shall describe gives us means of investigating. After the lapse of one-tenth of a second the capacity of the eye to receive a stronger impression has become saturated, and though the gaze may be indefinitely prolonged the image will become no brighter unless the illumination is increased.

This being premised, let us compare the sensitivity of the eye with that of the rapid plate in the photographic camera under conditions in which the eye is just capable of obtaining a clear view, let us say during an overcast day in a sitting room whose window does not occupy more than one-thirtieth of the total area of wall and ceiling, which is the light under which most of us habitually write and read. A glimpse under these circumstances of one-tenth of a second in duration, suffices, as we have just seen, to give a clear view, but the sensitive photographic plates sold in the shops as "instantaneous" will not give a portrait in that light under thirty seconds exposure. In other words, the sensitivity of the eye is fully 300 times as great as that of the plate. Of course I am aware that more sensitive plates than these have been made, and I have seen a rapidly revolving wheel photograped under the momentary illumination of an electric spark, but I have never heard of that being done when at the same time the revolving wheel was not perfectly distinct to the eye.

The range of ordinary illumination is very great. The photographer who requires thirty seconds in a dim window-light, would photograph clouds in some minute fraction of a second, showing that the illumination of the latter is fully one thousand-fold greater. If then the eye has been shaded and adapted to a dim light, an object in bright sunshine may require no more than the thousandth part of the tenth of a second to be visible, and in saying this, I am confident that I am underestimating what could be done. Consider what even this means: a cannon ball of ten inches diameter in its mid career travels with a velocity of little more than 1,000 feet in a second; in one ten thousandth of a second it would shift its place through only one tenth of its diameter, and would present to the eye, if it could be viewed under the above-mentioned conditions, the appearance of an almost circular disc elongated before and behind by only a slight blur.

It may be said, how is it possible to give such brief exposures as the above? I see no difficulty at all in the matter. Let us take two examples, (1) of quick movement, and (2) of very quick, but by no means the quickest possible, movement. As regards the former, I can flip with my forefinger, and with the greatest ease, a light weight (such as a very small stone) nine feet up in the air; now the maximum velocity of the tip of my forefinger is that of the initial velocity of the stone, which is calculated at once by the usual formula, $v = \sqrt{2fs}$, or taking $2f = 64$, which it is very nearly, $v = 8\sqrt{s}$, the units being in feet and seconds. The velocity in question is therefore 24 feet, or 288 inches per second. As regards a very rapid movement, we may take that of the wing of a bird, which can undoubtedly be rivalled mechanically. A pigeon is by no means the swiftest of birds, but it can fly easily at the rate of 35 miles an hour, and the part of the wing by which it is chiefly propelled and which cannot be its extreme tip, must move much more rapidly than this; let us say, very moderately, at 70 miles an hour, or 1,232 inches per second.

Now the duration of an exposure depends on three data, namely, the rapidity with which the screen moves past the eye, the width of the slit through which the momentary glimpse is obtained, and the diameter of the available portion of the pupil of the eye. I prefer not to limit the pupil by using a small eyehole which is a source of much trouble in actual work, but to have as large an eyehole as is in any way desirable. I find the width of the pupil of my eye in an indoor light as measured by holding a scale beside it and reading off in the looking-glass, to be about 0·1 inch, and I use a slit of the same diameter. The exposure begins when the advancing edge of the slit is in front of the near edge of the pupil, and it ceases when these conditions are reversed, in other words it lasts during the time that the screen is occupied in moving through one fifth of an inch. In the cases just taken of velocities of 288 and 1,232 inches per second, the duration of the exposure would be the 1,440th and the 6,160th part of a second, respectively. There is therefore no difficulty either theoretical or practical about shortness of exposure and sufficiency of illumination. The power exists, and can be utilized, of seeing bodies in motion by a rapid-view instrument, showing them in apparent stillness, and leaving a sharply-defined image on the eye, that can be drawn from visual memory, which in some persons is very accurate and tenacious.

I find on trial that great rapidity of exposure is in nowise essential for analysing the attitudes of a galloping horse or a flying crow. The instrument I commonly carry with me is a very rude one, but convenient for the pocket, and is shewn below. The duration of the exposure given by it under the action of its spring is the 360th part of a second, but the beginning and end of the exposure ought not to count, so little light passing through the edges of the pupil at those times that what is then seen is relatively faint and is disregarded. I estimate its practical duration at about one 500th of a second, and it is rather less when the finger acts with a sharp tap in opposition to the spring. The instrument is shewn in Fig. 1, without its sliding lid, which protects it from injury in the pocket. A is an arm which turns through a small angle round C, its motion being limited by two pins. Its free end carries a vertical screen, R R, which is a cylindrical (or better, a conical sheet described) round an axis passing through C perpendicular to the arm. As the arm travels to and fro, this screen passes closely in front of the end of the box, which is cut into a hollow cylinder (or cone) to correspond. There is a slit in the middle of the screen, and an eyehole in the centre of the end of the box. When the slit passes in front of the eyehole, and the nstrument is held as in Fig. 2, a view is obtained. A stud, S, projects upwards from the arm, and an india-rubber band, B, passing round a fixed pin and a descending spoke of the arm acts as a spring in causing the stud S to rise through a hole in the side of the box, where the finger can press it like the stop of a *cornet à piston*. In using the instrument it is held in the hand as in Fig. 2, with the eyehole in front of the eye. Nothing is then visible, but on pressing or tapping the stud the slit passes rapidly in front of the eyehole, and the view is obtained.

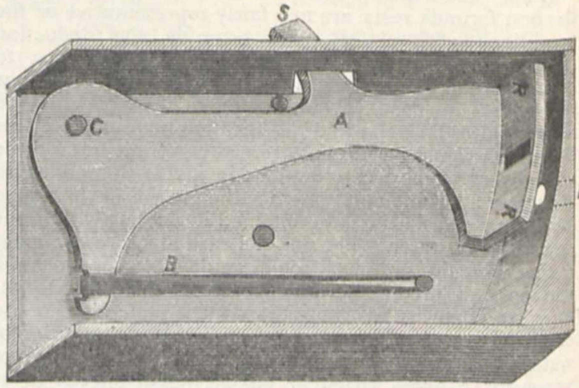

Fig. 1.

After this, the stud is released and the arm springs back wards, when a second view can be obtained, or the eye may be purposely closed for the moment.

I measured the velocity of the instrument by filing a nick on the stud and laying a light weight (a small bent nail) upon it, after having temporarily put in a peg that checked the arm in its recoil when the slit was opposite the eyehole. Then holding the instrument firmly against the wall with the projecting end of the stud as vertical as might be, I drew back the arm and released it, and noted the height to which the weight was tossed. It was three inches. This gave the velocity of the stud in the central portion of the arm, and from this datum the velocity of the more distant screen was easily calculated. I have made more elaborate instruments with multiple levers and with revolving discs (Messrs. Tisley, 172, Brompton Road, are now making one of these for me), but am not as yet prepared to recommend any one of them in particular. Different sorts would be probably be wanted by different persons. For instance it might in some cases be convenient that the trigger should be pulled at the right moment by a bystander, the eye of the observer being in the meantime kept closely shaded from the surrounding light. Again, there are periodic movements which would be best analysed by a slit in a rotating disc whose period of rota-

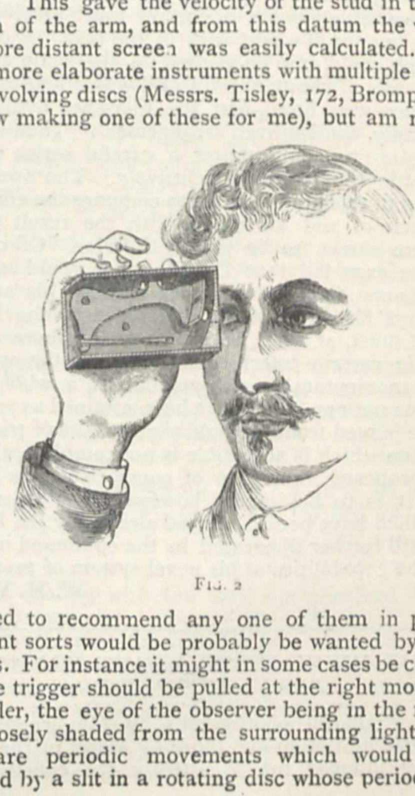

Fig. 2

tion was a little slower than that of the movement, so that each exposure should show a phase one step in advance of the previous ones; or, again, the rapidity of the periods or that of the motion may be such as to make it necessary to expose only at each second, third, or longer periodic interval. This would be effected by the use of two discs rotating at different velocities. Suppose, for example, one to revolve three times while the other revolved twice, then the two slits would be in accord in front of the eye-hole only once in three revolutions.

In order to present the images formed by two successive glimpses as simultaneous pictures seen side by side in the field of view, I took a prismatic eyeglass of the sort sold by spectacle-makers to correct want of parallelism in the optical axes. I cut it in two pieces, and placed these in opposite ways in front of two horizonal slits, lying one above the other in a shutter that fell vertically between slides. When the first slit came in front of the eye, the image it transmitted was deflected four degrees to the left; and when the second slit followed it, its image was deflected four degrees to the right, and two apparently simultaneous pictures were produced. Also, by crossing the prisms I found it would be easy to construct an apparatus with four successive slits shewing four images; 1, up to the left, 2, up to the right; 3, down to the left, and 4, down to the right. I doubt, however, whether this would be often found a useful development of the instrument, owing to the difficulty of watching more than a small area with attention.

I noticed an important optical effect, namely that the image first seen was always considerably fainter than the others, showing that its brightness had faded in the brief interval that elapsed before comparison began. It would appear that the law of the rate of fading could be investigated by this apparatus. I have not now the opportunity of doing so myself, but if I had, I should mount two prisms below radial slits in a disc that was revolving steadily at a known velocity, and I should watch a circular wafer through them. The width of the slits would be adjustable, and so would the angular distance of the prisms, and I should measure under various circumstances the width of the second slit that was necessary to tone down its image to an equal brightness with that seen through the first. Or the investigation might be made without prisms, by using two wafers and watching them with the same eye through slits at different radial distances, separated by various angular intervals, the adjustments being such that only the outside wafer should be seen through the outer slit, and the inside wafer through the inner one. FRANCIS GALTON

THE CHEMISTRY OF THE PLANTÉ AND FAURE CELL

PART III.—*The Discharge of the Cell*

THE two plates of a Planté or Faure battery consist essentially of lead peroxide as the negative element, and metallic lead in a spongy condition as the positive. These are brought into communication with one another through the lead plates which support them, together with the connecting wire.

The lead peroxide reacts both with the lead plate that supports it, and with the lead on the opposite plate. At first sight, it might be expected that the reaction between it and the supporting plate would be the greater, as the space between them is so small, and the resistance of the intervening liquid in consequence almost inappreciable. The action is, indeed, probably greater at the first moment, but, as explained in our first paper, sulphate of lead is immediately produced, and that which lies at or near the points of junction, forms no doubt a serious obstacle to further local action, and admits of the lead on the opposite plate coming more fully into play.

If we consider *a priori* what is likely to be the reaction between lead peroxide and lead, with water as the connecting fluid, we should expect:—

$$PbO_2 \mid H_2O \mid H_2O \mid Pb = PbO \mid H_2O \mid PbH_2O_2.$$

On experiment this is found to be actually the case, yellow oxide appearing on the negative plate, and white hydrate on the positive.

If, however, the reaction takes place in presence of dilute sulphuric acid, the result will inevitably be sulphate on both sides, for even if oxide be first formed, it will be attacked by that acid. Of course this production of lead sulphate on each side might be expected gradually to produce a perfect electrical equilibrium. This, in fact, does take place under certain circumstances, but not under others. The reaction on the negative plate is always of this character, as far as our analyses have shown. We have invaraibly found the deposit to consist of sulphate of lead mixed with unaltered peroxide. If, however, the cell be allowed to discharge itself rapidly, the lead on the positive plate is converted, not only into the sulphate, but, very partially, into lead peroxide. This is sometimes evident to the eye from the puce colour of the superficial layer, and we found also that this was confirmed by several chemical tests.

It is difficult to conceive how the reduction of the peroxide of lead on the one plate to oxide or sulphate, should be attended by a direct oxidation of lead on the other plate up to peroxide itself, as that would involve a reversal of the electromotive force. It is more easy to imagine that the peroxide results from the oxidation of sulphate of lead already formed, through the agency of electrolytic oxygen.

When this peroxide is formed on the positive plate, it is not difficult to foresee what must happen. A state of electrical equilibrium will be approached before the peroxide of lead on the negative plate is exhausted. But the two sides are in very different positions with regard to local action. On the negative plate, the peroxide being mixed with a great deal of lead sulphate, it will suffer decomposition only very slowly through the agency of the supporting plate, but the lead peroxide on the positive plate, being mixed not only with lead sulphate, but with spongy metallic lead, will be itself speedily reduced to sulphate. Hence, on breaking the circuit, when local action alone can take place, the peroxide formed on the positive plate during the discharges will be destroyed much more easily than the original peroxide on the other plate. The difference of potential between the plates will be restored, and on connection the cell will be again found in an active condition.

