THURSDAY, DECEMBER 11, 1879

CAMBRIDGE UNIVERSITY

THE draft of the proposed Statutes just issued by the Commissioners, will, if we mistake not, mark an era in the history of one, at all events, of our Universities. It indicates a large and wise view on the part of the Commissioners, and though it will scarcely place Cambridge on a level, so far as teaching power goes, with a second-rate German University, it will go far to remedy the present state of things, and on it a superstructure may in time be laid in true harmony with the wants of the time.

What the Commissioners have really had to do is to convert an assemblage of "Hauts Lycées" into a living University, and, of course, this had to be done, if it were done at all, at the expense of the Colleges. This has long been foreseen, and the way in which it has been approached leaves nothing to be desired, so far as the manner goes; if a minimum only had not been fixed many might have said that the proposal hardly went far enough. The Commissioners evidently have faith. It will be best to give in the first instance an analysis in the words of the Statutes as far as possible.

In order to obtain contributions from Colleges for university purposes, it is ruled that the Colleges shall pay to the University in every year, out of their revenues, a sum determined according to the following quota, viz.:—

For every 1,000*l.* levied,—

Peterhouse	23
Clare	47
Pembroke	47
Gonville and Caius	62
Trinity Hall	33
Corpus Christi	43
King's	126
Queens'	19
St. Catharine's	19
Jesus	57
Christ's	57
St. John's	169
Magdalene	7
Trinity	229
Emmanuel	33
Sidney Sussex	25
Downing	4

This quota, which must have cost somebody a vast amount of trouble, enables any one to judge of the effect of the scheme on any College. Thus, assuming that Peterhouse pays its non-Resident Fellows 230*l.* a year, the sacrifice of two of these will alone be required to enable that College to do its share towards providing 20,000*l.* annually for University purposes.

We mention this because we are sure to hear of the Colleges being crippled, and it is clear that only wooden legs are threatened.

The quota is subject to revision at any time not less than five years after the approval of the Statute by the Queen in Council, and again after intervals of not less than ten years from that or any subsequent revision, the revision at such times being made, on the requisition of any one or more Colleges, by the Chancellor of the University with assistants.

The sum to be contributed by the Colleges in any year from January 1 next after the approval of the Statute by the Queen in Council to the end of the year 1882 is not to be less than 8,000*l.* nor more than 10,000*l.*; in each of the years 1883, 1884, 1885, and 1886 not less than 12,000*l.* nor more than 15,000*l.*; in each of the years 1887, 1888, 1889, and 1890, not less than 16,000*l.* nor more than 20,000*l.*; in each of the years 1891, 1892, 1893, and 1894, not less than 20,000*l.* nor more than 25,000*l.*; and in every subsequent year not less than 25,000*l.*

The Colleges will not be required to contribute in any year a greater sum than 25,000*l.* without the consent of a majority of votes at a meeting of Representatives of the Colleges called for the purpose of considering the question.

This money contribution, however, is not the only one. Taking advantage of a system which has, it may be said, been suggested by the best of the Colleges themselves, it is ruled that there shall be in every College one or more Fellowships assigned to Professorships, such Fellowships to be called Professorial Fellowships.

The Professor admitted into any Professorship to which a Fellowship is thus assigned shall thereby *ipso facto* vacate any Fellowship he may hold at any College; and he shall have the same privileges, dividend, and emoluments as any other Fellow of the College to which the Professorship is attached. A Professor admitted into any Professorship to which a Fellowship is assigned by this Statute shall *ipso facto* vacate any Mastership he may hold at a College other than that to which the Professorial Fellowship attached to the Professorship is assigned; and if the Professor be admitted to the Mastership of any College other than that to which the Professorship is attached, he shall vacate his Professorship.

If upon the vacancy of any Professorial Fellowship the College declines to elect as Fellow the Professor to whose office the Fellowship is assigned, the Fellowship will remain vacant, its dividend being paid to the University.

A Professor retiring from office after holding it for not less than twenty years, shall be deemed thereafter an Honorary Fellow of the College, enjoying such privileges and advantages as the College may from time to time determine.

The first vacancy in the Fellowships of a College after the election of a Professor to whose office a Fellowship at that College is assigned, is to be appropriated to the Professorship.

The next section of the new Statutes deals with the Financial Board of the rehabilitated University. We need not refer to this here, except to say that the scheme seems wisely drawn and that the Colleges are to be well represented on it.

We next come to the Boards of Studies.

Eleven such Boards are to be constituted for all important departments of study recognised in the University, and are to consist of the Professors hereinafter assigned to such boards severally, together with such Readers, University Lecturers, Examiners, and other persons as may be chosen from time to time by the Senate.

The Boards to be first appointed are for—

Divinity.	Medicine.
Law.	Classics.
Language.	History.
Mathematics.	Moral Science.
Physics and Chemistry.	Music.
Natural Science.	

But with great wisdom, and here it is to be added that the Commissioners have introduced as much elasticity as possible, the University is to have power to vary the number and designation of these Special Boards from time to time on the recommendation of the General Board of Studies, provided that the whole number of such Boards shall never be less than eight.

The Professors assigned to the said eleven Boards are as follows:—

Divinity	Regius. Lady Margaret's. Hulsean. Norrisian. Ely.
Law	Regius. Downing. Whewell.
Medicine	Regius. Downing. Anatomy. Pathology.
Classics	Regius of Greek. Latin.
Language	Regius of Hebrew. Arabic. Sanskrit. Anglo-Saxon.
Mathematics	Lucasian. Plumian. Lowndean. Sadlerian.
Physics and Chemistry	Jacksonian. Chemistry. Mechanism. Cavendish of Physics. Astronomy and Astronomical Physics.
Natural Science	Woodwardian. Botany. Mineralogy. Zoology and Comparative Anatomy. Physiology.
History	Modern History. Disney. Thirlwall. Dixie.
Moral Science	Knightbridge. Political Economy. Mental Philosophy and Logic.
Music	Music.

Power is again given to the University to vary the assignment of Professors to the several Special Boards on the recommendation of the General Board of Studies.

Each Special Board is to consult together from time to time on all matters relating to the studies and examinations of the University in its department, and in consultation with the Professors, Readers, and University Lecturers connected with its department, frame a scheme of lectures in every year; taking care to provide that the subjects of the said lectures be determined with regard to the general objects of every particular Professorship, so as to distribute the several branches of learning in the best manner.

These Special Boards are to be controlled by a General Board of Studies, consisting of the Vice-Chancellor, one member of every Special Board of Studies elected by that Board, and eight members of the Senate.

The duty of the General Board is to consult together on all matters relating to the studies and examinations of the University, including the maintenance and improvement of existing institutions, and the establishment and maintenance of new institutions.

Among the functions of the General Board are the superintendence of laboratory work and the subordination when necessary of the Readers and University Lecturers to the professors.

Those who know Cambridge at present will have seen in the foregoing lists some new Professorships. As a matter of fact six new Professorships are to be established in the University for the following subjects, viz.:—

Physiology.
Pathology.
Mental Philosophy and Logic.
Astronomical Physics.
History, Thirlwall.
Ecclesiastical History, Dixie.

The Professors in these subjects are to be appointed before the end of the year 1882.

Here again the Commissioners show a wise discretion in ruling that the University shall have power to establish from time to time Professorships for other departments of learning or science. The Professorships so established may either be limited to a definite term of years or to the tenure of office of one Professor only; and if not so limited, they may be suspended or discontinued on the occurrence of any vacancy.

The stipends of the Professors, it is suggested, should be raised from their present level to correspond with the following scheme:—

Professors.

	£		£
Regius of Law	600	Experimental Physics	750
Whewell	500	Mechanism	400
Regius of Medicine	400	Astronomical Physics	500
Anatomy	300	Woodwardian	500
Pathology	600	Botany	300
Greek	750	Mineralogy	300
Latin	750	Zoology and Comparative Anatomy	600
Arabic	500	Physiology	600
Sanskrit	500	Modern History	400
Anglo-Saxon	500	Thirlwall.	
Lucasian	750	Dixie.	
Plumian	750	Knightbridge	400
Lowndean	600	Political Economy	300
Sadlerian	600	Mental Philosophy and Logic	400
Jacksonian	600	Music	200
Chemistry	750		

It must not be forgotten that the above sums are exclusive of the dividend on the Fellowship which is held by each Professor; and, further, the University is given power to vary the stipends from time to time, *provided that no such variation shall affect the interest of a Professor without his consent, or diminish the aggregate amount of payment to the whole body of Professors.* That is to say, the scheme is perfectly elastic, only the Commissioners do not intend to have it improved into effeteness.

The actual increase to the Professoriate, it will have been seen, is small; the ultimate increase to the teaching power of the University is, however, great. This is accomplished by the appointment, in connection with the departments of study for which Special Boards of Studies are appointed, of a body of teachers called Readers.

The number of Readers to be appointed is twenty-nine, distributed as follows:—

Divinity	2
Law	3
Medicine	2
Classics	4
Language	4
Mathematics	6
Physics and Chemistry	4
Natural Science	2
History	1
Moral Science	2

Of these not less than fourteen are to be appointed before the end of the year 1882, and the rest before the end of the year 1886.

The University may vary the connection of the Readers with the several Special Boards of Studies, and increase their number, upon the recommendation of the General Board of Studies.

The stipend of a Reader is 400*l.* a year, subject to variation by grace of the Senate upon the recommendation of the General Board of Studies, but no such variation shall affect the interest of a Reader without his consent, *or diminish the aggregate amount of payments to the whole body of Readers.*

The University is to have power to give pensions to retiring Readers according to circumstances, as the Senate may think fit.

Another arrangement for increasing the teaching power in the University is the appointment of University lecturers.

The General Board of Studies acting in conjunction with any Special Board may choose as Lecturers in the department of study for which the Special Board is formed such College Lecturers as they may think fit, who are willing, with the concurrence of their respective Colleges, to throw open their lectures to all students of the University.

The Lecturers so chosen are to be called University Lecturers, and each of them shall receive from the University an annual stipend of 50*l.*

No one is to be appointed to this office who does not receive from his College an annual stipend of at least 200*l.* as Lecturer, irrespective of the income of a Fellowship or other College emolument; the office of University Lecturer becomes *ipso facto* vacant if the holder of it ceases to hold the office of College Lecturer or receives from such office a less stipend than 200*l.* a year.

The number of University Lecturers and their connection with the Special Boards of Studies shall be determined from time to time, provided that when fit persons can be found the whole number shall be not less than thirty [one-half to be appointed before the end of the year 1882, and the rest before the end of the year 1884].

There is only one other point of the Statutes which we need analyse on the present occasion; this refers to the duties of Professors and Readers.

It is laid down that it shall be the duty of every Professor and Reader *as well to devote himself to research and the advancement of knowledge in his department* as to give lectures in every year.

It is impossible to estimate the good these words will do to the cause of research in England, where so many of our Professors sink to the level of mere traders. They should, though perhaps less necessary at Cambridge than elsewhere, be put up in letters of gold on the Senate House.

It will be sufficiently clear from the foregoing that with the great increase of teaching power which the Statutes confer the University should rise phœnix-like from its ashes, and that the present condition of things will be entirely changed.

How Cambridge in the new order of things will stand as compared with other Universities, and the lines along which future work and reforms may run, are questions so interesting that we may return to them and others on a future occasion.

AURORÆ

Auroræ: their Characters and Spectra. By J. Rand Capron, F.R.A.S. (London: E. and F. N. Spon, 1879.)

IN Mr. Gore's delightful book on the "Art of Scientific Discovery," it is said that "during the prosecution of an original investigation, the area of question and discovery enlarges as we proceed, and the research in some cases develops into such complexity and magnitude, that solution of its questions appears for a time hopeless. Generally, however, when that discouraging point is attained, the subject begins to clear, and by persistent research is gradually reduced to order, and is found to conform to a few general laws or principles."

The first part of this paragraph is only too apt a description of the present stage of the inquiry into the causes and nature of the Polar aurora. The striking character of the phenomenon itself, its evident connection with electric and magnetic disturbances, its unaccountable spectrum, and the relations which various observers have believed they had detected with solar spots, and coronal rays, are powerful stimulants to scientific curiosity. But so far the most painstaking researches have failed to seize the connecting link which should unite these various aspects into one organic whole; and we can only hope that the concluding sentence which we have quoted may be a prophesy of ultimate success. Under such circumstances Mr. Capron has done good service to science by collecting in a compact form the whole information which we possess on the subject, for it is only by careful study of what is already known that we can decide on the point of attack which gives the best hope of further conquest.

The first four chapters of the book are taken up with descriptions of specific auroræ. Among these we are sorry to miss a fuller account of the careful and accurate observations made by Lieut. Weyprecht during the Austrian Arctic Expedition of 1872-4. His description of arctic auroræ, as quoted from Payer's "New Lands Within the Arctic Circle," is exceedingly graphic and picturesque, but the original paper[1] as read before the Imperial Austrian Academy of Science, with its accurate classification of auroral forms, seems to have escaped the author's notice, as it is not even named in the list of papers in the appendix.

In Chapter V. the question of sound produced by the northern lights is discussed with the result that the balance of evidence is against it. Upon the height of

[1] "Die Nordlichtbeobachtungen der österreichisch-ungarischen arctischen Expedition 1872-74," von Carl Weyprecht, vorg... t 17 Mai, 1877.

auroræ the most diverse conclusions are quoted, trigonometrical measurements giving results varying from a few thousand feet up to 1,000 miles, while there are several well attested instances in which auroral rays have been seen actually between the observer and terrestrial objects. If these latter observations are correct it is evident that auroræ may be produced near the earth's surface, and consequently in air of considerable density. They are supported by the fact that the lower trigonometrical measurements are less liable to fallacy than the higher, since in the latter it may always be objected that observers at different stations might have seen different arches, or that the auroral arch in general is merely a perspective illusion produced by the termination of vast numbers of parallel rays at the same height. Additional observations of auroræ seen between the observer and mountain-tops or other elevated objects would be of great scientific interest.

Another very important line of inquiry noted by Mr. Capron is that of the connection of clouds and auroræ, some types of cirrus cloud so much resembling auroræ in their forms and arrangement that it is very probable that in some of the reported cases of daylight auroræ the observers may merely have noted arches of cirrus. On the other hand, it is by no means unlikely that some form of cloud, especially that which consists of small particles of ice, may be illuminated by electric discharges, and be the actual material basis of the phenomenon. In this connection the coincidence of auroræ with mock suns and similar appearances is of interest, since these indicate the presence of minute ice-crystals in the upper air. The Whitby fishermen, on September 23 of this year, reported a considerable aurora, and on the same night the moon, "prior to being obscured by clouds, seemed to shed a radiant glow straight up and down" (probably a rudimentary *paraselene*).[1] If aurora really is ever visible by daylight, it would seem almost incontestable that it must consist in some form of mist capable of reflecting as well as of emitting light, for the light of the brightest aurora is very inferior in *intensity* to that of the moon's surface, and the moon by daylight only appears like a faint white cloud. An aurora is a very brilliant one which lights the earth as brightly as the full moon, and yet it probably covers a great part of the sky, while the moon's diameter is only half a degree.

On p. 47 Mr. Capron summarises a most interesting investigation of Donati's on the time of appearance of the great aurora of February 4, 1872, in which he shows that it did not appear everywhere really simultaneously, but *at the same local hour*, as if it depended, like celestial phenomena, on something fixed and external to the earth and its rotation. If this were more than a mere coincidence it would be of the utmost importance, as proving the cosmical character of the aurora, and it is very desirable that the investigation should be repeated as soon as a sufficiently extended display presents the opportunity. Probably there is already such information stored in meteorological registers for whoever will take the trouble to seek it out.

In Chapter VII. some observations of the moon during eclipse are described, and it is suggested that the curious red lighting of the shadowed portion may be due to lunar aurora. Spectral observations, however, seem to lend no support to the theory. It is noted that the colours of Jupiter's bands seem brightest during periods of auroral frequency.

The suggested connection between auroræ and zodiacal light is dismissed as unfounded, the latter evidently being some form of reflected sunlight, and having a totally different spectrum. The relation of the aurora to the solar corona seems almost equally shadowy, depending solely on a supposed coincidence of *one* of the lines in the coronal spectrum with a faint band of doubtful position in that of the aurora. We entirely sympathise with the author in his protest against the identification of spectra by the mere coincidence of *single* lines. Such coincidences within the limits of observation with instruments of small dispersion are exceedingly numerous, and the only safe ground of identification is that of likeness of general features, or at least coincidence of many lines.

The latter half of the volume is mainly devoted to the discussion of the auroral spectrum and its supposed coincidences. A reference to the plate and catalogue of auroral lines (p. 104), however, is sufficient to show that it is little use as yet to compare these measures with the accurate determinations of solar and spark lines, only one line out of the nine or ten given being positioned with any approach to accuracy or general agreement of the observers, even to the third figure. It is much to be hoped that Mr. Capron's suggestion of photographing the spectrum may prove practicable, and after his extraordinary success with the lines of vacuum tubes, as evidenced in his recent work on "Photographic Spectra," we can hardly doubt it. Dry plates are now prepared of extraordinary sensitiveness, and there is practically no limit to the time of exposure which may be employed.

We may briefly summarise, however, the results of comparison, so far as it is possible to compare with such defective measures.

Perhaps the first supposed identification of the auroral spectrum was that of Procter, who announced the correspondence of the bright yellow-green line with a band in a vacuum tube, which he supposed to be due to oxygen, but afterwards ascribed to a hydrocarbon impurity. We should not allude to this here, since the correspondence broke down under high dispersion, the auroral line proving slightly more refrangible than that of the tube; but that we wish to give a word of explanation as to the constant recurrence of these carbon lines, which have proved misleading to many experimenters. As is well known, the glass tubes and apparatus employed in such researches are made by the use of a blowpipe fed with coal-gas. The imperfectly burnt products of combustion inevitably pass into the comparatively cool glass tubes, and some of them, such as naphthalene, being of high density, they are condensed on the inner surfaces, and obstinately retained. When, however, they are subjected to the high vacuums of the Sprengel pump, they slowly volatilise, and being good conductors of the electrical discharge, become frequently so brilliant as completely to mask the spectrum of the small residue of other gas in the tube. By heating the tube strongly during exhaustion and "washing out" many times with the pure gas of which the spectrum is desired, these accidental spectra

[1] *Friends' Schools Nat. Hist. Journ.*, November 15.

may be got rid of, or at least, so much paled as to betray their character as interlopers. This, however, is an amount of labour hardly to be expected of those who make tubes in a commercial way, and it is to be regretted that in Mr. Capron's painstaking research, he was compelled to employ such tubes instead of preparing them for himself. In a future research we would suggest the employment of tubes thoroughly heated and washed out with air in the first instance, and then worked with a blowpipe fed with pure hydrogen.

Unfortunately throughout, the tubes employed both by Mr. Capron and by Dr. Vogel seem to have been of doubtful purity. That figured on plate xiv. as hydrogen, contains bands of most suspicious resemblance to those of nitrogen, while the oxygen tubes, beside the one or two lines which seemed peculiar to themselves, gave others which were proved by direct comparison, to coincide with those of carbon and hydrogen, though the relative intensities seemed somewhat altered.

Supposed coincidences have been pointed out by Ångström, Vogel, and others, between the auroral spectrum and those of the various gases, such as oxygen, nitrogen, and hydrogen, which are present in the atmosphere. Unfortunately these coincidences do not extend to the one bright line which has been accurately measured, but only to the fainter ones, the positions of which are so doubtful that they might be made to correspond with any spectrum the lines of which were tolerably numerous, so that, intrinsically probable as they may be, we cannot regard them as positively established.

Absolutely no coincidence has been made out between the bright yellow-green line of the aurora and a principal one of any other known spectrum, and the same may be said of the sharp red line which occasionally flashes out in the spectrum, of red auroræ. Mr. Capron, however, points out that the green line coincides with a faint atmospheric absorption band, while the red line seems to occupy the position of the well-known *a* line of the solar spectrum, which Prof. Smyth has shown to be due to dry air.

It would not be fair to conclude our notice of "Auroræ" without a few words of praise to the admirable illustrations, several of which are chromolithographs. Of these perhaps the best in artistic effect is a facsimile of a water-colour drawing of a white aurora seen by the author at Kyle Akin in Skye. But in fact the whole appearance of the book suggests at first glance art rather than science, and we should suppose it is but rarely that a purely scientific treatise has appeared in so ornamental a dress.

OUR BOOK SHELF

A Treatise on Metalliferous Mines and Mining. By D. C. Davies, F.G.S. 8vo. (London: Crosby Lockwood and Co., 1880.)