Now it has been frequently observed that partially discharged accumulators do give an increased current after repose, that is, after the circuit has been broken and re-established. It remained for us to ascertain whether the chemical change above described coincided in any way with the physical phenomena. For this purpose we prepared plates according to the method of Faure, and examined carefully the changes of electromotive force and strength of current, which took place during their discharge under known resistances, and the chemical changes that took place under the same circumstances.

We found that the initial electromotive force of freshly prepared cells was 2·25, 2·25, 2·21, and 2·31 volts, averaging 2·25, but that after standing for thirty minutes or so, or when allowed to discharge for a few minutes, it was reduced to about 2·0 volts. We take this to represent the normal electromotive force of the arrangement of lead, lead peroxide, and dilute sulphuric acid, and believe that the higher figure obtained at the first moment is due to the hydrogen and oxygen occluded on the respective plates, and which either diffuse out or are speedily destroyed.

We found, however, that in the discharge the electromotive force diminished under certain conditions. Thus, in an experiment in which the external resistance was 1 ohm, and the internal 0·58 ohm, the E.M.F. sank in forty-five minutes from 2·25 to 1·92, but after being disconnected for thirty minutes, it was found to have risen to 1·96, and after eighteen hours' repose it had actually risen to 1·98 volts. These observations were made many times in succession during the course of the experiment, which lasted six days.

With twenty times the external resistance, the diminution of electromotive force was much slower; but after discharging three days, the fall was more pronounced, and the rise on repose very apparent.

With 100 ohms resistance, the electromotive force varied very little for three days.

It is more difficult to obtain satisfactory chemical evidence of a quantitative character. It is clear that as chemical examination means the destruction of the substances, the same plate cannot be analysed in two consecutive stages. Nor can two plates be easily compared with one another, although they have been formed under the same circumstances. Even the same positive plate, during or after discharge, presents to the eye very different appearances in different parts. To a certain extent we obviated this difficulty by cutting the plate in two, longitudinally, analysing the one half at once, and allowing the other to repose for a given time before examining it for peroxide of lead.

As to the estimation of peroxide in the presence of metallic lead, we finally adopted as the best method that of reducing it by means of oxalic acid, although we were not certain that the whole amount is obtained in this way, even though the solution be kept hot for a considerable time.

By this method many chemical examinations were made of the positive plate. The results are as follows:—First of all, when the external resistance did not exceed 20 ohms, the peroxide of lead was generally visible in patches, and its presence was demonstrated and approximately measured by various chemical tests. On repose, the quantity of this peroxide visibly diminished, and in the majority of instances the chemical analyses also showed a smaller amount. In all cases sulphate of lead makes its appearance early in the action, and gradually increases in quantity, becoming finally the only product of the discharge.

The deposit on the negative plate shows the presence of nothing but sulphate of lead in addition to the unchanged peroxide. At the conclusion of the action, we have always found more or less of this substance unaltered. Thus, as one instance, after a discharge lasting five days, and approximately complete, we found that only 68 per cent. of the deposit was lead sulphate.

We conclude therefore that the chemical action of the discharge is essentially what is expressed by the following theoretical formula:—

$$PbO_2 \mid H_2SO_4 \mid H_2SO_4 \mid Pb = PbO \mid H_2O \mid H_2SO_4 \mid PbSO_4,$$

which becomes

$$PbSO_4 \mid H_2O \mid H_2O \mid PbSO_4.$$

This reaction is, however, sometimes complicated by the formation of a small amount of peroxide of lead on the positive plate. We believe this to be due to the oxidation of sulphate, an action which was explained in our last paper.

Another conclusion has reference to the resuscitation of power observed on repose. This is not due to any purely physical action but is a necessary consequence of the formation of PbO_2 on the positive plate. As sooner or later the result of the action becomes solely $PbSO_4$, this temporary formation of peroxide does not seriously affect the quantity of electrical force that may be regained from the accumulator, but it does affect the evenness of its flow. The flow is more regular if the discharge be made slowly, but in that case the loss on the negative plate from local action will probably be greater.

As to practical conclusions, we may note—1. Although, as stated in our paper of March 9, the most economical arrangement for the initial charging of the cell is to "make the red lead to be hydrogenated much smaller in amount than that to be oxidated," yet, as foreshadowed in the same paper, this arrangement is not desirable for the discharge of the cell. Nor is it for its subsequent charging, since, as will have been seen, the substances to be acted upon are now very different. On the negative plate there will be the sulphate of lead produced by the discharge, plus sulphate of lead produced by local action, together with more or less unaltered peroxide. On the positive plate there will be the sulphate of lead produced by the discharge, together with excess of lead, if any. Unless, therefore, the peroxide of lead unacted upon is allowed to be very considerable, the quantity of lead compound on the two sides ought to approach equality. 2. Care should be taken that sulphuric acid is in sufficient excess to allow of there still remaining some of it in solution after all the available lead has been converted into sulphate. If it is removed and only water is present, an oxide or hydrate will be produced with probably some serious consequences to the cell.

J. H. GLADSTONE
ALFRED TRIBE

July 3

ON THE DEVELOPMENT OF THE CROCODILIAN SKULL

THE most striking thing in the development of the Crocodile is the structure of its visceral arches, and especially those that form the jaws and the hyoid or lingual arch.

(*a*) *Endoskeletal Parts of the Upper Jaw.*—Inside the massive outer bones of the upper face, or maxillaries and

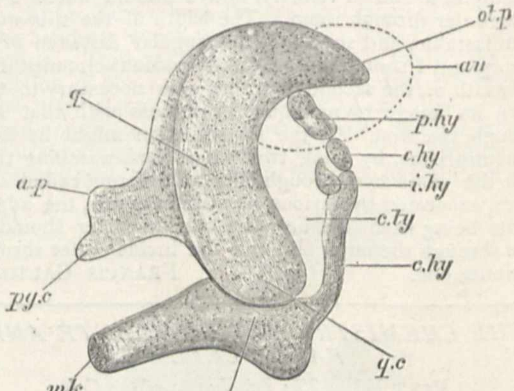

FIG. 1. ×13.

FIG. 1.—Upper part of mandibular and hyoid arches, outer view of second stage (*Alligator missisipensis*), 1½ inch long. *a.u*, auditory capsule (in outline); *q*, quadrate cartilage; *ot.p*, its otic process; *a.p*, ascending process; *pg.c*, pterygoid cartilage; *q.c*, condyle of quadrate; *mk*, Meckel's cartilage; *ar.c*, condyle of articular region of mandible; *p.hy*, pharyngo-hyal; *e.hy*, epi-hyal; *i.hy*, inter-hyal; *c.hy*, cerato-hyal.

jugals, there are the more delicate palatines, transpalatines, and pterygoids. These are formed in a membranous tract of the palate, and but little cartilage, such as is seen in fishes, makes its appearance.

The pterygoids assist the palatines and maxillaries in forming the "hard palate" or secondary floor to the nasal passages, just as in the Ant-bear, Tamandua, and some Cetacea amongst the Mammalia. This hard palate is not seen in Snakes, Lizards, and the smaller Tortoises, but is developed in some degree in the large Turtles. It is but little developed in Birds; for in them only a few -

such as the Hornbill and *Podargus* have the palatines meeting at the middle below.

The *quadrate* is very huge in the Crocodilia, and is *fixed* as in the Turtle and its congeners, and as in them it forms the greater part of the tympanic cavity; in Snakes, Lizards, and Birds the quadrate, or pier of the lower jaw, is movable.

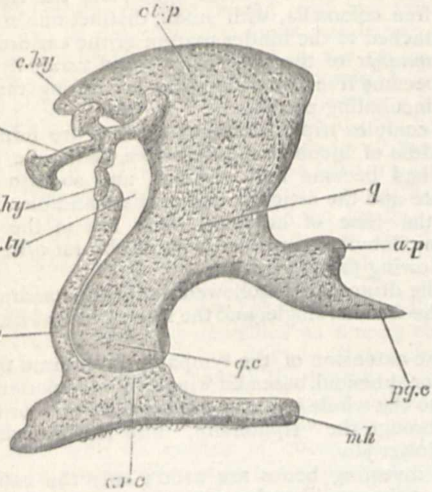

FIG. 2. ×10.

FIG. 2.—Upper part of mandibular and hyoid arches of third stage (*Crocodilus palustris*) outer view, 1⅜ inch long. Letters as in Fig. 2, except *co*, columella.

In Salamanders the quadrate cartilage grows up to the top of the skull, in front of the ear-capsule; this part is called the "ascending process; the other fork runs inwards under the fifth nerve, and is either articulated to or fuses with the basis cranii.

In all lizards except the Chameleons such an ascending process is found, but it is segmented off from the quadrate and becomes ossified as the "columella," which supports

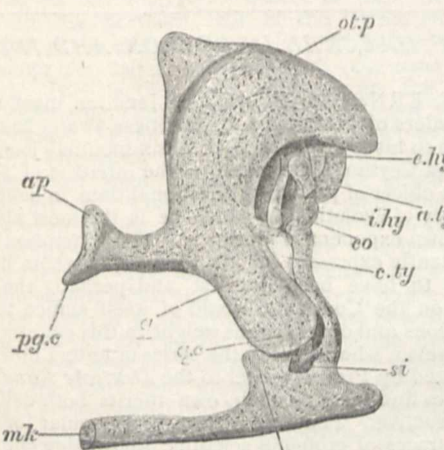

FIG. 3. ×6

FIG. 3.—Same part of same species (fourth stage), 3½ inches long, as Fig. 2 (inner view); *a.ty*, cartilaginous annulus tympanicus.

the roof (this is not the auditory columella, or stapes); I call the former the "epipterygoid." In the Crocodile there appears, very early, a forked process to the quadrate; here the upper fork is the rudiment of the ascending process or "columella," and the horizantal fork is a rudiment of the pterygoid cartilage, which is so large in Sharks and Skates, and forms their upper jaw.

The lower jaw of the Crocodilia corresponds with that of the other Sauropsida—the other Reptiles and Birds, being composed of six splint bones, and an ossification of the articular end of the cartilage, "articulare internum," which unites with the nearest splint, "articulare externum," to form one bone, this, however, is pneumatic, the cartilage itself being hollowed out and com-

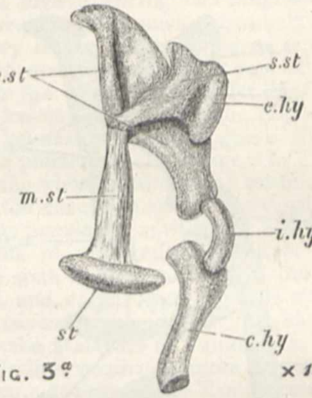

FIG. 3a ×12

FIG. 3*a*.—Part of same object as Fig. 3 (inner view). Letters same as last, with addition of *st*, stapedial plate; *m.st*, medio-stapedial; *e.st*, extra-stapedial; *s.st*, supra-stapedial.

municating by a tube with the cavity of the ear-drum. That tube is called the "siphonium," and Prof. Huxley (see *Proc. Zool. Soc.*, May 27, 1869, p. 391) thought that Prof. Peters had mistaken this tube for a rod of cartilage, which the latter described ("Monatsber. König. Akad. der Wissenschaft. zu Berlin," November, 1868, p. 592) as running directly from the auditory columella into Meckel's cartilage. Such a continuity of the auditory columella

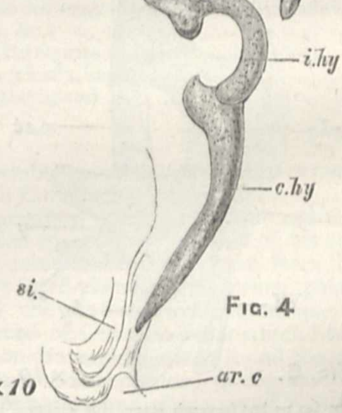

FIG. 4 ×10

FIG. 4.—Same species as last (fifth stage, 4½ inches long), outer view. Lettering the same, with addition of *si*, siphonium.

(*stapes* and *incus* in one) with the hyoid arch and the endoskeletal lower jaw does, however, exist from an early period, up to the middle of incubation. Prof. Peters' observations were made upon small embryos, Prof. Huxley's upon ripe young; the former observed rightly, but his reasoning upon the facts seems to me to be quite at fault; Prof. Huxley had not the proper materials to work upon, but his reasoning was perfect, and the truth of his deductions, in spite of his mistake about the temporary continuity of the mandibular and hyoid arches, appears to me to be absolutely incontrovertible.

As far as I have seen, there is no other type in which the hyoid "cornu" is chondrified continuously with Meckel's cartilage, or the endoskeletal lower jaw.

This may be an acquired peculiarity, but I rather incline to the view that it is an old *hereditary* characteristic,

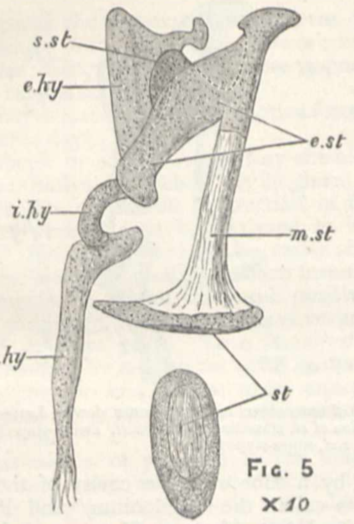

FIG. 5
×10

FIG. 5.—Same species as last (same stage, more advanced, 5 inches long), outer view. Lettering the same; the internal face of the stapes, *st*, is shown.

derived from a very remote ancestry, in which the visceral arches formed a basketwork of cartilage, and not a series of properly segmented arches, such as we are familiar with in most fishes. In *some fishes*, the "marsipobranchii"—Hag and Lamprey—we still see this lower, non-differentiated state of things.

There is a small distal part to the lingual or hyoid arch, but the lower part of the "cornu" (cerato-hyal) is

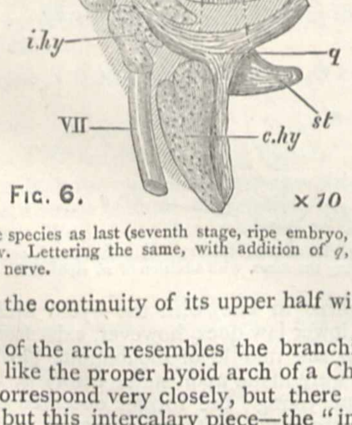

FIG. 6. ×10

FIG. 6.—Same species as last (seventh stage, ripe embryo, 10 inches long), outer view. Lettering the same, with addition of *q*, quadrate bone; VII., facial nerve.

aborted by the continuity of its upper half with the lower jaw.

The rest of the arch resembles the branchial arch of a fish, and is like the proper hyoid arch of a Chimæra; the segments correspond very closely, but there is one piece too many, but this intercalary piece—the "inter-hyal"—is found in ganoid and osseous fishes—uniting their hyomandibular with their epihyal.

This fish-like hyoid soon becomes a continuous bar, as in the New Zealand Lizard (*Hatteria*), where the auditory columella and the hyoid arch are one continuous structure.

That condition, however, in the Crocodile, is only continued through the middle part of the term of incubation; towards the latter part of the time the parts that were fused all come to pieces again, and the ripe young has a free columella, with small, distinct nuclei of cartilage attached to the hinder margin of the ear-drum, these are *remnants* of the *epi-*, *inter-*, and *cerato-hyals*—the latter become free from the lower jaw during the middle of the incubating period.

The complex triple Eustachian tubes are formed after the middle of incubation, but before that time the basis cranii had become hollowed out, and so also had the quadrate and the articular end of the mandible.

By the time of hatching there are in the complex tympanic labyrinth or diverticula of the 1st *visceral* cleft, the following parts, namely:—

a. The drum-cavity hollowed out of the quadratum.

b. The middle, single, and the lateral, forked Eustachian tubes.

c. The extension of the tympanic cavity into the whole posterior sphenoid, base and wings, into the periotic bones, and into the whole circle of the occipital arch or ring.

d. Through the "siphonium," into the articular region of the lower jaw.

The investing bones are solid; only the ossifications of the primary chondrocranium are pneumatic; this hollowing out begins to take place before ossification sets in.

The pneumaticity of the Crocodile's endocranium is similar to what obtains in birds, the whole tympanic labyrinth in the two types is singularly like, and singularly unlike.

NOTE.—For descriptions of these parts in the bird-class I must refer the reader to my papers in the Royal, Linnean, and Zoological Societies. A full account of the development of the skull of the Crocodilia will soon appear in the *Transactions* of the latter society.

W. K. PARKER

PROF. HAECKEL IN CEYLON AND INDIA

I.

PROF. ERNST HAECKEL of Jena, as most of the readers of NATURE are doubtless aware, has lately returned to his University after a six months' journey in India and Ceylon, undertaken in the interests of science with the object of providing additional data in support of the theory of evolution, of which he is the most able and best-known exponent in Germany. The veneration which he constantly expresses for Mr. Darwin, of whom he may be said to have been the first and perhaps the chief disciple on the Continent, would of itself suffice to give his opinions and observations weight in this country. No one, however, who has read the series of letters now being contributed by Prof. Haeckel to the *Deutsche Rundschau*, can fail to find them on their own merits both delightful and instructive. They are written in a popular form, but contain traces of profound scientific knowledge combined with great quickness and freshness of observation, and an almost boyish exuberance of delight in the presence of nature's wonders. Of the three letters or articles already published, the first contains an account of the voyage to India, the second, entitled "A Week in Bombay," describes with vivid enthusiasm the caves of Elephanta and the other marvels of that most interesting of tropical cities, and the third, contained in the June number of the *Rundschau*, of which we propose to give a short reproduction for the benefit of our English readers, brings the Professor to the "promised land" of his scientific yearnings—that island of Ceylon which exhibits in all its varied charms "the highest conceivable development of Indian nature."

It was on November 21, 1881, that the Austrian Lloyd steamer *Helios*, bearing Prof. Haeckel and his numerous chests, some containing scientific instruments, others empty for the reception of specimens, came to an anchor in the harbour of Colombo. He describes in a few graphic words the vision of beauty which met his eager gaze as the morning twilight cleared away, and the island, with its fringe of delicate palm forests, and more thickly wooded interior highlands, crowned in the centre by the mysterious summit of Adam's Peak, expanded before him in all the blaze of tropical sunshine. Directly in front lay the fort and harbour, to the right (or south) the beautiful suburb of Colpetty, in which the majority of the Europeans have their residence, and to the left (or north), the Pettah or "Black town," inhabited by the native races. Prof. Haeckel was warmly received on landing by his countryman, Herr Stipperger, the agent of the Austrian Lloyd, in whose bungalow, on the northern side of the town, at a considerable distance from the fort, and still farther from Colpetty, he passed the two first weeks of his stay in Colombo, which he describes as among the most delightful of his life. His first drive in Ceylon, from the Fort to Whist Bungalow, through the Pettah, opened out before him, as he himself says, a quick succession of scenes of Eastern beauty. The brown clay huts of the natives, each with its garden of cocoa-nut palms and plantains; the motley population of red-brown Singhalese, and darker Tamils, grouped round the doors, carrying on all their domestic concerns in the open air, combined with the bright red tint of the soil to produce bewildering contrasts of form and colour, together with a charming impression of primitive simplicity, and harmony with surrounding nature. It would be impossible to make even a passing mention of the Singhalese and their domestic life without digressing into a description of their most valued and often their only possession, the cocoa nut palm of whose substance every part is turned by them into account.

"The number of cocoa palms on the island," says Prof. Haeckel, "is calculated at 40,000,000, each palm yielding from 80 to 100 nuts (8-10 quarts of oil). It is not found in the northern half of the island, nor on a great part of the eastern coast. Its place is here supplied by the not less useful palmyra palm (*Borassus flabelliformis*). This is the same which covers the hot and dry districts of Hindostan, growing in great profusion near Bombay. Even from a distance the two palms vary greatly. The palmyra is a fan-palm, with a strong, very straight black stem, topped by a thick bunch of fan-shaped leaves. The cocoa, on the other hand, is a feather-palm, its slender white stem, 60 to 80 feet high, is gracefully curved, and adorned with a bushy crown of feathery leaves. The lovely Areca palm (*Areca catechu*) has similar, but stiffer and smaller leaves, and a tapering reed-like stem; it is an invariable feature of a Singhalese garden, carefully tended for the sake of the nut, which, being chewed together with the leaf of the betel pepper, colours the teeth and saliva red. Another palm, the Kitool (*Caryota urens*) is cultivated chiefly on account of its abundant sugar-sap, from which palm-sugar (*Djaggeri*) and palm wine (*Toddy*) are prepared. Its stiff strong stem supports a crown of double-feathered leaves resembling those of the maiden-hair fern (*Adiantum capillus Veneris*)."

"After the palms the most important trees in the little gardens of the Singhalese are the bread-fruit and the mango. Of the former there are two kinds, the ordinary bread-fruit (*Artocarpus incisa*), and the Jak tree (*Artocarpus integrifolia*), growing everywhere in great profusion. Another tree frequently cultivated by the natives is the curious cotton tree (*Bombax*). Mingled with these round the Singhalese huts is the beautiful banana or pisang tree, well deserving the name of "fig of Paradise" (*Musa sapientum*). Its beautiful yellow fruit, affording excellent nourishment either raw or cooked, is here seen in numerous varieties. Magnificent clusters of its gigantic light green leaves topping a slender stem from 20 to 30 feet high overhang the Singhalese huts, and form their loveliest adornment. Scarcely less effective are the arrowy leaves of the Aroideæ, especially of the Caladium, cultivated for its esculent roots, the same being the case with the Manihot, with its lovely clusters of hand-shaped leaves (belonging to the Euphorbiaceæ)."

[1] Sir J. Emerson Tennent ("Ceylon," I., p. 127), mentions, as curiously illustrative of the minute subdivision of property in Ceylon, a case which was decided in the district court of Galle, the subject in dispute being a claim to the 2520th *part of ten cocoa nut trees!*

Prof. Haeckel next proceeds to give a short statistical account of the population of Ceylon. In Columbo itself, as well as in the whole southern and western crests of the island (with the exception of the north-west) the large majority of the population consists of Singhalese proper, or descendants of the Indian Hindoos who overran Ceylon in the sixth century B.C., but in the northern half of the island, and on the east coast, as well as in large tracts of the central highlands, the Singhalese have been driven out by the Malabars or Tamils from the southern parts of the Indian peninsula, more especially from the Malabar coast. At present the Tamils comprise about a third of the whole population of Ceylon, and their number is yearly increasing; they are stronger and hardier than the Singhalese, and all the heavier labour falls to their share, the Singhalese only occupying themselves in the lighter kinds of agricultural work. Besides these, there are the Indo-Arabians of Ceylon (called Moormen or Moors), descendants of the Arabs who gained a footing in the island more than two centuries ago. The residue of the native population is composed of the wild aborigines (Veddahs and Rodiyahs) of immigrant tribes from various parts of Asia and Africa, and of Malays, Javanese, Parsees, Afghans, Negroes, and Kaffirs; in all about 25,000. Europeans number altogether only three to four thousand, principally, of course, English and Scotch. The whole of this motley population at the present time may be calculated at 2,500,000, divided as follows:—

Singhalese (chiefly Buddhists)	1,500,000
Tamils (or Malabars, chiefly Hindoos)	820,000
Indo-Arabians (Moors, chiefly Mohamedans) ...	150,000
Mixed descendants of various races	10,000
Asiatics and Africans (Malays, Chinese, Kaffirs, Negroes, &c.)	8,000
Burghers (Portuguese and Dutch half-bloods) ...	6,000
Europeans (chiefly English)	4,000
Veddahs (aborigines)	2,000
Total	2,500,000

A considerable number of all the native races have been converted to Christianity.