THE objects of this book, as stated in the preface, are "to describe in a concise and systematic manner the conditions under which metallic ores are found in different countries in the world," and further, "by defining the zones occupied by the various metallic ores to lessen somewhat the amount of unsuccessful search for them." For the first purpose the author notices a large number of mines in various parts of the world, partly from his own observations and partly from accounts published in special journals and in the transactions of scientific societies; and for the second, he deduces from such descriptive matter certain general conclusions, which, in their more important points, are as follows:—

"Gold and silver never occur in strata newer than the carboniferous period."

"Copper ores with trifling exceptions are only found in the lower Cambrian carboniferous and new red sandstone formations."

"The highest horizon of lead ores is in the carboniferous limestone."

The conclusions are apparently derived from the study of phenomena in Wales, and to render them universally applicable all that is necessary is to reconstruct the geology of the rest of the world to suit them, which the author does in a thorough-going fashion. Thus the system requires for Cornwall that the age of the granites should be Laurentian, and the killas and other schistose rocks Cambrian, Silurian, Devonian, &c., in regular succession; and therefore the author concludes that the received view which makes the granite post-carboniferous is a mistake, and corrects his authorities accordingly, even when quoting their observations. Thus in reproducing Dr. Foster's account of the Hay Tor iron ores he disputes their probable carboniferous age, and states that they may belong to an older group, and that possibly of a still older age are the deposits of the West of Ireland, which are found interstratified on the basaltic and porphyritic rocks that skirt the west coast. It appears from a preceding page that by these are meant the iron ores of Antrim, which occur in miocene basalts on the north-east coast between Larne and the Giant's Causeway, and about whose age no question can possibly be raised by any one with the smallest geological knowledge.

Much of the information concerning foreign mines is exceedingly inaccurate, indeed it is difficult to see whence some of it is derived. For example, on p. 240, in a paragraph describing the zinc ores of Silesia, it is stated that the calamine of that country averages 20 to 30 per cent. of metallic zinc, which by selection and dressing is brought up to 70 per cent.; that in 1876 sixty-four mines produced 31,315 tons of zinc ore, and a reference to a paper by Huene in the *Journal* of the German Geological Society is given as an authority. As these statements are contrary to what is generally known upon these subjects, an attempt has been made to verify them; and it appears that (1) the average yield of the Silesian zinc ores in 1876 as smelted was 11·84 per cent.; (2) the production of zinc ores in Silesia in 1876 was 449,374 tons; (3) the paper by Huene, published in 1851, has nothing whatever to do with Silesia, as it describes some zinc mines at Bergisch-Gladbach near Cologne.

The above examples taken quite at random will be sufficient to show the generally untrustworthy character of the book. H. B.

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.*]

Why the Air at the Equator is not Hotter in January than in July

THE following, I think, is the explanation of Mr. Fisher's difficulty (NATURE, vol. xx. p. 577), why the January temperature at the equator when the earth is in perihelion is not much higher than in July when in aphelion. The temperature to which Mr. Fisher refers is the ordinary temperature as indicated by the shade thermometer, which of course is simply that of the air. The difficulty is more apparent than real, for if we examine the *indirect* results which follow from the present distribution of land

and water, we shall see that there is no reason whatever why the air at the equator should be hotter in January than in July.

It is well known that, notwithstanding the nearness of the sun in January, the influence of the present distribution of land and water is sufficient to make the mean temperature of the whole earth, or, what is the same, the mean temperature of the air over the surface of the earth higher in July than in January. The reason of this is obvious. Nearly all the land is in the northern hemisphere, while the southern hemisphere is for the most part water. The surface of the northern or land-hemisphere, for reasons to which I need not here refer, becomes heated in summer and cooled in winter to a far greater extent than the surface of the southern or water hemisphere. Consequently when we add the July or midsummer temperature of the northern to the July temperature of the southern hemisphere, we must get a higher number than when we add the January or midwinter temperature of the former to the January temperature of the latter. For example, the mean July temperature of the northern hemisphere, according to Dove ("Distribution of Heat on the Surface of the Globe") is 70°·9, and that of the southern hemisphere 53°·6; add the two together and we have 124°·5, which gives a mean for both hemispheres of 62°·3. The mean January temperature of the northern hemisphere is 48°·9, which, added to 59°·5, the mean January temperature of the southern hemisphere, gives only 108°·4, or a mean of 54°·2. Consequently the air over the surface of the globe is hotter in July by 8° than in January, notwithstanding the effects of eccentricity. It is obvious that, were it not for the counteracting effects of eccentricity, the difference would be much greater. Ten thousand years ago, when eccentricity and the distribution of land and water combined to produce the same effect, the difference must have been far greater than 8°.

But it will be asked, How can this affect the air over the equator, which is not situated more on the one hemisphere than on the other? It is true that those causes have but little *direct* effect on the air at the equator, but *indirectly* they have a very powerful influence. The air is continually flowing in to the equatorial regions from both hemispheres. In fact, the air which we find there is derived entirely from the temperate regions. In July we have the northern trades coming from a hemisphere with a mean temperature as high as 70°·9, and the southern trades coming from a hemisphere with a mean temperature not under 53°, while in January the former trades flow from a hemisphere as low as 50°, and the latter from a hemisphere no higher than 60°. Consequently the air which the equatorial regions received from the trades must have a higher temperature in July than in January. The northern is the dominant hemisphere; it pours in hot air in July and cold air in January, and this effect is not counterbalanced by the air from the opposite hemisphere. The mean temperature of the air passing into the equatorial regions ought therefore to be much higher in July than in January, and this it no doubt would be were it not, let it be observed, for the counteracting effects of eccentricity. The tendency of the present distribution of land and water, when our northern winter occurs in perihelion, is to counteract the effects of eccentricity. But ten thousand years ago, when our winters were in aphelion, that cause would co-operate to intensify the effects of eccentricity. In fact, it would actually more than double the effects then produced by eccentricity. Now if the influence of the present distribution of land and water is so great as not merely to counteract but to reverse the effects of eccentricity to the extent of making the mean temperature of the earth 8° warmer in July than in January, it is not surprising that it should be sufficient to make the equatorial regions at least as warm in the former as in the latter period.

The fact that the equator at present is not hotter when the earth is in perihelion, instead of being an objection to the theory that the glacial period was due to an increase of eccentricity, as Mr. Fisher supposes, is in reality another strong argument in its favour, for it shows that a much less amount of eccentricity would suffice to induce a commencement of glacial conditions in the northern hemisphere than would otherwise be required, were it not for the circumstance to which Mr. Fisher refers. This objection, like many others which have been urged against the theory, arises from looking too exclusively at the *direct* effects of eccentricity.

There is another cause which must also tend to lower the January and raise the July temperature of the equator, viz., the northern trades pass further south in January than in July, and consequently cool the equatorial regions more during the former than the latter season. This general tendency of the trades to lower the temperature of the equatorial regions more in January than in July is of course subject to modifications from the monsoons, the rainy seasons, and other local causes; nevertheless, so long as the present distribution of land and water endures, so long will eccentricity have a counteracting effect upon the temperature of the air at the equator, which but for that would be hotter in July than in January.

Mr. Fisher somewhat misapprehends what he designates my "fundamental proposition." What I stated was "the temperature of a place *other things being equal* is proportional to the heat received from the sun." Those who have read what I have written on this point will remember that what I mean is, that if the temperature of any place depended alone on the direct heat of the sun that temperature would be proportional to the amount received. But then there is no such spot on the face of the globe—there is no place where heat or cold distributed by ocean or aërial currents does not affect the temperature—and I have in "Climate and Time," pp. 41–44, proved that, with the exception of the Arctic regions, there is no part where the temperature is so much affected by those currents as the equator. Were it not for the cooling effect produced by them the equator would be uninhabitable. No knowledge whatever as to the intensity of the sun's heat can be obtained from observations on the temperature of the air at the equator. The comparatively cold air flowing in from the temperate regions has not time to be fully heated by the sun's rays before it rises as an ascending current and returns to the temperate regions from whence it came. More than this these trades prevent us from being able to determine with accuracy the intensity of the sun's heat from the temperature of the ground; for the surface of the ground in equatorial regions is kept at a much lower temperature by the air blowing over it than is due to the intensity of the sun's heat. It thus becomes a very intricate problem to determine how much the surface of the ground is kept below the maximum temperature by the heat absorbed by the moving air.

I may add that although my estimates of the lowering effect resulting from the decrease of the sun's heat arising from increase of distance were computed according to Newton's law, yet I distinctly stated that this law holds only approximately true, but that nevertheless, for reasons given at p. 34 of "Climate and Time," it would be found near enough for my purpose.

JAMES CROLL

A Possible Consequence of our Present Weather

I HAVE observed on several occasions that abnormally cold weather in November has been followed by an unusually mild mid-winter and January. These may possibly have been mere accidental coincidences, or they may be connected by a link of causation thus. Our climate, and more especially our winter climate, is largely influenced by the Gulf Stream, and whatever augments this raises our winter temperature, and *vice versâ*.

How, then, is the Gulf Stream likely to be affected by an unusual prevalence of Arctic winds and unusual cold in these latitudes? Such winds, must, to some extent, drive the waters of the Atlantic towards the source of the Gulf Stream, and tend to heap them there, and if there is any truth in the theory which attributes ocean currents to differences of oceanic temperatures, the present unusually cooled waters of the temperate zone will co-operate with the winds and augment this accumulation by their underflow. I do not mean that these combined actions are reversing the Gulf Stream at the present time, but simply that they are exerting a counter action or retarding influence which must result in augmenting the normal magnitude of the reservoir, or tropical accumulation, the outflow of which constitutes the Gulf Stream, and that thus the volume and velocity of the tropical waters which usually flow towards our coast will be augmented when the pressure of the present Arctic winds shall cease, and that our climate will be influenced accordingly. If I am right we may, in spite of present symptoms, or rather on account of them, have an unusually warm Christmas season and January.

This idea is not thrown out as a mere weather prophecy, but as a suggestive hypothesis and an incentive to what appears to me to be a very important and a much neglected branch of meteorological research, viz., systematic observation and record of the variations of the Gulf Stream. The countries whose coast is washed by this beneficent river of ocean are deeply interested in its movements. The Norwegians have already done something towards recording its variations, but so far as I can learn we, who are almost as deeply concerned as they are, have done little or nothing.