Whist Bungalow, where, as we have already mentioned, Prof. Haeckel spent the earlier part of his stay in Ceylon, received its somewhat curious name from the passionate addiction to card-playing of a former possessor. It is situated on one of the most picturesque spots in the neighbourhood of Colombo—that which lies to the north of the fort on the angle between it and the mouth of the river Kalany. Some portions of the description of the site of the bungalow and of his friend's garden must be given in Prof. Haeckel's own words:—

"The airy verandah commands a magnificent view of the sea, of the mouth of the Kalany, and of a lovely little island covered with vegetation, which lies in its delta. Further north, the eye follows a long strip of cocoa wood extending along the coast to Negombo. To the south lies the garden of the Bungalow, and beyond it a picturesque plot of land scattered over with fishing huts, nestling under the shade of slender palms; in their midst a little Buddhist temple, and further on a rocky swamp covered with screw pine (*Pandanus*), &c. From this swamp springs a narrow sandy neck of land extending northward to the river's mouth, and so lying as to inclose a peaceful little lake in front of our garden. A few fishing huts are erected on this tongue of land, and from morning to night it presents a constant succession of animated and amusing pictures. Here in the early morning, before sunrise, the inhabitants of the huts assemble to take their morning bath in the river. Then the horses and oxen have their turn, and are brought down to water. Busy washers are at their work all day, beating the clothes with flat stones, and spreading them on the shore to dry. Fishing boats go up and down continually; and in the evening, when they have been drawn up to land, and the great square sails have been spread to dry, the lagoon, with its long row of motionless sails, looks wonderfully picturesque, especially when the evening breeze swells the sails, and the sun, sinking into the sea, floods the whole shore with a radiance of gold, orange, and purple. . . . . The garden of Whist Bungalow has been converted, by the care and taste of its proprietor, into a veritable earthly paradise, containing examples of almost every native plant of importance, and thus forming a valuable botanical collection, as well as a fragrant and delightful pleasure garden. On the very first morning of my stay, as I wandered in rapturous delight under the shade of palms and fig trees, bananas and acacias, I gained a very comprehensive idea of the flora of the plains. Here the noble palm, in all its variety of foliage and fruit, rears its stately columns; cocoa and talipat, areca and borassus, caryota and palmyra; here the banana spreads its great feathery leaves to the wind, and displays its clusters of precious golden fruit. As well as various kinds of the common banana (*Musa sapientum*), a fine example of the Traveller's tree of Madagascar may here be seen (*Urania speciosa*). It stands just at the division of the principal walk, from which the path to the right leads to the bungalow, and that to the left brings us to a magnificent specimen of the banyan or sacred fig tree (*Ficus bengalensis*), forming, with its hanging air-roots and numerous stems, a very striking object; beautiful Gothic arches open out among the roots which, pillar-wise, support the main structure of the tree. Other trees of various groups (terminalia, laurels, myrtles, ironwood trees, bread-fruit, &c.) are over-grown and intertwined with those lovely creeping and climbing plants which play so important a part in the flora of Ceylon. These belong to the most varied families, for in the dense forests of this magic island, and under the favourable influences of moisture and warmth, a countless multitude of climbing plants strive and cling, and grasp their way upward to the light and air.

"Among the charms of this most lovely garden must be included the large-leaved Calla plants or Aroideæ, and the graceful feathery ferns, two groups of plants, which, both by their individual mass and by the beauty and size of their development, occupy an important place in the lower flora of Ceylon. Scattered among them are many of the finest shrubs and flowering plants of the tropics, partly indigenous, partly introduced from other tropical regions, especially from South America, but all perfectly at home here. Among these rises the stately Hibiscus, with great yellow or red flowers, the flame tree or acacia, a mass of splendid flame-coloured clusters (*Cæsalpinia*); venerable tamarinds with their aromatic blossoms; while from every branch hang clinging convolvuli with gigantic bell-shaped flowers, and aristolochias, yellow and brown. Rubiaceous plants, such as lilies, orchids, &c., bear extraordinarily large and beautiful blossoms. . . . The animal life inhabiting this garden of Eden does not altogether correspond in variety and abundance with its vegetable world; this is especially the case with its larger and more striking forms. In this respect, as far as I have been able to ascertain, the island is inferior to the Indian mainland and to Sunda Island, and still more so to tropical Africa and Brazil. I must confess that my first impression was one of disappointment, which rather increased than diminished as I came to know the fauna more intimately, even in the wilder parts of the island. I had expected to find the trees and bushes thronged with apes and parrots, and the flowering plants with butterflies and winged insects of curious form and brilliant hue. But my expectations were doomed to remain unfulfilled, and my only consolation was that other zoologists visiting the island had been equally disappointed. Nevertheless, careful search reveals much that is curious and interesting, even to the zoologist, and in its main features the fauna of Ceylon, though not so rich and brilliant, is quite as singular and characteristic as its flora.

"The vertebrate animals which first claimed my attention in Whist Bungalow and the immediate neighbourhood of Colombo, were numerous reptiles of brilliant colours and curious forms, especially snakes and grasshoppers, and pretty little tree frogs (*Ixalus*), whose weird, bell-like note, resounded in the evenings. The birds chiefly visiting the gardens are starlings and crows, water-wagtails and bee-catchers, and above all the pretty little honey-sucker (*Nectarinia*), which here takes the place of the humming-bird; kingfishers and herons abound on the river banks. Among mammalia the most frequently occurring is the pretty little squirrel that leaps about among the trees and shrubs, and is very tame and confiding; its colour is a brown grey, with three white stripes lengthwise down its back (*Sciurus tristriatus*). Among the insects, dense swarms of which abound everywhere, the first to be named are ants (from the minutest to the most gigantic sizes) including the destructive termites or white ant; wasps and bees among the hymenoptera, and gnats and flies among the diptera are also very abundant. The larger and finer forms of insect life, such as chafers, butterflies, &c., do not exist in any proportion to the flora of the island. Orthoptera (grasshoppers, crickets, &c.), on the other hand, are very varied and curious in form. I will content myself at present with this cursory mention of a subject to which I hope later to return.

"Of articulate animals the spiders (*Arachnidæ*) form a very interesting and curious class, from the minutest mites and ticks upwards to the bird-spinners and scorpions. The closely-allied Millipeds or Myriapodæ are very numerous and of colossal size, sometimes as much as a foot long. I saw one famous specimen on my first morning in the garden of Whist Bungalow, but I was too lost in admiration of the glories of the vegetable kingdom round me to have time for a nearer examination of the animal world."

In this first intoxication of delight which accompanies the realisation of a life-long dream, we must for the present leave Prof. Haeckel, hoping in a future number to give some further account of his observations on the fauna and flora of Ceylon.

NOTES

We hear that Princeton College, New Jersey, is going to despatch a second scientific expedition this summer to the "bad lands" of Dakotah and Nebraska in search of fossils. It will be under the charge of Mr. W. B. Scott, of the "E. M." Geological Museum of Princeton, who is known to many readers of Nature on this side of the Atlantic by his papers on the development of *Petromyzon*, &c. A former expedition of a similar kind, undertaken in 1877 under the same auspices, and composed of Messrs. Scott, H. F. Osborn, and F. Speir, jun., succeeded in making a valuable collection of vertebrate remains, which have been fully described in the "Palæontological Report of the Princeton Scientific Expedition of 1877" (Princeton, 1878), and now adorn the geological museum there.

AN interesting telephonic experiment was made on Tuesday at Malta, during the bombardment of the Forts at Alexandria. A telephone was attached at Malta to the Alexandria cable, and connection was made with the other end of the cable on board the *Chiltern*, off Alexandria. It was found that, owing either to the distance, or to the vibration caused by the firing, it was impracticable to send a verbal message, but the firing at Alexandria was distinctly heard, through the telephone, at Malta—a distance of more than a thousand miles.

A VISIT was paid on Tuesday to the School of Military Engineering and the Royal Engineer establishment at Chatham by the members of the Society of Telegraph Engineers and Electricians. Over 500 of the members, associates, and friends of the society accepted the invitation of the president, Col. Webber, R.E., and were entertained by him at luncheon at the Royal Engineers officers' mess. The guests were shown over the schools, following a programme arranged by the Acting Commandant, and conducted by the officers of the Royal Engineers, who were indefatigable in providing for the entertainment of all. A lecture on torpedo warfare was delivered in the theatre by Major Armstrong, R.E., and the guests visited amongst other sights in the Royal Engineer Institution the schools of electricity, photography, chemistry, architecture, and surveying. Outside, the Engineers' Field Park, the mechanical workshops, the construction of military bridges, use of brushwood for military purposes, siege batteries, earthworks, demolition of railways and stockades, also submarine mine explosions, afforded a most interesting programme, especially so at a moment when all these appliances may be at any moment brought into practical use.

THE Rector of a small parish in Warwickshire is endeavouring to protect and preserve a fine granite boulder, identified as having been floated from Mount Sorrel in Leicestershire, a distance of sixty miles, and now exposed to danger of destruction. To rail it in and record its history by a permanent inscription will cost about 12*l*. The parish is a poor one, and the Rector crippled by an unlet glebe; but 5*l*. has been promised in the village, and 1*l*. has been given by the Boulder Committee of the British Association through its Secretary, Rev. H. W. Crosskey, who has seen the boulder, and will vouch for its scientific interest and value. If any reader of NATURE is good enough to send a small contribution towards the 6*l*. still wanted, to the address of "Rector—care of Editor of NATURE," it will be acknowledged in these columns.

WE regret to announce the sudden death of M. Antoine Breguet, at the early age of thirty years. He was the son of M. Breguet, the member of the Institute, one of the directors of the International Exhibition of Electricity in Paris, and had had for two years the editorship of the *Revue Scientifique*, and the direction of the well-known Breguet optical and horological workshop.

THERE is now at Gresham College, in Basinghall Street, an interesting collection of objects which have been sent over from the Technical School at Iserlohn, in Westphalia. They comprise examples in wax, plaster, wood, and metal, the works executed by students in the special trade-school which was founded by the Prussian Government, and which is said to have rendered important service to the manufactures of the district. The collection has been sent over in response to the application of Mr. Philip Magnus, one of the Royal Commissioners on Technical Education, and inspection will be permitted on application to that gentleman during this week.

BY last advices from Manila (May 17), according to the *London and China Telegraph*, two German naturalists, Messrs. Schadenburg and Koch, had just arrived there from Mindanao, where they had recently successfully ascended a volcano called Apo, the highest mountain in the Philippines, a feat only once before achieved by Europeans, this being in October, 1880. After several vain attempts, Senor Rajal, in 1880, a few months after assuming the governorship of the district, determined to ascend the volcano, notwithstanding the opposition of the Bagobo savages, who assured him that a human sacrifice was essential for success. His influence over them was, however, so great that he prevailed on fifty of the savages to accompany him as guides and porters, and was thus enabled to set out on the expedition in October that year with several Spaniards and Dr. Montano, a French naturalist. The ascent proved so dangerous and difficult that only Dr. Montano and Senor Martinez reached the top on the north-east side of the volcano, its height being determined by them at 3130 metres above the sea. The safe return of this expedition after nine days' absence without the human sacrifice required by the savages resulted in lessening their superstitious dread of the Apo. The *Diario* states that Messrs. Koch and Schadenburg made two ascents of the Apo in February and March last, under the guidance of several savages, during which they ascertained the height of its south-west peak to be 3000 metres (10,824 Eng. feet) above sea level.

IN the July number of the *American Naturalist* is a paper of much value by Mr. Ivan Petroff on the Limit of the Innuit Tribes on the Alaska Coast, in which the writer combats some of the conclusions come to by Mr. Dall. Mr. Petroff has been familiar for years with these coasts, and his conjectures as to the origin and migration of the Innuits and other tribes will interest ethnologists. In this connection Mr. Petroff has some important observations on the rate of accumulation of shell-heaps. He says:—"The time required for the formation of a so-called layer of 'kitchen refuse' found under the sites of Aleutian or Innuit dwellings, I am inclined to think less than indicated by Mr. Dall's calculations. Anybody who has watched a healthy Innuit family in the process of making a meal on the luscious echinus or sea urchin, would naturally imagine that in the course of a month they might pile up a great quantity of spinous *débris*. Both hands are kept busy conveying the sea fruit to the capacious mouth; with a skilful combined action of teeth and tongue, the shell is cracked, the rich contents extracted, and the former falls rattling to the ground in a continuous shower of fragments until the meal is concluded. A family of three or four adults, and perhaps an equal number of children, will leave behind them a shell monument of their voracity a foot or eighteen inches in height after a single meal. In localities in Prince William Sound I had an opportunity to examine the camp-sites of sea-otter hunters on the coast contiguous to their hunting-grounds. Here they live almost exclusively upon echinus, clams, and mussels, which are consumed raw in order to avoid building fires and making smoke, and thereby driving the sensitive sea-otter from the vicinity. The heaps of refuse created under such circumstances during a single season were truly astonishing in size. They will surely mislead the ingenious calculator of the antiquities of shell heaps a thousand years hence."

IN the same article Mr. Petroff has also some interesting observations on the action of tides on the coast:—"As an instance of the rapidity with which the tides of this region will change outlines of coast and other land marks, I may cite an observation made by me during my stay on Nuchek island last summer. At a short distance from the settlement there was a cave in a rocky cliff situated about three or four feet above high water mark. visited the place frequently, as it afforded a view over the approaches to the harbour. About the middle of June an eclipse of the moon occurred when it was full or nearly so, causing tidal commotion of unusual extent and violence. When I visited my cave on the day following the eclipse, I found it almost filled with shingles and *débris*. This cave was situated at about the same height above the water as the cave of Amaknak, from which Mr. Dall extracted such voluminous information as to the antiquity of strata of refuse found therein. I cite these instances only for the purpose of showing that it is not safe to ascribe great age to any and all accumulations of *débris* found on the coast of Alaska, and also as a support for my theory of a general Innuit migration along the coast at a comparatively recent period, subsequent to the invention of the kaiak or a similar structure."

FROM the Italian Census of December 31, 1881, it appears that in 23 out of 24 provincial chief towns the number of persons knowing how to read and write has greatly increased since 1871. In ten years the citizens of Udine had increased in such knowledge at the rate of 9 per cent.; in Como, 6·50 per cent. Brescia made a strange exception; in 1871 there were 2899 persons ignorant of reading and writing, and in 1881 this number was increased to 3120 persons; data are wanting to explain this fact. In the 24 capitals of provinces the average result is that a little more than 50 per cent. of the inhabitants know how to read and write.