It may be that our agricultural troubles of the past three years are in some measure due to its disturbance; if so, it is of national importance that we should study its variations in order to learn whether they are reducible to law, and thus capaple of anticipations sufficiently reliable to induce prudential preparation for their national consequences. W. MATTIEU WILLIAMS

Stonebridge Park, Willesden

[With the extreme desirableness of an immediate and systematic observation, by European nationalities, of the temperature of the Gulf Stream, and of variations in the rate and direction of movement northwards from the tropics of the warm water and of the cold water southwards we very cordially concur. As another illustration of the practical utility of a better knowledge than we now possess of this subject, we may refer to the higher temperature and consequently larger evaporation than usual of the Atlantic in lower latitudes, along with a lower temperature, and consequently lower evaporation than usual farther north, in the beginning of the winter of 1878-79, as being in all likelihood one of the chief causes which brought us the miserable weather of the last twelve months. It is far from being beyond the reach of science to show how the larger evaporation from the more southerly regions of the Atlantic continued to spread itself over Europe further to south than usual, from which resulted the more southerly course pursued by our European storms, with the accompanying plague of east wind and rains over the British Isles, and the commercial distress thus deepened and prolonged. The importance of the inquiry is all the greater when it is considered that the past three years have impressively taught us how, not in India only, as shown by Blanford, but also in our British climate, certain types of weather, such as cold, warm, wet, or dry, when once fairly set in, tend to repeat themselves, and stamp their character on whole seasons or even a succession of seasons. It is by such lines of research that something more than a mere guess of the weather of coming seasons is to be obtained.—ED.]

The Climate of England

WILL you permit me, as a student for twenty years of the phenomena and laws of weather, to express my surprise that in meteorological tables or records, and weather notices in general, so little attention is bestowed upon the direction of the wind? It is true that in the daily forecasts issued from the Meteorological Office, this has been made for some time past a prominent, and, to my mind, the most valuable feature. Still the point has by no means been adequately dwelt upon by writers upon meteorology, the result being the loose and utterly unscientific talk we are accustomed to hear upon the very first principles of the problem of climate.

What is more common than to hear people remark that the climate of England has changed within the last few years? Their main ground for saying so is our having had for four or five seasons winters of exceptional mildness, followed last year by one of as remarkable severity and duration, and to all appearance likely to have following it one of not very different character.

The popular idea of climate has always seemingly been that of something affixed to the soil, a feature as fixed and characteristic as the rivers or mountain chains. Now, strictly speaking, there are for us but two real sources or loci of climate, the pole and the equatorial belts; the cold heavy currents of air from the Arctic regions flowing south, to take the place of the light warm air so rarefied by the sun's heat as to form a comparative vacuum. The aërial set of flux and reflux thus tending to be set-up along meridian lines is deflected eastwards by the rotation of the earth on its axis, with the result that in our part of the earth at least the wind is found to blow from some point of west to east for much about 200 days out of the 365. So limited is our sea-girt insular area, that within a few hours, depending on the velocity of the wind, the whole breadth of Great Britain is traversed, so that instead of breathing a climate engendered by local conditions, and to be called our own, we live in an atmosphere reaching us from abroad, and modified by the conditions through which it passes to us (into which I forbear at present to enter in detail). Observation combines with theory to establish the primary fact that what may be called the ruling line or axis of prevailing wind in our island is that from south-west to north-east approximately. Along this line may be said to take place, in the main, the perennial contest of opposing air-currents, on which depends the character of our seasons, the light warm balmy breath of the equatorial current, or so-called Gulf Stream, having to battle with the dry, heavy, chilling atmospheric masses bearing down direct from the Polar regions, or circling over the steppes of Russia, or the uplands of Scandinavia. Drawing a line at right angles to this, or from north-west to south-east, we shall find that so long as the wind keeps well within the south-westerly aspect of this diagonal, frost either sharp or long is with us impossible, and as an immediate response to the vane veering or backing from one side to the other, a rise or fall of the thermometer is to be observed, which may vie with that due to the sun's place in the zodiac. The mercury may be seen to stand as high in January as in June. If we ask why the four or five winters preceding the last severe one were so exceptionally mild, the proximate answer is that during the months when the sun's power continued low, we enjoyed a succession of south-westerly winds which tempered "winter's flaw." Last year, on the contrary, the wind kept early and persistently to the northerly and easterly quarters; and were proper tables available, I believe that an abnormal prevalence of those Polar currents would be shown to have marked the later seasons of this most exceptional year.

The problem is thus shifted a step.

What we have to inquire into is the cause or causes to which is due so exceptional and persistent a flow of wind from one alternative quarter to the other.

To aim at anything like a forecast of winter or summer weather before knowing what the prevalent set of the aërial currents is to be, is to invert the essential conditions of the problem, and to put the cart before the horse. It is for meteorologists, I would urge, to concentrate their attention upon the causes or laws, which determine or disturb the periodical motions of the earth's envelope, especially as it oscillates to and fro across the limited and exceptionally situated group of the British Islands. Simple as such a suggestion may appear to men of science, the notices they have as yet given us will by no means, I believe, show it to be superfluous. It is the conviction that the primary and elementary conditions of the problem are far from having been grasped by the general public that has led me thus far to trespass upon your space.

Gray's Inn, December 2 ALEXANDER TAYLOR

A Correction

A FEW weeks ago I had some correspondence with the late Mr. J. Allan Broun on the subject of my communication to NATURE, vol. xx. p. 54, in the course of which he drew my attention to an error in my value for the barometric oscillation corresponding to 1° F. $\left(q = \frac{\Delta p}{\Delta t}\right)$ at Sibsagar. He said:—

"You had a note on the difference of results for Lucknow and Sibsagar both nearly at the same height; the values of q you made 0·017 and 0·028, the latter for Sibsagar should have been 0·018 or $\frac{\Delta p}{\Delta t} = \frac{0{\cdot}477}{26{\cdot}6}$."

I acknowledge the error, and take this opportunity of mentioning it as I fear Mr. Broun's article on the subject, which he told me was shortly to appear in NATURE, and in which he would most probably have drawn attention to my error, has been cut short by his sudden and lamented decease. His last letter to me containing the above correction was dated November 15, just a week before he died.

I may add that while the above error (which was due to my taking Δt to be 16·6 instead of 26·6) disqualifies Sibsagar from demonstrating that the value of q depends on the distance from the coast independently of the altitude, the rule is nevertheless generally evident, and can be shown equally well by taking Goalpara instead of Sibsagar with Lucknow.

At Goalpara $h = 386$ feet,

$$q = \frac{\Delta p}{\Delta t} = \frac{0{\cdot}448}{18{\cdot}7} = 0{\cdot}023.$$

E. DOUGLAS ARCHIBALD

Tunbridge Wells, November 29

Monkeys in the West Indies

IN his very interesting paper on "Tails," which appeared in NATURE, vol. xx. p. 510, Prof. Mivart says, "Monkeys are scattered over almost all the warmest parts of the earth save the West Indies, Madagascar, New Guinea, and Australia." As regards the West Indies the statement is not quite correct, and I am sure Prof. Mivart will be glad to receive the following

information on the subject. In the islands of St. Christopher and Nevis, which form part of the division of islands commonly called the Lesser Antilles, monkeys are found in large numbers, and a planter friend in the former island, which I have recently visited, assured me that he had lately been obliged to appoint a "monkey-watchman" to protect the cane-fields and the sweet-potato fields of his estate from the destructive raids of bands of monkeys.

In the island of Nevis, which at one time must have formed part of St. Christopher, and which is now only divided from the latter by a very narrow arm of the sea, appropriately called "The Narrows," monkeys—the same as those of St. Christopher—exist in great numbers, and I may add that the tails are "perfectly prehensile," *i.e.*, "naked beneath towards the tip."

Of Trinidad I cannot speak from personal observation, but a scientific friend of mine, Dr. H. A. Alford Nicholls, who lately visited Trinidad, kindly writes to me as follows:—"Prof. Mivart has certainly made a mistake about there being no monkeys in the West Indies. I find, too, that in a work on 'Central America, the West Indies, and South America,' edited by the traveller, Bates, it is stated that there are no monkeys in the Antilles. You know more of the monkeys of St. Kitts and Nevis than I do, but I can tell you something of your Trinidad cousins. There are two kinds of monkeys in Trinidad, and as the fauna is continental, they will doubtless be found on the mainland of South America. One belongs to the Mycetes, and it is called the Red Howler, partly on account of its loud and hideous cries; the other, a diminutive specimen of the Cebidæ, is called the 'Sapajou;' it is a Cebus."

I shall be glad to supply any further information on the subject of monkeys in St. Christopher and Nevis.

Dominica, British West India, November 11 EDMUND WATT

Earthquakes in Iceland

IN NATURE, vol. xxi. p. 89, I see the earthquake which occurred in Iceland on September 24 last ascribed to "volcanic eruptions in the Krísuvík Mountains, a locality where eruptions have not been known within the memory of the present generation." The use of the word "eruption" here is misleading, for though the earthquakes, which frequently occur at Krísuvík, are no doubt caused by volcanic action, nothing of the nature of an *eruption*, in the usual sense of the word, has been known to occur there within the historical period. The boiling springs, mud caldrons, and sulphur deposits, for which Krísuvík is noted, are, on the authority of Prof. Bunsen (Letters to Berzelius), to be ascribed to a pseudo-volcanic action occurring at comparatively slight depths. Though slight earthquake shocks have frequently occurred, during the last eighteen months, while I was at Krísuvík, I have never observed that they had any effect on the boiling springs and other thermal phenomena.

The earthquake of September 24 last, though more violent than any other which I have experienced there, differed from the rest in no other respect. They are generally confined to the neighbourhood of the hot springs and sulphur beds, though the last was felt over a wider area, and seldom do any damage.

Edinburgh, December 1 W. G. SPENCE PATERSON

Diatoms in London Clay

I DO not know if diatoms have been observed in the London clay, or not. If they have not, it may interest many to know that I have discovered triangular, quadrangular, elliptical, and discoidal forms in the London clay of Sheppey. The frustules are frequently perfect, and the markings are plainly discernible as square-sided depressions or elevations; I am not certain which. One of the discoidal forms is an old friend, for I observed it in abundance two years ago; but as I then had no knowledge of diatoms, I passed large quantities by as pyritous concretions.

In my ignorance I stated in a paper on the well referred to (*Proc.* Geol. Assoc., vol. v. p. 357): "It should be mentioned that at and below 293 feet the clay was thickly studded with very minute disks of iron pyrites, each having a boss in the centre, and the edge slightly turned up all round. They were uniformly perfect, as much so as if cast in one mould."