MESSRS. TRÜBNER AND CO. have issued a second and much enlarged edition of their "Catalogue of the Principal Languages and Dialects of the World." The original catalogue contained about 1100 titles on 64 pages, while this edition enumerates nearly 3000 titles on 170 pages. The utility of such a catalogue to students of language is obvious.

WITH praiseworthy promptness Messrs. Blackie and Son have issued the third volume of the new edition of the Imperial Dictionary, edited by Mr. Charles Annandale. This volume extends from L to Screak, and in all respects is up to the two first volumes. The only omission of importance we detect is Photophone, which perhaps came too late to be put in its proper place.

A FRENCH engineer has originated a plan by means of which passing ships could send messages by submarine cables; he would float buoys with the necessary connecting wires and apparatus at intervals of a day's journey along the line of the cable, each numbered and properly lighted at night. The writer in the *Moniteur de la Flotte* considers that the plan presents but few difficulties, and would obviate much anxiety and many dangers.

DR. SCHLIEMANN is carrying on new excavations at Hissarlik, with the assistance of two eminent German architects. No fewer than 150 workmen are daily employed in laying bare the foundations of the ancient cities. Two perfectly distinct cities have lately been discovered in the burnt stratum, the lower one resting on the large walls which have hitherto by mistake been attributed to the second city. Hissarlik now turns out to have been the Acropolis of this lower burnt city, this being proved by the walls and the pottery, as well as by two vast brick buildings, one of them 43 feet broad by 100 feet long, the other 23 feet broad by less than 100 feet long. These buildings seem to have been temples, a separate gateway, flanked by enormous towers, leading up to them. There are, besides, three or four large buildings, apparently dwelling-houses, but no smaller buildings. The city walls now stand out very imposing. They rest on a substructure of large blocks, 33 feet high, afterwards superseded by great brick walls. All the treasures formerly found by Dr. Schliemann are now ascribed to the first burnt city. Dr. Schliemann has found in the temples copper nails of a very peculiar shape, weighing from 1000 to 1190 grammes. The second burnt city, being the third city from the rock, and hitherto identified with the Homeric Troy, turns out to have had but very small houses and no lower town at all. Dr. Schliemann will continue his excavations till the beginning of August.

SOME interesting objects which have, according to the *Daily News* correspondent, just been found in Neuchatel are considered by Swiss archæologists to throw a new light on the history of the lake-dwellers, and the discovery is consequently looked upon as one of importance. Amongst the objects are a carriage-wheel with iron rim, iron swords, and many human bones.

THE *Field Naturalist* is the name of a new natural history journal, published by A. Heywood of Manchester; it is stated to be "a medium of intercommunication," and for this purpose it will doubtless be of service to the many cultivators of science throughout the country.

THE *Proceedings* of the Liverpool Naturalists' Field Club for 1881-82, gives the usual account of the numerous excursions of this Society; they seem to have been successful. We have also received an interesting brief Report of the work done by the York School Natural History Society during the past year; this Society has founded a special section, exclusively devoted to scientific workers.

THE additions to the Zoological Society's Gardens during the past week include a Red-legged Partridge (*Caccabis rufa*), European, presented by Dr. A. O. Grosvenor; a Ring Ouzel (*Turdus torquatus*), British, presented by Mr. H. A. Macpherson; a Red-sided Eclectus (*Eclectus polychlorus*) from New Guinea, presented by Mr. A. Lubbock; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Master Charles Ed. Napier; a Dwarf Chameleon (*Chamæleo pumilus*), eighteen Rough-scaled Lizards (*Zonurus cordylus*), a Banded Skink (*Euprepes vittatus*), a South African Skink (*Scelotes bipes*), four Beetles (*Scarites rugosus*), four Beetles (*Psorodes*, sp. inc.) from Robben Island, South Africa, presented by the Rev. G. H. R. Fiske, C.M.Z.S.; a Goshawk (*Astur palumbarius*), European, deposited; two Black Leopards (*Felis pardus*), an African Elephant (*Elephas africanus* ♂) from Africa, a Hardwick's Hemigale (*Hemigale hardwicki*) from Borneo, a Cuvier's Lagotis (*Lagotis cuvieri*) from Patagonia, a Pronghorn Antelope (*Antilocapra americana*) from North America, a Malayan Tapir (*Tapirus indicus*), two —— Hornbills (*Buceros*, sp. inc.) from Malacca, purchased; a One-Wattled Cassowary (*Casuarius uniappendiculatus*) from New Guinea, received in exchange; three Chiloe Wigeons (*Mareca chiloensis*), bred in the Gardens.—The following insects have emerged during the week:—Silk Moths: *Actias selene*, *Telea polyphemus*; Butterflies: *Parnassius apollo*, *Vanessa polychlorus*, *Thecla spini*, *Melanagria galathea*; Moths: *Deilephila euphorbiæ*, *Sciapteron tabaniformis*, *Bembecia hylæiformis*, *Zygæna filipendulæ*, *Plusia concha*.

PROF. MENDELEEF ON THE HEAT OF COMBUSTION OF HYDROCARBONS[1]

"IN considering the numerical data as to the heat of combustion," Prof. Mendeleeff says, "it will be perceived that until now sufficient attention has not been given to the distinction between purely calorimetrical data and those physical and mechanical changes which accompany chemical reactions, while it was recognised long ago that it is essential to separate, as far as possible, the heat of the reaction from the heat disengaged by physico-mechanical processes. The drawback arising from this is especially noticeable with regard to the heat of combustion of compounds of carbon, as this heat is used for measuring the heat of formation of compounds of carbon from simple bodies, which last is, as is known, but a small fraction of all the heat of combustion." Thus, for example, when the products of combustion of CO_2 and of H_2O act on incandescent charcoal, both reactions are very similar, if we do not give attention to the physical process which accompanies the second reaction. The

[1] "Notice on the Heat of Combustion of Hydrocarbons," in the *Journal* of the Russian Chemical and Physical Society, vol xiv. pp. 230-238.

reaction $CO_2 + C = CO + CO$ shows that out of two volumes of CO_2 we receive four volumes of CO, and it is accompanied with absorption of heat, which is determined by the fact that the combustion of one atomic weight of carbon develops 97 K (*i.e.* 97 great calorics, or 97,000 common ones), while the combustion of CO develops 68·4 K; the reaction is thus accompanied by the following thermal result: $97·0 K - 2 \times 68·4 K = -39·8 K$. The result $(97·0 - 68·4 - 68·4 = -39·8 K)$ is the same for the following reaction: $H_2O + C = CO + H_2$; and, if the combustion of hydrogen in the calorimeter were not accompanied by a formation of liquid water, it might be admitted that the combustion of CO and of H_2 develops the same amount of heat, which, however, is not the case.

After having shown how the conclusions on the heat of formation of hydrocarbons from hydrogen and coal, or diamond, are vitiated by not taking into account the heat developed, or absorbed, by physical and mechanical processes, and how M. Thomsen (*Berliner Berichte*, 1880, p. 1321) was brought to erroneous conclusions as to the structure of the molecule of coal and diamond, as well as to the structure of hydrocarbons; M. Mendeleef says:—"In using calorimetrical data of chemical reactions to judge of the variation of chemical energy in a reaction, it is necessary to free them from the influence of physical and mechanical processes which accompany the reaction. Of course, the relative influence of these secondary processes is not very great, as the chemical process is the most important one, especially in such energetic reactions as the combustion of hydrocarbons; but it is important, for strictly maintaining the principle itself of thermo-chemistry, always to apply this correction, as we always apply the correction for loss of weight in the air, especially when weighing gases." "Only in the gaseous state can we consider the thermal relations of bodies free from the influence of the modified internal work, as was well pointed out by Berthelot in the first chapters of his work: 'Essai de Mécanique chimique'; therefore, all comparisons must be made in the gaseous state, as well for the bodies entering into reaction, as for those which we receive. When the determination of the heat of combustion is made for solid or liquid bodies, we obviously must add the latent heat of evaporation (and liquefaction) of the body, and deduct the latent heat of evaporation of water. This last is well known, and for a molecular weight in grammes (18 grammes) of water, it is equal to about 10·7 K at the temperature of 15° to 20° Cels. As to the heat of evaporation of hydrocarbons, it is still not sufficiently known. But we know that the heat necessary for the evaporation of *molecular quantities* of different bodies comparatively volatile, varies from 4 K (as for NH_3 and N_2O) to 15 K (as for quicksilver and ethyl), and usually is between 6 K to 10 K." This correction not being very great, and the determinations of heat of combustion not being yet very accurate, Prof. Mendeleef takes, for those bodies whose heat of evaporation is not yet determined, an approximate correction. Another correction is that which results from changes of volume of combining bodies. The mechanical work which results from this increase or decrease of volume is not very great (0·57 K in most of the determinations of Thomsen), but always must be taken into account.

By applying these corrections, Prof. Mendeleef gives a new corrected table of heats of combustion of twenty different hydrocarbons, as well as the heats of formation of these bodies from CH_4, CO, and CO_2. The corrections are not insignificant, as, for instance, for hydrogen, CH^4, C^2H^6, C^3H^5, and C^7H^{16}, whose heats of combustion, as determined by Thomsen, Berthelot, and Loughinin, are respectively—68·4, 213·5, 373·5, 533·5, and 1137·4; the corrected figures, as given by M. Mendeleef, are—57·4, 192, 342, 492, and 1062.

THE WEDGE PHOTOMETER[1]

MUCH attention has recently been directed to the use of a wedge of shade glass as a means of measuring the light of the stars. While it has been maintained by various writers that this device is not a new one, the credit for its introduction as a practical method of stellar photometry seems clearly to belong to Prof. Pritchard, director of the University Observatory, Oxford. Various theoretical objections have been offered to this photometer, and numerous sources of error suggested. Prof. Pritchard has made the best possible reply to these criticisms by measuring a number of stars, and showing that his results agreed very closely with those obtained elsewhere by wholly different methods. His instrument consists of a wedge of shade glass of a neutral tint inserted in the field of the telescope, and movable so that a star may be viewed through the thicker or thinner portions at will. The exact position is indicated by means of a scale. The light of different stars is measured by bringing them in turn to the centre of the field, and moving the wedge from the thin towards the thick end until the star disappears. The exact point of disappearance is then read by the scale. The stars must always be kept in the same part of the field, or the readings will not be comparable. By a long wedge the error from this source will be reduced. A second wedge in the reversed position will render the absorption uniform throughout the field. Instead of keeping the star in the same place by means of clockwork, the edges of the wedge may be placed parallel to the path of the star, when the effect of its motion will be insensible. To obtain the best results, the work should be made purely differential, that is, frequent measures should be made of stars in the vicinity assumed as standards. Otherwise large errors may be committed, due to the varying sensitiveness of the eye, to the effect of moonlight, twilight, &c., and to various other causes.

[1] By Prof. Edward C. Pickering. Presented May 10, 1882, at the American Academy of Arts and Sciences.

A still further simplification of this photometer may be effected by substituting the diurnal motion of the earth for the scale as a measure of the position of the star as regards the wedge. It is only necessary to insert in the field a bar parallel to the edge of the wedge, and place it at right angles to the diurnal motion, so that a star in its transit across the field will pass behind the bar, and then undergo a continually increasing absorption as it passes towards the thicker portion of the wedge. It will thus grow fainter and fainter, until it finally disappears. It is now only necessary to measure the interval of time from the passage behind the bar until the star ceases to be visible, to determine the light. Moreover, all stars, whether bright or faint, will pass through the same phases, appearing in turn of the 10, 11, 12, &c., magnitude, until they finally become invisible. For stars of the same declination, the variation in the times will be proportioned to the variations in the thickness of the glass. But since the logarithm of the light transmitted varies as the thickness of the glass, and the stellar magnitude varies as the logarithm of the light, it follows that the time will vary as the magnitude. For stars of different declinations, the times of traversing a given distance will be proportional to the secant of the declination. If δ, δ' are the declinations of two stars having magnitudes m and m', and t, t' are the times between their transits over the bar and their disappearances, it follows that $m' - m = A\,(t \sec \delta - t' \sec \delta')$. For stars in the same declination calling $A \sec \delta = A'$ we have $m' - m = A'\,(t - t')$. Accordingly the distance of the bar from the edge of the wedge is unimportant, and, as in Prof. Pritchard's form of the instrument, it is only necessary to determine the value of a single constant, A. Various methods may be employed to determine this quantity. Prof. Pritchard has recommended reducing the aperture of the telescope. This method is open to the objection that the images are enlarged by diffraction when the aperture is diminished; constant errors may thus be introduced. Changing the aperture of a large telescope requires some time, and in the interval the sensibility of the eye may alter. These difficulties are avoided by the following method, which may be employed at any time. Cover the wedge with a diaphragm in which are two rectangular apertures, and place a uniformly illuminated surface behind it. Bring the two rectangles into contact by a double image prism, and measure their relative light by a Nicol. From the interval between the rectangles and the focal length of the telescope, the light in magnitudes corresponding to one second, or A may be deduced. Perhaps the best method with a small telescope is to measure a large number of stars whose light has already been determined photometrically, and deduce A from them.