A few days ago I saw *Anlicodiscus oreganus*, and was struck by its resemblance to the disks I had seen in the London clay. As I had not preserved any of these, I set to work to get more, if possible, and last night I was fortunate enough to find several distinct species. W. H. SHRUBSOLE

62, High Street, Sheerness-on-Sea, December 2

Colour-Blindness

THE remarks of Mr. Everett at the close of his paper (NATURE, vol. xxi. p. 62) on Prof. Hering's theory, seem to be founded on a misconception. Prof. Hering assumes, not four, but six elements of colour-sensations connected by the equations—

$$B + W = 0 \quad R + G = 0 \quad B' + Y = 0.$$

The specification of any colour in his system contains three independent variables, and is of the form

$$\cdot D = a W + b' R + c b,$$

and it will usually take four equations to eliminate $W R$ and B.

It must be noted that Prof. Hering assumes that the red-green and blue-yellow sensations never occur in nature pure, but always mixed with white. If this is granted I do not think that the result of Maxwell's experiments on colour-mixture will be found inconsistent with his theory. JOHN TENNANT

19, The Boltons, S.W., November 28

Intellect in Brutes

I OFFER the following illustrations of reasoning powers in animals, should you care to insert them.

1. Some years since, while hunting in Northern Michigan, I tried, with the aid of a professional trapper, to entrap a fox who made nightly visits to a spot where the entrails of a deer had been thrown.

Although we tried every expedient that suggested itself to us, we were unsuccessful, and, what seemed very singular, we always found the empty trap sprung.

My companion insisted that the animal dug beneath it, and putting his paw beneath the jaw, pushed down the pan with safety to himself; but though the appearances seemed to confirm it, I could hardly credit his explanation. This year in another locality of the same region, an old and experienced trapper assured me of its correctness, and said in confirmation, that he had several times caught them, after they had made two or three successful attempts to spring the trap, by the simple expedient of setting it upside down, when, of course, the act of undermining and touching the pan would bring the paw within the grasp of the jaws.

2. A Dandie Dinmont terrier, after the death of his mistress, was playing with some children in a room into which was brought a photograph (large) of her, that he had never previously seen. It was placed upon the floor leaning against the wall. In the words of my informant, who witnessed it, the dog, when he suddenly caught sight of the picture, "crouched and trembled all over, his whole body quivering. Then he crept along the floor till he reached it, and, seating himself before it, began to bark loudly, as if he would say, 'Why don't you speak to me?'" The picture was moved to other parts of the room, and he followed, seating himself before it and repeating his barking.

3. The dog whose demoralisation by the salute of a monkey was published in NATURE, vol. xviii. p. 77, recently had another encounter with one, and behaved in so sneaking a manner as showed that he had not forgotten his first impression.

Boston, November 22 C. F. CREHORE

Electric Lighting

IN NATURE, vol. xx. p. 641, you say, "For the first time perhaps in the history of electric lighting two rival magneto-electric machines are illuminating the same hall." I can state an earlier instance, though not an exact parallel. At the annual fair of the American Institute, held in New York during September, October, and November, 1878, the main hall was illuminated by the Wallace-Farmer machine and light, and the machinery hall—directly communicating with it, by the Brush apparatus. The two halls form practically one.

ALEX. S. GIBSON

Norwalk, Conn., U.S.A., November 14

JEAN BAPTISTE ALPHONSE CHEVALLIER

THE death is recorded on December 1 of Prof. A. Chevallier, who deserves notice here as one of the Nestors of French pharmaceutical chemistry. He was

born at Langues, in Lorraine, July 19, 1793. After completing a course of scientific study, he opened a pharmacy in Paris, where he soon attracted attention by his talent for investigation, as well as by his ability in scientific literary work. In 1825 he assumed the editorship of the *Journal de Chimie médicale*, and continued this labour until some years prior to his death, having as associates Payen, Pelouze, Robinet, Orfila, Péligot, Dumas, and other leading chemists of the day. Soon after entering upon his career as investigator, his merits were recognised by the government, and he gave up his business connections to accept the Chair of Chemistry at the École supérieure de Pharmacie, a position which he occupied up to the time of his death.

Among Chevallier's earlier researches should be mentioned his investigations on the absorptive capacities of living plants for various inorganic solutions, and especially his exhaustive studies in connection with Payne, on the hop and the potato, which attracted general attraction. In physiological chemistry notice should be taken of his detection of various poisonous metals, such as lead and copper, in normal organisms. The knowledge of French mineral waters is also greatly indebted to his numerous and exhaustive analyses, and the presence of arsenic in many springs was first signalled by him. The greater portion of Chevallier's life was devoted to the chemical phases of public hygiene, and in this connection he published a number of valuable papers on the detection and prevention of adulteration in a large variety of articles of food, methods of preserving food, disinfectants, &c. Of his devotion to the cause of scientific inquiry an interesting anecdote is related from the earlier part of his career. A case of poisoning was to be tried at Paris in which acetate of morphine had been used, and Chevallier, who had sold the salt to the murderer, was summoned as a witness. Anxious to have the full nature of this hitherto untried poison well established, and being limited as to time, he immediately undertook a thorough investigation of its toxic effects on his own system, and succeeded so well that at the trial he was able to give a detailed description of the symptoms attending the use of the drug in question.

As a scientific writer Chevallier was widely and deservedly known. His first work in 1824, in connection with Payen, "Traité des réactifs chimiques," reached a third edition in five years. In 1826-29 he published, with Richard and Guillemain, an extensive "Dictionnaire des Drogues simples et composées," in five volumes. In 1850 appeared his admirable "Dictionnaire des Altérations et Falsifications des Substances alimentaires, médicamenteuses, et commerciales," which reached a third edition in 1858, and was translated into other languages. Other important works were "Recherches sur les Moyens appliquées à la Conservation des Substances alimentaires" (1858), "Du Café, son Histoire, son Usage, etc." (1862); "Traité des Désinfectants sous le Rapport de l'Hygiène publique" (1862).

T. H. N.

THE SEWAGE OF LONDON

GENERAL SCOTT, in his recent paper at the Society of Arts, entitled "Suggestions for Dealing with the Sewage of London," deserves credit for having drawn attention to a subject which in itself must have especial interest for all residents in the metropolis, but which, from the manner in which he has dealt with it, possesses further attractions for those who have made the scientific aspects of the sewage question their study, in that he has really attacked this much-debated problem in an entirely new direction, and has in so far entered upon fresh ground. We do not remember that any previous investigator has set himself the task of examining into the composition and character of the suspended matters of water carried sewage coupled with the possibility of the mechanical separation by simple subsidence (1) of the heavier mineral particles or the detritus, and (2) of the lighter flocculent particles, which latter, consisting as they do mainly of the fecal matters, possess a far higher manurial value than the heavier substances washed from the roads and pavements.

The sludge deposited from sewage by one or the other systems of precipitation has received hitherto the chief share of attention from scientific men, and even when the possibility of recovering the solid matters in sewage by some system of straining or rude filtration, or the retention of such solids in tanks, in which the sewage is brought to temporary quiescence, has been considered, it seems on all occasions to have been the practice to regard the entire bulk of such deposits as an inseparable compound of very low value from the manure point of view. It is of course the manurial value of the ingredients contained in suspension and in solution in sewage which has been so frequently inquired into by chemists; and, beginning with the report of Dr. Hoffman and Mr. Witt in 1857, down to that of Messrs. Rawlinson and Read in 1876, a vast mass of valuable information concerning the nature, composition, and value of the manurial elements of town sewage has been accumulated. It has remained for General Scott to point out that—

1. A very large proportion of the solid suspended matters may be removed from sewage by simple subsidence.

2. That such matters may roughly be separated, the more valuable from the valueless, by the method in which such subsidence is accomplished.

3. That after such preliminary treatment, any chemical process for the clarification and partial precipitation of the dissolved impurities of sewage may be carried out far more readily, and under conditions rendering their success in an economical point of view one of greatly increased probability.

4. General Scott has indicated various simple methods for dealing with the silt and detritus removed from the sewage at a relatively small expense; of deodorising and fitting the sludge obtained by subsidence for the manufacture of a manure; and lastly, a mode of further purifying the London sewage by a system of chemical treatment whereby it may be rendered suitable for discharge into a river of large volume.

Assuming the dissolved impurities to be incapable of recovery unless the sewage water can be utilised for irrigation, the first object of General Scott's paper was to show how large an amount of harm was done to rivers and the dwellers on their banks solely by the solid matters contained in sewage. By means of extracts from the reports of the various Royal Commissions who have examined into this question, and the information furnished to the Metropolitan Board of Works by their own advisers, Messrs. Bidder, Hawksley, and Bazalgette, he proved that the deposits in the river, the mud banks, the foul emanations from which were most unhealthy, and the dangers to navigation were all due to the discharge of the solid ingredients of raw sewage into rivers and into the Thames.

General Scott next entered very minutely into the composition of the suspended matters of sewage. An estimate of the total weight of solid matters due to a mixed population of 3,500,000 persons, with a proportionate allowance for the fertilisers existing in the excreta of animals, together with the *débris* of the animal and vegetable substances which might find their way into the sewers, would manifestly represent the sum total of the organic matters in London sewage.

Concerning the gross annual amount of organic matters different estimates appear to vary very slightly, and in assuming them in the case of London at 50,000 tons per

annum, there would seem to be but a small margin for error; the quantities of detritus, however, have been very differently stated by the various authorities. From the most reliable analyses of the London sewage, taken at all periods of the day and night, and in many different parts of the metropolis, there appears to be a tolerable unanimity in assigning the ratio of the organic to the mineral ingredient of the suspended matters to be as 1 is to 2. After a period of settlement it is found that the proportion is, by the subsidence of the heavier mineral particles, exactly reversed, as the larger portion of these valueless components of sewage impurities rapidly subside, entangling with them about ⅓th of the organic matters in suspension. General Scott proposes, therefore, a double system of tanks. The first set would consist of a series of shallow catch pits, in which the sewage will only be brought to a state of partial repose, and in which it will part with about four-fifths of the solid mineral matters and one-fifth of the organic matter. In the second set of tanks, in which more time will be given for the settlement of the matters in suspension, the sewage will be deprived of nearly all the remaining suspended impurities, namely, one-fifth of the mineral, and four-fifths of the organic matters. If we assume the gross weight of the organic matters at 50,000 tons per annum, the mineral ingredients will, according to the analyses quoted by General Scott, equal 100,000 tons, and the total of 150,000 tons thus obtained, is, in reality, a very low estimate of the amount of the suspended matters in London sewage. These matters, General Scott is of opinion, he could roughly separate in his tanks thus:—In the detritus tanks he would obtain 80,000 tons of mineral matters, together with 10,000 tons of organic matters; in the second set of tanks he would expect to find about 20,000 tons of mineral matters mixed with about 40,000 tons of organic matters. The exact percentage composition of this latter sludge would, he believes, after studying and comparing many analyses and valuations, be somewhat as follows:—

Organic matter (without nitrogen)	66·50
Nitrogen	3·50
Phosphoric acid 2·80 = tribasic calcic phosphate...	6·07
Potash	1·25
Sand and inert mineral matter	22·68
	100·00

In the debate which took place after the paper, Dr. Frankland, while admitting General Scott's process to be "worthy of trial," took exception to this estimate, and maintained that his experience was "that after the separation of detritus from London sewage, the maximum percentage of organic matter was 63, whilst the minimum was 21, the average being 39½, and these high percentages were obtained under exceptionally favourable circumstances, because, in the collection of these samples of sewage, little or none of the so-called detritus was mixed with it at all." He further stated that "he did not think it would be safe to calculate on more than 33 per cent. of organic matter in the dried sludge." This question of the possibility or otherwise of effecting a separation more or less perfect, of the mineral from the organic elements of the sludge lies at the root of General Scott's proposals, and while giving all due weight to Dr. Frankland's high authority, we are compelled to admit that General Scott's figures, many of them based on the analyses of Dr. Frankland himself, seem to point in the opposite direction to that pointed out by Dr. Frankland, as concerns the relative proportion of the mineral and the organic matters after settlement.

The question to be decided is, admitting the composition of the sewage solid to be in the first instance 2 mineral to 1 organic, can we reduce this proportion to 2 organic to 1 mineral, by bringing the sewage to a state of quiescence in tanks? This could be tried on a sufficiently large scale to settle the point at issue in a very short time, and as it is a question which to a great extent depends upon the result of actual experiment on a large scale, it is certainly one for the officers of the Metropolitan Board of Works to decide.

Passing over the theoretical values of the deposits, based upon their contents in nitrogen, phosphoric acid, and potash, which General Scott has dealt with very carefully, we come to the question of deodorising the sludge and its preparation as a manure. For the former purpose the employment of slaked lime is advocated, used in the small quantity of only ·66, or less than 1 per cent. of the total weight of the sludge. This slaked lime, made into milk of lime by the addition of water, is to be thoroughly incorporated with the sewage deposit, and a sufficient amount of crude superphosphate is then to be added, in order nearly, but not quite, to neutralise the lime. A crystalline precipitate of phosphate of lime is thus formed in the sludge, which greatly aids in the drying of the compound, or, to put it more correctly, facilitates the extraction of the water. Some of those who took part in the debate doubted whether General Scott, in his estimate of 20*s.* per ton on the dried material, which included the cost of chemical treatment, had made a sufficient allowance for the great labour and difficulty which would have to be incurred in drying the sludge for use as a manure. Dr. Voelcker, who pointed out that "he had gone very carefully into the figures in the paper, and was very glad to find that General Scott had avoided those exaggerations which frequently disfigured calculations of this kind," quoted some observations he had made tending to show that sewage sludge parted with water with extreme difficulty, though he admitted that after treatment with lime and phosphoric acid such sludge would dry with greater rapidity. In the various forms of filter presses now largely used for drying clay slip and expressing precipitates, very great improvements have recently been effected, and it has been stated on good authority that it becomes possible by their use to reduce the moisture in such materials as low as 50 per cent. There still remains, however, a large proportion of water to expel, and, as Dr. Voelcker stated, this can only be accomplished by means of artificial heat.

The question of the cost of drying sludge is one which possesses many features of interest, and the entire subject would be one well worthy of the special consideration of the Society of Arts at their annual conference on the treatment of sewage. We should like to have devoted more time to the calculations of General Scott of the theoretical value of the three chief fertilisers present in sludge, viz., nitrogen, phosphoric acid, and potash, as also to the expense of preparing soluble phosphoric acid, concerning which latter point Dr. Voelcker threw out some valuable suggestions during the discussion, but we must now conclude. We entirely agree with General Scott in his denunciation of the folly and imprudence of continuing to cast raw sewage into the Thames; he has certainly pointed out a way of greatly abating the present evil, and as the plan he advocates could be tried upon a sufficient scale at an almost nominal expense, we feel justified in urging with Dr. Frankland that this should be done, and we cordially echo his concluding observation, "that the Board of Works have no right to look for a profit in getting rid of the objectionable matter. If they can succeed in doing it without a loss or at a cost not greater than that involved in dredging it out of the river again, it ought to be done; because if sewage mud is deposited in the river there must be an obstruction to navigation, besides the putrefaction of organic matters which, when deposited on the banks of a tidal estuary, become very offensive, especially in warm weather."

So far as one can judge from the facts adduced by General Scott, his scheme promises to be more efficient for the ends aimed at than any hitherto proposed, and certainly it seems to us that the great scientific principles

which are applicable to the subject have been kept well in view. And from our standpoint this must be the test of the efficiency of any scheme for the disposal of sewage. We fear that hitherto those with whom the decision rests as to what scheme shall be adopted for the disposal of the sewage of London have looked upon the question too much as one between rival "schemes," and considered far too much the supposed interests of rival "bodies," and too little the clear teachings of science and the welfare of the public. It is evident that for London, at least, the whole subject of the disposal of sewage will have very soon to be reconsidered, and we trust that the authorities concerned will take into their council reputable chemists and physicists, who we are sure, can have no interests more at heart than to see the unmistakeable teachings of science practically applied to the salvation of society.

THE NEW WEALDEN DINOSAUR

AT the last meeting of the Geological Society, Mr. J. Whitaker Hulke, F.R.S., brought forward some new facts concerning the remarkable Dinosaur *Ornithopsis*, which cannot fail to interest both geologists and naturalists.

In the original collection of Wealden fossils made by Dr. Mantell, and acquired for the British Museum, were two fragmentary bones, the nature of which was somewhat doubtful. Dr. Mantell regarded and figured one of these as a tympanic bone of *Iguanodon*, at the same time pointing out that it presented some resemblance to a vertebra. Prof. R. Owen adopted Mantell's views, and figured it as the tympanic bone of *Iguanodon*, or, perhaps, of *Cetiosaurus* or *Streptospondylus*.

In 1869 Prof. H. G. Seeley pointed out that the fossil in question was undoubtedly a portion of a vertebra, and one of a new and very remarkable type. It exhibited points of comparison with the vertebræ of birds, in the lightness of its construction, and in the existence of great cavities penetrating into the centrum. Hence Prof. Seeley suggested for it the generic name of *Ornithopsis*.

In 1870 Mr. Hulke, who was at that time unaware of Prof. Seeley's determination of the vertebral character of the British Museum specimens, gave a description of the neural arch of a vertebra which he had discovered in the Wealden of the Isle of Wight. From the beautiful character of the groined entrance to the neural canal, Mr. Hulke was led to suggest the name of *Eucamerotus* as a provisional one for the new Dinosaurian genus which the specimen evidently represents.

He especially pointed out as of great interest the enormous size of these vertebræ, and the fact that they are built up of thin plates of very compact osseous tissue, with immense spaces of cancellous tissue between them. At a later date Mr. Hulke recognised the identity of his *Eucamerotus* with the *Ornithopsis* of Prof. Seeley.

In 1876 Prof. Owen again took up the study of the forms in the British Museum. He adopted Prof. Seeley's and Mr. Hulke's views as to the vertebral character of the fossils—but he rejected Prof. Seeley's generic name on the ground that the resemblance between these vertebræ and those of birds is merely superficial, and that the name of *Ornithopsis* is therefore misleading. Prof. Owen described two new forms presenting this peculiar structure in the vertebral column, and to these he gave the names of *Bothriospondylus* and *Chondrostosaurus*; he insisted that the large cavities seen in the fossil vertebræ were probably originally filled with cartilaginous substance, as is the case in the sharks and rays, and argued, therefore, that any comparison with the vertebræ of birds was a misleading one. Mr. Hulke and Prof. Seeley, however, while admitting that the structure does not necessarily imply the powers of flight in the forms possessing it, yet insist that in all probability the cavities in the vertebræ were true air-cells, and therefore that the structure is "bird-like;" on these grounds they maintain that the name of *Ornithopsis* ought not to be superseded.

In 1877 Prof. Marsh recognised among the numerous Dinosaurian remains obtained from Colorado a number of gigantic forms with vertebræ presenting the same peculiarities as are found in *Ornithopsis*; to these forms he gave the names *Atlantosaurus*, *Morosaurus*, *Apatosaurus*, *Allosaurus*, and *Diplocus*. Prof. Cope had simultaneously described three other forms—*Camarasaurus*, *Amphicœlias*, and *Epanterias*, all presenting the same peculiarities as are found in the English form *Ornithopsis*. One of the American forms, *Atlantosaurus* had a femur seven feet in length. When the two distinguished American palæontologists visited this country in 1878, they both recognised the specimens of *Ornithopsis* in Mr. Hulke's collection as presenting numerous points of resemblance with the new forms which they had described.

Now in the communication which he has recently made to the Geological Society, Mr. Hulke has described vertebræ from several parts of the spine of *Ornithopsis*. This he is enabled to do by the courtesy of the Rev. W. Fox, of Brixton in the Isle of Wight, who has long been such an indefatigable collector of the vertebrate fossils of the Wealden, and has permitted Mr. Hulke to make use of his materials. Mr. Hulke shows that while the dorsal vertebræ were closely bound together by processes, so that this part of the spine must have possessed great rigidity, as is the case with birds, the cervical vertebræ indicate the existence of the greatest mobility. But the point on which Mr. Hulke principally insists, from its bearing on the discussion which has taken place between himself and Prof. Seeley, on the one hand, and Prof. Owen on the other, is that the cavities and cancellous tissue are confined to the dorsal vertebræ, and do not occur in the other portions of the spinal column; this he insists is inexplicable, if, as Prof. Owen insists, the cavities in question had no functional character, but were filled up with cartilaginous tissue, while it finds a ready explanation in the supposition of Prof. Seeley and himself that they are truly pneumatic cavities. Mr. Hulke also points out that there are reasons for believing that some at least of the vertebræ referred to the genus *Cetiosaurus* belong to the new group of forms to which so much attention has been directed during the last few years.

There can be no doubt that there existed during mesozoic times, both in this country and on the American continent, a group of reptiles of gigantic dimensions, which presented such peculiarities of structure, especially in their vertebral column, that they must be placed in a distant sub-order of the *Dinosauria*. For this, perhaps the name of *Sauropoda*, suggested by Prof. Marsh, may be adopted.