The great advantage claimed for this form of wedge photometer is the simplicity of its construction, of the method of observing, and of the computations required to reduce the results. It may be easily transported and inserted in the field of any telescope like a ring micrometer. The time, if the observer is alone, may be taken by a chronograph or stop-watch. Great accuracy is not needed, since if ten seconds correspond to one magnitude, it will only be necessary to observe the time to single seconds. The best method is to employ an assistant to record and take the time from a chronometer or clock. If the stars are observed in zones, the transits over the bar serve to identify or locate them, as well as to determine their light. A wedge inserted in the field of a transit instrument will permit the determination of the light of each star observed without interfering with the other portion of the observation. If the stars are all bright, time may be saved by dispensing with the thin portion of the wedge. In equatorial observations of asteroids the light may be measured photometrically with little additional expenditure of time. Perhaps the most useful application would be in the observation of zones. When the stars are somewhat scattered it would often happen that their light might be measured without any loss of time. By this instrument another field of usefulness is opened for the form of horizontal telescope advocated at a former meeting of this Academy (*Proc. Amer. Acad.* XVI. 364). Very perfect definition would not be required, since it would affect all the stars equally. To an amateur who would regard the complexity of an instrument as a serious objection to it, a means is now afforded of easily reducing his estimates of magnitude to an absolute system, and thus rendering them of real value.

ELECTRICITY ON PIKE'S PEAK

THE following extracts relative to electricity, from Pike's Peak Monthly Abstract Journals, have been very kindly forwarded to us by General Hazen, the chief of the U.S. Signal Service, in accordance with a request made by us; we believe their publication will prove useful:—

November 23, 1873.—Atmospheric electricity manifested itself when line was broken by a crackling sound when binding screws were touched, and bright sparks drawn when storepipe was touched by my fingers.

December 7, 1873.—While line was broken I heard relay working; thinking line had been repaired, I hastened to adjust; received a severe shock, which convinced me that something stronger than our battery had charged the wire. Instrument cut out and lightning arrester screwed closer; in a few minutes a continuous stream of electricity passed between the two plates of the arrester with a loud noise, resembling that produced by a child's rattle; the fluid passed not in sparks, but in five or six continuous streams of light, as thick as a pencil lead, for two or three minutes at a time, with short intervals between; this continued for over an hour.

December 11, 1873.—On retiring I accidentally touched my drawers with two fingers of my hand, and drew two sparks from them. This is a common phenomenon after a snow-storm.

January 12, 1874.—Electric shocks.

January 24, 1874.—Received electric shock when opening stove door; as usual, it was not repeated.

February 25, 1874.—Same as January 24.

May 11, 1874.—During the entire day severe shocks were felt by any one touching the wire, and, the line being open, I could make plain signals with the key for about ten minutes.

May 20, 1874.— p.m., report could not be sent on account of atmospheric electricity (a thunder-storm).

May 21, 1874.—A flash of fire about two feet long leaped from arrester into the office, illuminating the rooms.

May 24, 1874.—A heavy thunder-storm passed slowly and directly over the peak; large sparks passed constantly through the arrester, while a strange crackling of the snow could be heard at times. While making the 2 p.m. observation, I heard the snow crackle as above mentioned, and felt at the same time on both temples, directly below the brass buttons of my cap, a pain as if from a slight burn. Putting up my hands, there was a sharp crack, and all pain had disappeared.

May 29, 1874.—At 6.20 a terrific storm commenced; blinding flashes of fire came into bath-rooms from the lightning-arrester and stoves; loud reports followed in rapid succession.

July 1, 1874.—A party of visitors were caught in a thunderstorm not far from the summit, and all state that they experienced peculiar burning sensations on face and hands, and heard a hissing sound proceeding from hair and whiskers.

July 9, 1874.—Heavy thunder-storm; large sparks passed through the arrester during its continuance. Mr. Copley telegraphed me this forenoon that he twice got knocked down, while repairing the line, by electric shocks.

July 14, 1874.—Thunder storm; lightning in beginning very severe. I received a very painful shock while working over the line by my fingers accidentally touching the metal of the key.

July 15, 1874.—Thunder heard in the distance throughout the evening, while strong ground currents passed through the arrester.

July 16, 1874.—Severe thunder-storm; sharp flashes and retorts came through the arrester to the terror of several lady visitors. Outside the building the electric effects were still more startling. The strange crackling of the hail mentioned before was again heard, and at the same time my whiskers became strongly electrified and repellant, and gave quite audible hissing sounds. In spite of the cap I wore my scalp appeared to be pricked with hundreds of red hot needles, and a burning sensation was felt on hands and face; several of the visitors who were outside had the same experience. A large dog who had followed his master out-doors became terrified, and made for the door with a pitiful howl. Lightning was seen in all directions in the evening, and ground currents passed incessantly through the arrester.

July 19, 1874.—A severe thunderstorm passed close over the Peak between 1.30 and 2.30 p.m.; lightning struck wire between 2nd and 3rd poles from the house; for a moment the wire resembled a rope of fire and vibrated violently for some minutes after the discharge—no damage done. Frequent loud discharges took place along the ground-wire between it and the rocks on which it rests. Hair and whiskers of anyone outdoors were electrified by each discharge.

July 21, 1874.—Heaviest thunderstorm of the season to-day; lightning terrific; constant crackling of fallen hail and peculiar clattering of the rocks as if shaken by subterranean convulsions, indicated the highly electrified state of the summit.

August 2, 1874.—I was obliged to keep the telegraph instruments cut out during the greater part of the day.

August 3, 1874.—The lightning rendered the line almost useless the entire afternoon; I got severely shocked when sending my report.

August 13, 1874.—Seventeen visitors to day; some of them made the ascent during a severe thunderstorm, and were much alarmed by the effects of the electricity upon their hair, one of them declared that his hair stood up so stiffly as to lift off his hat!

October 5, 1874.—Severe thunderstorm below summit in afternoon, observers severely shocked whilst calling Fenton at lower station.

May 22, 1875.—During storms to-day (hail and snow) electricity quite strong.

May 23, 1875.—Electricity strong at intervals during day and night.

May 24, 1875.—Hail from 3.55 p.m. till midnight, accompanied by very strong electricity, decreasing and increasing in intensity, a notable fact in all hail-storms.

May 25, 1875.—Electricity has shown itself nearly all day with variable force (hail frequent during the day).

May 29, 1875.—Hail about midday accompanied by electricity. In all our hailstorms the fall of hail entirely ceases for about a half a minute, following a heavy electric discharge, and the hailfall is considerably heavier for some little time following the discharge than before.

July 5, 1875.—Terrible electric storm in afternoon, at first its effects were felt only by the line, but about 2 p.m. its presence was evident everywhere on the summit; a constant stream of flame from the arrester; a constant crackling noise heard out of doors as though made by small pistols.

May 11, 1876.—During hailstorm at 7.30 I was compelled to cut out the wires owing to intensity, this I attempted with ungloved hand, and learned a lesson that was an impressive one; luckily I escaped with a slightly bruised head and a fearful scare.

May 25, 1874.—During a thunderstorm the wire outside, at two or three places, kept up a peculiar singing noise, resembling the singing cricket. I have previously noticed that the singing noise is never heard except when the atmosphere is very damp, and rain, hail, or snow is falling.

June 16, 1876.—At 5.20 p.m., as I was sitting on a rock near the monument, on the eastern edge of the summit, a blinding flash of lightning darted from a cloud seemingly not more than 500 feet north-east of me, and was accompanied by a sharp, quick, deafening report, and at the same time I felt the electricity dart through my entire person, jerking my extremities together as though by a most violent convulsion, and leaving tingling sensations in them for a quarter of an hour afterwards. Straine, who was sowing wood in the shed at the time received a similarly violent shock, and says that a ball of lightning appeared to pass through the store-room and wood-shed in which he was working, leaving behind a strong sulphurous smell.

July 13, 1876.—Singing on the wire. It also seemed to come from the instrument shelter and the house, as well as from the wire. Thunder loud and continuous during the afternoon.

July 23, 1876.—The anemometer stopped working on account of the electric storm. Privates Straine and O'Keefe were shocked while trying to fix it, so that they had to give it up until the storm had subsided somewhat.

August 18, 1876.—A beautiful phenomenon was observed by myself, Private Greenwell, and four visitors. The peculiar singing noise (or sizzing noise) was heard again, always before in day, but this time at night, but the line for an eighth of a mile was distinctly outlined in brilliant light which was thrown out from the wire in beautiful scintillations. Near us we could observe these little jets of flame very plainly. They were invariably in the shape of a quadrant, and the rays concentrated at the surface of the line in a small mass about the size of a currant, which had a bluish tinge. These little quadrants of light were constantly jumping from one point of the line to another, now pointing in one direction then in another. There was no heat to this light, and when I touched the wire I could only feel the slightest tingling sensation. Not only was the wire outlined in this manner, but every exposed metallic point and surface was similarly tipped or covered. The cups of the anemometer appeared as four balls of fire revolving slowly round a common centre. The wind vane was outlined with the same phosphorescent light, and one of the visitors was very much alarmed by sparks, which were plainly visible in his hair, though none appeared in ours. At the time of this phenomena snow was falling.

March 27, 1877.—Singing noise heard upon the wire today.

May 12, 1877.—Hailstorm, accompanied by intense electricity.

May 24, 1877.—Sergeant Hobbs and Private Greenwell received severe shocks during the day.

August 6, 1877.—Intense electricity; all metal objects were tipped with sparks.

November 25, 1877.—Snow-storm all day attended by intense electricity, which could be heard crackling in a person's hair continuously, although no reports of thunder were heard.

December 26, 1877.—The atmospheric electricity was very intense during the day, and at times would crackle on various objects in the room.

January 25, 1878.—Several thunderstorms occurred in the surrounding parks and gulches. The electricity on the summit was very intense, causing a continuous snapping of the lightning arrester.

May 12, 1878.—A snow-storm commenced during the night, and at 1 p.m. was drifting furiously by a rising gale. The electricity varied with wind-gusts, and was so intense at times as to render our position exceedingly dangerous. The telegraph wires were cut out, but violent sparks would still jump six inches between the disconnected *windows*. One violent discharge seemed to have occurred in the chimney, for a terrible commotion was caused in the soot and ashes.

May 24, 1878.—At 8 p.m. snow commenced, attended with severe electricity, lasting for an hour. The wires had to be cut out and parted, and a vivid glaring was continuous in the windows. A lamp set in the north window would, with its flame, cast a shadow on the opposite wall for several seconds.

July 1, 1878.—During afternoon sleet fell, accompanied by intense electricity. At 3.20 a violent explosion occurred in the room, near the stove, scattering the wood and knocking down the stove-pipe.

April 10, 1879.—The telegraph wire heavily charged with a ground current of electricity this evening, and it was with difficulty that signal was transmitted. The current at times was entirely reversed.

June 16, 1879.—Light sleet, accompanied by thunder. Only a few peals were heard, when it gave way to a strong steady current over the wire, and for twenty minutes one of those electric storms peculiar and common to Pike's Peak prevailed. A queer hissing sound from the telegraph line, the wind-vane post, and other posts standing in a deep snow-drift near by. I stepped out to view the phenomenon, but was not standing in the snow-drift long, when the same buzz started from the top of my head, my hair became restless, and feeling a strange creeping sensation all over my body, I made quick steps for the station; once inside upon the dry floor, the effects soon left me. After getting inside I opened the telegraph key, and found a continuous bright spark passing between the key and the anvil, even when they were separated one-eighth of an inch; and by putting two thicknesses of writing-paper in this space, it was scorched, and perforated by numerous burnt holes. By accident I completed the circuit with both hands, when I received a shock that sent me back on the floor.

June 29, 1879.—Thunder-storm (very severe), 11.10 to 11.30 a.m., during which time a bolt passed through the arrester with a report exceeding that of a rifle, and threw sparks all over the office. The suddenness and violence of the shock stunned me, so that it was a little while before I could realise what had happened.

August 11, 1879.—During passage of a thunder-storm over the Peak a great amount of atmospheric electricity was manifested.

August 12, 1879.—Heavy snow and sleet began falling at 5.30 p.m.; at 5.40 p.m. a ball of lightning went through the arrester with the report of a rifle, throwing a ball of fire across the room against the stove and tin sheathing; the wood-packers, Messrs. Wade and McDonald, had taken refuge in the station for a few minutes, but concluded immediately that this was rather an uncomfortable place during a storm, and left immediately; their dog however was far in advance in seeking shelter outside. Mr. Wade declared that the lightning struck him in his feet and legs. At 6 p.m. the lightning struck the wire and building at the north end, where the wires come through the window and arrester with a crash equal to any 40-pounder. It burned every one of the four wires coming in at the window into small pieces, throwing them with great force in every direction, and filled the room with smoke from the burned gutta-percha insulation; the window-sash was splintered on the outside, one pane of glass broken, and another coated with melted copper. The anemometer wires were also burned up and the dial of the anemometer burned and blown to pieces. Private Sweeny was about deaf for some time afterwards. One piece of the wire was thrown with such force that when it struck the barometer three feet distant it was wound around it, without, however, doing any damage to the barometer.

July 2, 1880.—Line worked poorly on account of storm, each flash of lightning causing the instrument to be thrown out of adjustment; the signals at midnight were got off with great difficulty.

July 19, 1880.—Atmospheric electricity quite prevalent during the evening.

July 21, 1880.—Hail in afternoon and night, accompanied by heavy flashes of lightning which played around the arrester, and exploded with great force.

July 23, 1880.—Hail, rain and snow during the day; ended at 5.40 p.m. Intense ground currents during prevalence of storm.

June 23, 1881.—A light fall of hail, accompanied by terrific flashes of lightning, which snapped on the lightning arrester, and exploded with great violence.

July 4, 1881.—During the progress of the rain-storm it was accompanied by the heaviest discharges of lightning and thunder that I ever witnessed in all my experience at this station. The lightning snapped on the arrester and exploded with great violence in the office. Several times during the evening I was certain that the station building would be struck and demolished, as the lightning was almost continuous.

August 21, 1881.—Heavy hail began falling at 12.30 p.m., continued at intervals until 4.15 p.m., when it ceased. The hail was accompanied with the heaviest discharges of lightning that I ever witnessed in all my experience at this station. It was impossible to remain in the office during the progress of the hailstorm, as the lightning was almost continuous, and snapped and exploded in all directions, so that I was compelled to retreat to the kitchen for safety. The south-west portion of the station-building was struck by lightning, but no damage of any consequence was done, nor was the station-building impaired by the shock. The lightning arrester and ground wires were badly damaged, but the worst feature of the storms was the fact that both the station and extra barometers were also struck, and the cisterns of both cracked.

During the storm a shepherd was killed by lightning, and when found was stripped of his clothing and boots; he had taken refuge under a tree.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

EDINBURGH.—Five Fellowships in connection with this University (the gift of an anonymous donor) of the value of 100*l.* each, for one year, but renewable for one or two further years at the pleasure of the Senatus Academicus, will be open to applicants in October next. There will be no examinations for election to these Fellowships, but Fellows will be elected by the Senatus Academicus after consideration of the qualifications and circumstances of the applicants. The Fellowships are open to any graduate of a Scottish University, not being more than thirty years of age at the date of application, and provided that he be not an assistant to any Professor, or an examiner in any department. They are intended for persons having attained some proficiency in, and who are desirous to prosecute, unprofessional study and research in one of the following subjects:—Mathematics (pure and applied), or experimental physics, chemistry, biology, mental philosophy, history, or the history of literature. Persons desiring to hold one of these Fellowships should address an application to the secretary of the Senatus, with statement as to previous course of study, and general purposes with respect to future work. Each Fellow will be expected to reside in Edinburgh during the winter and summer sessions of the University (1882-83) to prosecute his particular branch of study under the advice of the Professor to whose department the subject belongs; and within a year after his election to give evidence of his progress by the preparation of a thesis, the completion of a research, the delivery of a lecture, or in some other way approved by the Senatus Academicus. No other fellowship, scholarship, or bursary, in this or any other University, will be tenable together with one of the elective Fellowships.

THE budget commission of the French Chamber of Deputies have printed their estimates for public instruction for 1883. They claim 5½ millions sterling, irrespective of the sums granted by departments for the same purpose. About half of this sum is claimed for elementary instruction, exhibiting, an addition of more than 800,000*l.* on the credit given for 1882. This is in prevision of the working of the law of compulsory education. The more notable items are the following:—Government grant to the grammar schools for young ladies, 12,000*l.*; national library, extraordinary expenses for printing the catalogue, 2000*l.*; ordinary expenses, 21,000*l.*; other public libraries, 12,000*l.*; aid to men of science and letters, 8000*l.*; scientific travelling and exploring, 8000*l.*; College de France, 19,000*l.*; Museum of Natural History, 36,000*l.*; Institute of France, 28,000*l.*, of which 8000*l.* are granted to the Academy of Sciences; Academy of Medicine, 3000*l.*; School of Hautes-Etudes, 12,000*l.*; astronomical and meteorological establishments, 35,000*l.*; including a school for astronomers, which has been opened at the Observatoire of Paris, but will be closed as soon as the several French observatories will have procured a sufficient number of trained observers. The commission refuse to grant money to the meteorological observatory of Mount Ventoux.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, June.—On the several efficiencies of the steam-engine, and on the conditions of maximum economy (continued), by R. H. Thurston.—Ninety miles in sixty minutes (continued), by W. B. Le Van.—Ringing bells, by J. W. Nystrom.—Radio-dynamics; universal phyllotaxy, by P. E. Chase.—A thermograph, a new apparatus for making a continuous graphical record of the variations of temperature, by G. M. Eldridge.—Electricity, by A. E. Outerbridge, jun.—An essay on mechanics and the progress of mechanical science, 1824-82, by F. Finley.—Device for increasing the dynamic effect of the pulsations of diaphragms and the like, by W. B. Cooper.—Influence of pulley-diameter on the driving power of flat belts, by R. Grimshaw.—Recent improvements in the mechanic arts, by F. B. Brock.

Bulletin de l'Academie Royale des Sciences de Belgique, No. 4.—History of the Imperial and Royal Academy of Sciences and Belles-Lettres of Brussels, by M. Mailly.—On the dilatation of alums, by M. Spring.—One word more on the determination of latitude, by M. Folie.—On the rocks of the island of Fernando Noronha, gathered during the *Challenger* expedition, by M. Renard.—On the state of vegetation, March 21, 1882, by M. Dewalque.—On the respiratory variations of the sanguineous pressure in the rabbit, by MM. Moreau and Lecrenier.—Mineralogical examination of the rocks which accompany the diamond in the mines of the Cape of Good Hope, by M. Meunier.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xv., fasc. ix.-x.—On the nature and origin of tumours occasionally found free in the abdominal cavity, by S. Sangalli.—Presentation of a piece of wood from Brazil, with the apparent figure of a serpent, by Dr. Mantegazza.—On protistological examination of the water of Lake Maggiore, extracted at 60 metres depth, between Angera and Arona, by S. Maggi.—Zoological notes, by S. Pavesi.

Rivista Scientifico-Industriale, April 30 and May 15.—New seismic apparatus of the Brothers Brassart, by S. E. Brassart.—The comets seen in the last ten years and Comet Wells, by S. Zona.—On sounds produced by outflow of liquids, by S. Martini.—On succinine, by Drs. Funaro and Danesi.—*Sinaxylon muricatum*, Fab., in the Romagna, by S. Rovelli.—The story of a flint stone, by S. Mascarine.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, June 20.—Dr. A. Günther, F.R.S., vice-president, in the chair.—The Secretary exhibited a series of the diurnal and nocturnal Lepidopterous insects bred in the Insect House in the Gardens during the present season, and called attention to several specimens of clear-winged Moths (*Sesiidæ*), a group of insects which had not before been exhibited in the Insect House. The cocoon of *Cricula trifenestrata*, together with the imago, was also exhibited.—Mr. W. A. Forbes made remarks on the presence of a rudimentary hallux in certain birds—the Albatrosses and two genera of Woodpeckers (*Tiga* and *Picoïdes*), commonly described as being three-toed, and exhibited preparations showing its condition in the birds in question.—Prof. Owen read the twenty-fifth of his series of memoirs on the *Dinornis*. The present communication gave a description of the head and feet, with their dried integuments, of an individual of a species supposed to be called *Dinornis didina*. These specimens had been obtained by Mr. H. L. Squires at Queenstown, South Island of New Zealand, and being parts of one individual tended to elucidate in an unlooked for degree the external characters of the Moa.—A second communication from Prof. Owen contained some observations on *Trichina spiralis*.—Prof. E. Ray Lankester gave a description of the valves of the heart of *Ornithorhynchus paradoxus*, and compared them with those of man and the rabbit. Prof. Lankester also made some observations on the *fossa ovalis* of the Monotremes.—Prof. Huxley, F.R.S., read a description of the respiratory organs of *Apteryx*, which he showed did not differ fundamentally from the Avian type, and pointed out that neither of the structures that had been termed diaphragms in the *Apteryx* was really in correspondence with the Mammalian diaphragm.—Mr. W. A. Forbes read the sixth of his contributions to the anatomy of Passerine birds. In the present communication the author showed that *Xenicus* and *Acanthisitta*, hitherto considered to be allied to *Certhia*, *Sitta*, and *Sittella*, were really mesomyodian forms, most nearly allied perhaps to *Pitta*. The discovery of such low forms of Passerine birds in New Zealand was a fact of considerable interest, none of the allied groups being at all represented there at the present day.—A communication was read from Mr. Sylvanus Hanley on the shells of the genus *Leptomya*, to which was added the descriptions of two new species.—Mr. Sclater read a note on Rüppell's Parrot, and showed that the more brightly-coloured individuals, ordinarily supposed to be the males of this parrot, were really the females.—A second paper from Mr. Sclater gave the description of two new species of the genus *Synallaxis* from the collection of Messrs. Salvin and Godman.—A communication was read from Prof. M. Watson containing an account of the muscular anatomy of *Proteles* as compared with that of *Hyæna* and *Viverra*.—Mr. Oldfield Thomas read a paper containing a description of a new species of Rat from China. The specimens upon which the author had founded the description had been sent by the Abbé Armand David to Mr. Milne-Edwards, of Paris, who had placed them in the hands of Mr. Thomas for identification. The author proposed to call this Rat *Mus Edwardsi*.—A communication was read from Mr. E. W. White, F.Z.S., of Buenos Ayres, in which he gave an account of the birds collected by him in the Argentine Republic.—Mr. R. Bowdler Sharpe read the descriptions of two apparently new species of *Erythropygia*, one from the Zambesi, the other from the Congo River, which he proposed to call respectively *E. zambesiana* and *E. ruficauda*.—A second paper by Mr. Sharpe contained the description of a new Flycatcher which had been obtained by the late Governor Ussher on the Gold Coast. The author proposed to call it *Muscicapa ussheri*, in acknowledgment of the services which its discoverer had rendered to ornithological science.—A communication was read from Mr. F. Moon on the Lepidoptera collected by the Rev. J. H. Hocking, chiefly in the Kangra District, N.Y. Himalaya. The present communication, being the second on the same collection, contained the descriptions of seven new genera and of forty-eight new species. An account of the transformation of a number of the species was also given.