The existence of this bird-like character of pneumatic bones in reptiles of such gigantic dimensions as these peculiar Dinosaurs undoubtedly were is certainly very startling and unexpected. At the same time we believe that neither Prof. Seeley nor Mr. Hulke favours the idea that the forms in question were capable of flight. Mr. Hulke promises shortly to add another to his valuable contributions to our knowledge of these forms by describing the limb-bones of *Ornithopsis* and its allies, and discussing the habits which a study of their structure seems to indicate. All geologists and naturalists will look forward eagerly for the promised memoir.

CASSELL'S NATURAL HISTORY[1]

THE third volume of this well-illustrated and popular account of the animal kingdom contains descriptions of the Ruminantia by the late lamented A. H. Garrod,

[1] Edited by P. Martin Duncan, M.B. (Lond.), F.R.S., F.G.S. Vol. iii. London: Cassell, Petter, and Galpin, 1879.)

M.A.; of the Rodentia by W. S. Dallas; of the Edentata and Marsupialia by the Editor, and of the first two Orders of Birds by R. Bowdler Sharpe.

The ruminating animals are divided into the Bovidæ, the Cervidæ, the Tragulidæ, and the Tylopodæ. A little more attention to typographical details would have assisted in making this division more clearly perceptible. Thus the first three chapters are headed quite correctly, "Artiodactyla—Ruminantia: Bovidæ," while Chapter IV. is headed "The Cervidæ," and Chapter V. has no chief heading at all, although it treats of part of the Cervidæ, the Tragulidæ, and the Tylopodæ. Such a want of uniformity is apt to be a stumbling-block to the student, whose perplexity is no little increased when he finds the same confusion not only in the headings of the chapters, but also in the text itself. Thus, in the chapters on the Edentata the author seems only to have awoke up to the necessity of giving any details of the order as an order, when he had just finished all he had to write about the species contained in the order; and as a consequence, not only is the cart put before the horse, but the account of the order is far too short, and almost nothing is said as to the many anatomical peculiarities characterising it. So much for criticism, which we make in the interests of the work itself, which, if completed as begun, will doubtless form not only a work of useful reference to the general reader, but also will be most useful as an encyclopædia of zoology. To constitute it a complete natural history, of course the other kingdoms of nature will have to be also treated of.

For the antler-less deer (Tragulidæ) Mr. Garrod coined the useful word "deerlets." In respect of their toe-bones they seem to stand intermediate between the swine and the true ruminants. Each foot in the common pig possesses four toes, that corresponding to our thumb in the fore-limb and to our great toe in the hind-limb being absent. The bones of all the toes that are present are quite separate from one another just as in man, but those of the outer and inner digits in each limb are smaller than those which bear the larger hoofs. In the true ruminants, as is well known, these larger toes are partially fused together, the bones of the two central digits forming the "cannon bone," while the bones of the other toe are reduced to mere splints, or disappear. In the deerlets these bones are not blended at all in the fore-limbs of the water-deerlet of West Africa; in which, as in all the other species, the digits two and five are perfect from end to end. The want of antlers in either sex is another distin-

The Lophiomys.

guishing peculiarity. We would gladly have had more details given us of this very interesting group, the scientific names of the species of which are in no one instance given.

The chapters on the rodents are very well and carefully written, and the classification adopted is that proposed by Mr. Alston. The orderly sequence of the families in this section of the work might be commended as an example, and the scientific names of the species following their English names, in italics, is an immense improvement on the plan generally adopted throughout this work, and as a proof that the reader will find in this section new as well as interesting information, we quote the following account of perhaps the most remarkable rodent known:—

"The importance of an animal in the zoological system by no means depends either upon its size or on its abundance in the world; its rank in the classification is decided solely by peculiarities of organisation which distinguish it more or less from its fellows; and in many cases the creatures which are regarded with the most interest by the naturalist are those which seem most to withdraw themselves from general observation. A single genus, perhaps containing only one or two species, may, by a singular combination of characters, be so completely isolated from all the recognised allied groups that it cannot be placed in any of them, and accordingly a distinct family, possibly even an order, has to be established for its reception. Sometimes subsequent discoveries add to the number of species forming the group thus set up, and in this way the prescience of its founder is confirmed. Sometimes the group remains in its original condition, leaving us, according to circumstances, to regard the anomalous creatures of which it is composed either as a special development of their general type, or as the residue of a group which may have presented a greater variety of forms at some past period of the earth's history.

"The latter is perhaps the case with the curious little rodent which alone forms the present family, of which its original describer, M. Alphonse Milne-Edwards, writes as follows:—'In its general aspect it somewhat resembles certain opossums, and like these it is pedimanous (having the hind feet hand-like); but these are the only analogies it presents to the marsupials, and in its dental system, as also in the rest of its organisation, we easily see that it

belongs to the order Rodentia. It differs, however, from all the members of this group by characters of considerable importance; I may even say that, by some peculiarities of structure it departs from all other mammals, and that we find in it anatomical arrangements of which we have hitherto had examples only in the class of reptiles.' After an exhaustive discussion of the characters of this curious little animal, M. Milne-Edwards comes to the conclusion that it is most nearly related to the members of the following family, and especially to the hamsters, although he found it impossible to unite it with them. In this course he has been followed by other writers.

"The general construction of the skull is the same as in the Muridæ, but from the temporal ridges thin plates are developed, which bend downwards, and articulate with similar plates springing from the malar bones, and thus completely arch over the temporal fossæ after a fashion only met with in certain reptiles, and especially in the Hawksbill Turtle (*Chelone caretta*). The whole upper surface of the skull is covered with minute but perfectly definite granules, arranged with much regularity, and these, which occur in no other mammal, give the skull a very peculiar aspect, such as may be seen in some fishes. As in the Muridæ, there are three molars on each side in each jaw, and these are rooted and strongly tuber-

Hoffmann's Sloth (from life).

cular; the foremost in each series having three and the others each two ridges. Without entering in detail into the peculiarities described at great length by M. Milne-Edwards, we may say that in its general structure, and especially in that of the skeleton, the animal is murine, but with a very important distinction, namely, that the collar-bones, which are well developed in the rats and their allies, are here reduced, as in the hares and rabbits, so as to form only two small bony styles freely suspended among the muscles, and that the first toe in the hind feet, although not very long, is so attached as to be opposite to the rest, thus converting the organ into a prehensile hand which the animal uses freely in climbing. The cæcum is small.

"In its external characters this animal is as remarkable as in its anatomical structure. In general appearance, as stated by its describer, it has much resemblance to a small opossum, but the bushy tail and the peculiar arrangement of the hair on the body are met with in no marsupials. The head is small; the general form stout; the limbs short, and the hind ones not much longer than their fellows; and the ears are of moderate size and sparingly clothed with hair. The prevailing colour is blackish-brown, but a triangular spot on the forehead, a

streak under each eye, and the tip of the tail, are white; and the long hairs which clothe the body and tail are dark only in the middle, the base and tip being white, as are also a great quantity of finer and shorter hairs which form a sort of under fur. But the chief peculiarity of the coat is to be found in the arrangement of the hairs of the body. The long hairs of the middle of the back and tail, some of which are nearly three inches in length, are capable of being raised into a nearly upright position, forming a sort of crest which gives the animal a very peculiar aspect, and this crest is separated from the pendulous hair of the flanks by a sort of furrow clothed with very peculiar hair of a greyish-tawny colour. These hairs are unlike any others known to occur among mammals. The apical part is of the ordinary construction; but the following portion down to the base is 'very rugose, and presents a spongy aspect, due to the interlacing, and, so to speak, felting of a multitude of epidermic filaments emanating from radiate cells, which constitute a perfect network of irregular meshes. Within the sort of sheath thus formed longitudinal filaments which break up into bundles of fibrils are to be seen.'

"Very little is known as to the habitat of this animal, which M. Milne-Edwards has named *Lophiomys imhausi*, the former name referring to the crested character of the back, the second commemorating the person who first brought the creature to the notice of naturalists. M. Imhaus, stopping for a few hours at Aden, on his way home from Réunion, saw a living specimen of this rodent in the possession of a Negro, from whom he bought it, but could learn nothing as to its origin. He inferred, however, that it had not been brought very far, and that its native country was either Southern Arabia, or some region in Abyssinia, or Nubia, on the other side of the Red Sea. This specimen was brought to France, and lived for about a year and a half in the Garden of Acclimatization in the Bois de Boulogne, where it fed upon maize, vegetables, and bread, slept during the day, and climbed with ease upon chairs and other convenient objects by the aid of its hinder hands. It never took its food in the fore-paws to carry it to the mouth as so many rodents do. When irritated it elevated the crest right down to the end of the tail, and defended itself by biting vigorously."

The chapter on the fossil Rodentia contains a large number of facts packed into a small compass; reference will be found in it to very many of the recent discoveries of rodent remains in the miocene deposits in America, and a detailed account is given of that remarkable fossil form called *Mesotherium cristatum*, by M. Serres, and for which Mr. Alston has formed a section of the rodents called Hebetidentata from their incisor teeth, which, instead of having the chisel-like edge so characteristic of the incisor teeth of all rodents, are continuously enamelled and are four in number in the lower jaw, and two in the upper. The skull and teeth of this strange form are figured; as Mr. Alston says, "It appears to have been a survivor, to pliocene times, of a much earlier type, which represented an era at which the Rodents were not yet clearly marked off from their allies. In fact, Mesotherium seems to continue *into* the order Glires, that line of affinity which Prof. Flower has pointed out as extending from the typical Ungulates through Hyracodon, Homalodontotherium, Nesodon, and Toxodon."

The following is an account of Hoffmann's sloth (*Cholœpus Hoffmanni*):—

"This is a sloth with two clawed fingers on the fore, and with three claws on the hinder extremities. Living specimens are occasionally brought to Europe, especially from Porto Rico, so that its general appearance may now and then be studied at the Zoological Gardens, in the Regent's Park. If it be looked at there in the day-time, it certainly merits the name of sloth, for it resembles a bundle of long, light, brown hair, fixed on the top of a bar of wood close to an upright branch, or huddled up in a corner on the ground; but in the morning, and also late in the evening, the creature begins to move slowly, and to look out for the food put for its use on the floor of the den. All the Hoffmann's sloths have pale brown hair, whiter at the tips, and a white face, showing a brown band across the nose, extending to a ring round each eye. They have also a long and full crest of hair on the neck, and the hair on the limbs is darker than that of the rest of the animal. Dr. Peters, who discovered this sloth, examined the skeleton, and found only six vertebræ in the neck, and in this it differs from the *Cholœpus* just noticed.