Physical Society, June 24.—Prof. Clifton, president, in the chair.—New Members: Prof. Bartholomew Price, Principal Viriamu Jones.—Prof. G. Carey Foster moved a vote of thanks to Prof. Clifton for the excellent reception accorded to the Physical Society at Oxford on the preceding Saturday, and drew attention to the high efficiency of the Clarendon Laboratory and the admirable provision made for the teaching of physics at Oxford. Prof. W. G. Adams seconded the motion, and endorsed Prof. Forster's views of the position of physical science on the Isis. Prof. Clifton in response to the vote, stated that the University of Oxford had liberally supported him in organising the Clarendon Laboratory, giving him all the funds he required, and showing a laudable desire to put physical teaching on the best possible footing in Oxford.—Prof. C. A. Bjerknes of Christiania, was then introduced to the meeting, and, assisted by his son, M. Vilhelm Bjerknes, delivered a lecture on "Hydrodynamic Analogies to the Phenomena of Electricity and Magnetism," which was illustrated by experiments and projections on the screen. Prof. Bjerknes has been engaged in tracing these analogies for the last twenty-five years, at first mathematically, but latterly by experiments in verification of the deductions from his formulæ. These experiments were shown in the Paris Electrical Exhibition last year, and have been published repeatedly in this country. Dr. Bjerknes has, however, advanced beyond the results there shown. These were chiefly confined to illustrating the static attractions and repulsions of electricity and magnetism; but he has now taken up the subject of electrodynamic attractions and repulsions. The former effects are shown by brass balls oscillating, or by small tambours pulsating, near each other in water. These motions are communicated to the balls and drums by pulses of air transmitted from an ingenious air-pump or bellows along india-rubber tubes. A pulsating drum corresponds to a magnetic pole; an oscillating body to a magnet. When two tambours are vibrating near each other in like phase, they attract; when in unlike phase, they repel each other. The same holds true of the oscillating balls. The motion-lines round these bodies correspond to the lines of force round magnets, as was demonstrated by a hollow ball oscillating or a stem, and tracing its movements in ink on a glass plate. All the phenomena of magnetic forces were illustrated in this way by Prof. Bjerknes, including diamagnetism, which was shown by means of pith cylinders lighter than the water or medium of oscillation. A pulsating drum or oscillatory ball repelled the cylinder of pith, whereas it attracted a cylinder of wax, which is heavier than the water. The more novel part of the experiments consisted in representing the attraction between two electric currents flowing in the same direction by means of two cylinders about five inches long and one inch in diameter, oscillating round their longitudinal axes at close quarters in the water. The cylinders were oscillated by means of a pulsating tambour which communicated its motion to them by a toothed gearing on their ends. Attraction resulted when the oscillations of the cylinders were opposed to each other, and repulsion when they were in the same direction. This is an inversion of what might have been expected to take place after the theory of Ampère. A square of four oscillating cylinders was also formed, and a fifth cylinder oscillated inside it, the attraction or repulsion exerted on the latter being observed. A hydrodynamic galvanometer was made by placing an oscillating ball (which corresponds to a magnet) beside an oscillating cylinder, the result being a deflection of the ball according to the direction of the oscillation of the cylinder. The experiments were witnessed by a full meeting, which accorded a hearty vote of thanks to Dr. Bjerknes.—A paper by Dr. C. R. Alder Wright, F.R.S., was taken as read. It was on the determination of chemical affinity in terms of electromotive force (Part vi.), and on the relations between the E.M.F. in cells constructed like Daniell's cells, but containing different metals, and the chemical affinities involved in their actions. The cells employed were constructed of cadmium and copper, and their sulphates, zinc and cadmium and their sulphates, zinc and silver and their sulphates, cadmium and silver and their sulphates, copper and silver and their sulphates. In all cases the sulphate solutions were of equal molecular strengths. The general result is that the effect of a given alteration in the character of the plates opposed to cadmium or silver was found to be practically identical with that of the same alteration in the case of a Daniell cell. Volta's law of the summation of E.M.F. forces sensibly holds true in the cases examined. These cells also behave like a Daniel under variations of current density. The Society meets again in November.

Geological Society, June 21.—J. W. Hulke, F.R.S., president, in the chair.—Robert Bruce Napoleon Walker was elected a Fellow of the Society.—The following communications were read:—On *Thecospondylus horneri*, a new Dinosaur from the Hastings Sand, indicated by the sacrum and the neural canal of the sacral region, by Prof. H. G. Seeley, F.R.S., F.G.S.—On the dorsal region of the vertebral column of a new Dinosaur, indicating a new genus, *Sphenospondylus*, from the Wealden of Brook, in the Isle of Wight, preserved in the Woodwardian Museum of the University of Cambridge, by Prof. H. G. Seeley, F.R.S.—On organic remains from the Upper Permian strata of Kargalinsk, in Eastern Russia, by W. H. Twelvetrees, F.G.S. In this paper the author described the Kargalinsk steppe, north of Orenburg, as consisting of a grassy, treeless, undulating steppe, with sluggish, winding streams, in the banks of which, and in the ravines, the exposures of subsoil show only red marl or sandstone devoid of fossils. Mine-borings and shafts go down through red, yellow, and grey sandstones and red and white marls, which are fossiliferous wherever the beds of copper-ore exist. On the eastern border of the steppe there are two protrusions of limestone, with *Terebratula elongata*, *Loxonema*, &c., on outcrops running nearly north-west and south-east, which throw off the cupriferous sands east and west. The western of these outcrops in its southern continuation near Sakmarsk is charged with Permian Fossils, including the above; the same limestone, regarded by the author as belonging to the Zechstein, crops up in other places, and apparently underlies the whole basin of the steppe, the upper sandstones resting conformably upon it. From the latter the author gave the following list of fossils:—*Cardiopteris Kutorgæ* (=*Aroides crassispatha*), *Walchia biarmica* and *piniformis*, *Lepidodendron*, *Schizodendron tuberculatum*, *Anomorrhœa Fischeri*, *Caulopteris?*, *Calamites infractus*, *Suckowi gigas* and *leioderma*, *Unio umbonatus*, *Platyops Richardi* (a Labyrinthodont), *Rhopalodon Wangenhäuseri*, *Cliorhizodon*, *orenburgensis*, *Deuterosaurus*, and various Labyrinthodont and Reptilian remains. Upon these the author remarked that the list of plants has a Palæozoic aspect, while the Reptilian remains seem to be more of a secondary character. After consideration of all the facts, the author came to the conclusion that possibly some of the beds in the central part of what is known as the Permian basin may be passage-beds between the Permian and Trias, but that the Kargalinsk series includes the uppermost beds of the Permian.—The Rhætics of Nottinghamshire, by E. Wilson, F.G.S.—On the Silurian and Cambrian strata of the Baltic provinces of Russia, as compared with those of Scandinavia and the British Islands, by Dr. F. Schmidt. Communicated by Dr. H. Woodward, F.R.S., F.G.S. The Cambrian and Silurian strata in question are found stretching over an area 400 miles long by 80 miles wide. The country occupied by these strata is a nearly uniform plain covered by glacial deposits, but sections are presented by the sea-cliffs, which are from 90 to 150 feet high. The strata consist mainly of marls and limestones, arenaceous deposits being rare, and they form a continuous series from the base of the Cambrian to the top of the Silurian, the whole of these strata being in conformable succession and unconformably overlain by the Devonian. Although the representative of the Cambrian or Primordial Silurian contains neither *Paradoxides* nor *Orlenus*, nor, indeed, any Trilobites whatever, but only Lingulidæ and Graptolites, yet its stratigraphical position leaves no doubt as to its age.—On Chilostomatous Bryozoa from Bairnsdale (Gippsland), by A. W. Waters, F.G.S.—The Silurian species of *Glauconome*, and a suggested classification of the Palæozoic Polyzoa, by G. W. Shrubsole, F.G.S., and G. R. Vine.—On the cause of the depression and re-elevation of the land during the glacial period, by T. F. Jamieson, F.G.S.

EDINBURGH

Royal Society, June 19.—The Right Hon. Lord Moncreiff, president, in the chair.—Prof. Tait, in Part III. of his paper on Mirage, called attention to an elaborate Memoir on the subject by Biot, who had anticipated him in many particulars. Biot had pointed out the existence of the curve of vertices, which Prof. Tait made the basis of his discussion, but had not made any use of it, preferring to investigate the phenomena by means of the caustics—a much more difficult method. Further, in his explanation of the appearances described by Vince, Biot regarded the rays as being for the first part of their course concave upwards—a state of affairs which Prof. Tait regarded as very unlikely. Such a point, however, could be settled only by careful measurements of the dip of the horizon taken at different heights above sea-level.—Dr. Dobbie and Mr. G. G. Henderson, B.Sc., communicated the results of their analysis of the red resin obtained by Prof. Bayley Balfour, from the Socotra species *Dracæna Cinnabari*, and of their comparisons between it and other specimens of dragon's-blood. These they found to differ considerably, specimens going by the same name being often markedly distinct in their chemical properties. They concluded that of the several distinct and well-defined varieties which they had investigated, each was probably derived from a distinct genus, different species of the same genus yielding the same resin.—Prof. Crum Brown read a paper by the Rev. J. L. Blake, on breath pressure. This paper was a careful analysis of the individual efforts or distinct breath-pulses by which articulated utterance is effected, and by which emphasis is regulated; and was illustrated by examples selected from various authors. —In a preliminary notice on the effect of moisture on the electric discharge, Dr. Macfarlane and Mr. Rintoul mentioned that they had obtained indications that the difference of potential required to cause the discharge between two plates was greater in dried than in undried air.—Prof. Crum Brown communicated a note by Mr. A. P. Laurie and Mr. C. J. Burton, on the heats of combination of the metals with the halogens, which they had compared by the electrometer method, assuming Sir W. Thomson's formula which expresses the electromotive force of a cell in terms of the thermal equivalent of the chemical action. The results obtained were in fair agreement with those of direct calorimetric experiment.

GÖTTINGEN

Royal Society of Sciences, August 6, 1881.—On the Biehler collection of gems, by F. Wieseler.

December 3, 1881.—Observations in the Gauss Magnetic Observatory, by K. Schering.

May 6, 1882.—On the geological structure of the neighbourhood of Göttingen, by A. von Kœnen.—Contribution to knowledge of the inflammatory force of retarded discharges, by W. Holtz.

June 13, 1882.—Whence comes the x of mathematicians, by P. de Lagarde.

PARIS

Academy of Sciences, July 3.—M. Jamin in the chair.—It was announced that the *Romanche*, with the expedition for Cape Horn, would sail that week. Good wishes were expressed, also thanks to the Naval Minister for carrying out the Academy's request.—On the appearances of the electric arc in sulphide of carbon vapour, by MM. Jamin and Maneuvrier. When a little of the sulphide is brought into the vacuous receiver, there occurs an explosion, as it were, of brilliant unbearable light between the (parallel) carbons; the persistent arc is of horse-shoe form, and pale green, and a long flame rises above. The spectrum consists of four channelled spaces, quite alike, in red, yellow, green, and violet, the green, however, being most luminous. If air have remained in the jar, sulphur is deposited on the walls; if not there is a brown deposit, probably a compound of sulphur and carbon.—On the electrolysis of oxygenated water, by M. Berthelot. The minimum force required was a Daniell. The electrolytic reactions and heat consumed are shown to be in correlation with the electromotive forces.—On the electromotive force of a zinc-carbon element, by M. Berthelot. His experiments (with the Mascart electrometer) show the unfitness of the zinc carbon element to give a constant electromotive force.—M. Berthelot gave some observations on the Channel Tunnel, which he had visited.—Analysis of the mechanism of locomotion by means of a series of photographic images on one plate, representing successive phases of the motion, by M. Marey.—On the second comet of 1784, by M. Gyldén.—On the decomposition of protochloride of gallium by water, by M. Lecocq de Boisbaudran. Metallic gallium is dissolved in the cold state in concentrated hydrochloric acid. The The clear liquid produced, left to itself, yields gas very slowly, but if water be added, "in torrents."—On the mechanism of stoppage of hemorrhage, by M. Hayem. The hematoblasts play an active and considerable part in it, becoming adhesive when they reach the edge of a wound (as when they meet a foreign body), accumulating, stopping others, and so narrowing the orifice. The other elements of blood and the formation of fibrine have only a secondary *rôle*.—MM. Pellicot and Jaubert recommended sulphate of iron as a remedy for phylloxera.—On a new series in elliptic functions, by M. Faa de Bruno.—On entire transcendants, by M. Poincaré. —Researches on the use of crusher manometers for measurement of pressures developed by explosive substances, by MM. Sarrau and Vieille. The authors seek to render the indications of these instruments more definite.—On the theory of equipotential figures obtained by the electro-chemical method, by M. Guébhard.—Determination of the densities of vapour in glass globes at the boiling temperature of selenium, by M. Troost. With glass globes of small fusibility, and 300 c.c. capacity, he finds iodine vapour to have still at 665° a coefficient differing very little from that of air, while even at 440° its coefficient of compressibility is notably different from that of air. Sulphur vapour passes, like oxygen, from one allotropic state to another as the temperature rises.—Some remarks on didymium, by M. Clève.—Action of sulphuretted hydrogen on chloride of nickel, by M. Baubigny.—On the isomerism of cupreous sulphites, by M. Etard.—Reduction of certain silver ores by hydrogen and the wet process, by M. Laur. Wherever hydrogen appears in a liquid containing sulphide, chloride, bromide, and iodide of silver, a hydrogen acid is formed, and the silver passes to the metallic state.—Action of chloroform on β-naphtol, by M. Rousseau.—Introduction into industry of vanadium extracted from the basic scoriæ of Creusot, by MM. Witz and Osmond. The Creusot scoriæ contain vanadium estimated at 60,000 kg. annually. The authors have been able to extract either metavanadate of ammonium, or new vanadic products specially applicable to manufacture of aniline blacks with chlorates.—On an anomaly of the eye, by M. Dareste. He has noticed arrested development of the eye (reduced to the secondary optic vesicle) in anomalous or monstrous embryos.—On the histology of *Ciona intestinalis*, by M. Roule.—On the development of Gregarinæ and Coccidæ, by M. Schneider.—Use of oxygenated water in surgery, by MM. Peau and Baldy. The substance may be advantageously substituted for alcohol or carbolic acid in treatment of wounds, ulcerations, deep abscesses, &c. M. Bert remarked on the killing of microbes, and the incessant libation of oxygen to the wound. —Researches on a new cardiac medicament; physiological properties of *Convellaria maialis* (May lily), by MM. See and Bochefontaine. It acts like digitalis, but is without certain drawbacks to that substance. In man it has diuretic properties superior to those of any known agent.

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