"When its food, consisting of carrots and lettuce, and bread-and-milk, is put down in the morning it is soon in movement, and enjoys its milk hanging down from a bar with its hind legs, and resting its back on the floor of the cage. It seizes the food between the claws and the long straight palm of the fore-foot, and passes it into its mouth, chewing actively with the molar teeth, especially with the first, which are sharp. It cares little for the spectators, and when it has finished, slowly mounts up into a corner of its little den and settles down to sleep. In the evening it becomes lively, for it is, and, indeed, all sloths are, nocturnal in habit. The hairless snout, of a light red tint, the absence of 'smellers,' the little eyes with a few hairs around them, and the broad forehead, give the animal a curious appearance. The hair is brushed back on the forehead, and comes around the very small ears on to the cheeks, and is whitey-brown, and this same tint is seen over the whole of the back in long slender hairs. But the under hair is light red or red-brown. The long and slender hand, with its two claws, contrasts with the rather bulky upper part of the limbs, and the flesh-coloured palms are very remarkable.

"The whole of the sloths lead very monotonous lives; their food is ever within their reach, and it is abundant, and they do not appear to have to compete much or at all in the struggle for existence with other animals. Their enemies are snakes and the carnivora, but it is evident that they are much more readily preserved by their habits from the latter than from the former. Leading such an uneventful existence, there is no great call upon their nervous energies or intelligence, and these are at a low pitch. The brain consequently is very simple in regard to convolutions, which are few in number and shallow."

The portion of this volume devoted to the birds is what might have been expected from so well-known an ornithologist as Mr. Sharpe. In the preparation of the chapters on the anatomy of a bird, he acknowledges his obligations to his colleague in the British Museum, Mr. Jeffery Bell, and an excellently well written chapter it is, though it ends a little abruptly; and the periods of incubation in the case of some of the best known birds might usefully have been added.

In the present volume, the two first orders, that of the birds of prey and of the picarian birds, are treated of, and the rest of the orders will probably form volume iv., the publication of which, we trust, will not be long delayed. While aware of the vast multitude of the feathered throng which Mr. Sharpe has to pass under review, might we suggest to him that it is very important that when he gives a paragraph to a sub-family, he might so arrange it as to let the reader discover without difficulty what species quoted really belonged to it? Thus, the arrangement on p. 310 is very perplexing. The sub-family of the cockatoos is of the same value, so far as classification goes, as that of the Amazon parrots or of the Conures, and yet there is no uniformity, so far as typographical details go, to indicate this. If there be a genus Androglossa, it is not alluded to, and for want of quoting, at least one species of the genus Nasiterna in the preceding paragraph, the "it" that was found at Mafoor by von Rosenberg must remain an unknown bird to the reader. There are said to be about

thirty species of Amazon parrots known; which, then, is "the Amazon parrot" figured? The text is appealed to for an answer in vain. Not two lines are devoted to the Macaws. The same is very much the case all through: thus, the honey-guide is figured after Keuleman's sketch; eleven species are known, but neither is the name given of the species figured, nor is the name given of the species whose habits are described. The common goat-sucker, the whip-poor-will, and the lyre-tailed nightjar, are figured, and yet no scientific names for them are to be found. No doubt both author and editor will agree with us that the value of this work would be greatly added to if the good example set in this matter by Mr. Dallas were followed. The illustrations are in general very good, but is there not one egg too many in the nest of the edible-nest swiftlet? The general get-up of the volume—type, paper, and binding—are all that could be wished, and despite the few things in it which we think might be amended, we most cordially recommend it and its predecessors as very excellent volumes on the natural history of the mammals and birds.

PROF. HUXLEY ON TECHNICAL EDUCATION

AT the lecture by Prof. Silvanus Thompson, on "Apprenticeships," at the Society of Arts last week, Prof. Huxley was in the Chair, and in inviting discussion on the paper, said he would commence it by making a few remarks himself. He had listened to Prof. Thompson's paper with gratification, not only on account of the good sense it embodied, but also for a more selfish reason, inasmuch as it entirely accorded with the views which he, coming to the matter from a different side, had himself expressed. Unfortunately he had no personal acquaintance with the ordinary kinds of work in what were called handicrafts, but he ventured some two years ago in that very room to point his remarks with respect to technical education by the knowledge he possessed of medical education. He then expressed a hope that something real and practical would soon be done by the City Guilds, which had done him the honour of consulting him on this subject of technical education, and the advice he gave them was in precise accordance with the principles which Prof. Thompson had laid down that night. Whatever might be the merits or demerits of the old system of apprenticeship, it was as thoroughly doomed in the different kinds of ordinary handicrafts as it had been long doomed in physic. The only alternatives appeared to him to be of two kinds. In the first place, we ought to bring within the reach of the young people who were employed in our great manufactures the means of carrying on their education in the particular branches of business with which they were respectively occupied beyond the time during which the necessities of practical life obliged them to be at work in the workshop—that is to say, for a period corresponding virtually with what used to be their apprenticeship. One of his suggestions, therefore, was that there should be established in the neighbourhood of the great centres of industry schools to which young boys who are learning certain handicrafts could resort in order to receive instruction which would qualify them to work skilfully and intelligently at their trade. He likewise suggested that the guilds should employ part of their large funds in the establishment of a central institution, which should do for the teaching-power of the country that which such institutions as the École des Arts et Métiers in France, and the Polytechnicum at Zurich, did in their respective countries. In England there was not only a total absence of schools to which apprentices could resort, but there were no teachers competent to teach in such schools, even if they were established. He thought that the suggestions he made to the guilds were of a sound and practical nature, and calculated to advance the interests of technical education in this country. He understood Prof. Thompson to object to the existing elementary training in our Board schools on the ground of its technical nature and of its occupying the minds of the student entirely with book learning and matters which had no sort of bearing on his future life. No one endeavoured more earnestly than he, when he occupied a seat at the School Board, to remedy the evil of the exclusively book character of our ordinary school instruction. He did not entertain the slightest doubt that an extension of the Kindergarten system, including the use of tools and the knowledge of elementary machines, was a matter of great importance, but he could not think that the evil of not giving hand-work in the elementary schools was after all very great. Although it was a great thing to make skilled workmen, yet it was much more important to make intelligent men. The four or five years during which children ordinarily remained at school were not too much to devote to even an exclusive study of reading, writing, and arithmetic, and to the acquirement of some intelligent knowledge of geography, the elements of history, and the rudiments of physical science. On this point he might observe that no pupil was admitted to the Écoles d'Apprentis in Paris until he was thirteen years old, or unless he presented his certificate of elementary education. If we attained one half or a quarter of the good results reached in the Écoles d'Apprentis, the improvement in the condition of the average British workman would be exceedingly great.

In proposing a vote of thanks to Prof. Thompson for his paper, Prof. Huxley expressed his belief that, as far as London was concerned, it would be a scandal and a robbery if a single shilling were asked for out of the general revenues of the country for technical education. The City of London Guilds possessed enormous wealth, which had been left to them for the benefit of the trades they represent. If the people did not insist on the wealth being applied to its proper purpose, they deserved to be taxed down to their shoes. It would be well if those who had charge of these matters in the city of London would understand that they were morally bound to do this work for the country, and he hoped if they continued to neglect the obligation they would be legally compelled to do it.

NOTES

No more than justice has been done to Sir Joseph Whitworth by granting him a prolongation for five years for his process of manufacturing fluid-compressed steel. The powerful evidence brought before the Committee of the Privy Council as to the utility of this steel could not be resisted. Mr. James Wright, the Engineer-in-Chief of the Navy, stated that the invention "has met a want long felt for the principal parts of marine engines which have been subject to failures;" from his experience of it he has perfect trust in it. Mr. Hotchkiss, the patentee of the revolving cannon used by the French Government, stated that he never had occasion to reject a single *barrel* of the steel. The evidence from Mr. J. Davidson, of Woolwich, Mr. Purdey, the well-known gun-maker, and others, showed that by getting rid of the air-cells the steel answered perfectly, and is a better metal than had ever been produced by any previous process. Their Lordships were satisfied that it would in all probability be highly useful "in carrying out the highest achievements of engineering skill."

THE long-expected experiments by the *Thunderer* Gun Committee commenced on Tuesday at the proof butts on the Government marshes, Woolwich. In connection with these experiments, Sir William Palliser organised, and last week carried out, a successful series of experiments with a doubly-loaded gun, in order to ascertain whether double-loading was or was not the cause of the bursting of the *Thunderer's* gun. Five

double charges were fired, each successive charge being increased in length. No sign of flaw or damage could be perceived. A similar result attended experiments with an air-space between the powder charge and the base of the projectile. But when shall we have a gunner like Froude to abolish experiments on the scale of 12 inches to a foot? The navy now build a paraffin boat for a few shillings, instead of a real one costing a quarter of a million to experiment with. What will the experiments, including the bursting of the gun, cost? If smaller experiments cannot be devised, no one has a right to say that Palliser's experiments on a smaller scale teach us nothing.

WE are glad to see that decisive action has been taken on the side of the United States for the acquisition of the ground in the neighbourhood of Niagara Falls as an International Park, and so preserve visitors from the innumerable annoyances to which they are at present subject. At a meeting of the Board of Commissioners of the New York State Survey, on November 20, Director Gardner, of the Survey, presented conclusions arrived at by the board at its meeting in Niagara last September, illustrated with maps, diagrams, &c. The plan proposed is to take a strip along the American bank, varying from 100 to 600 feet in width, extending two miles from the new suspension bridge to the head of the rapids, and plant it with trees, to shut out from view the ugly bazaars, manufactories, booths, and hotels which destroy the natural scenery of the banks. The plan also involves the purchase of Goat and Bath Islands, which, the Commission has reason to believe, can be bought. The proposed park will extend to and include Canal Street, in the village, over which the State now has jurisdiction. Director Gardner places the total amount required to secure all the property needed at 800,000 dols. The Commissioners thought the estimate too low. A report recommending that the State shall purchase the property will be prepared by Messrs. Dorsheimer, Stout, and Barnard. It is the unanimous opinion of the Commission that New York should proceed to reclaim her side of Niagara without reference to what Canada may do. One map, shown by Director Gardner, indicated that the recession of the Falls since 1842, when a trigonometrical survey was made, has been something over 100 feet.

FRENCH meteorologists have observed a curious analogy between the present season and the severe winter 1788-1789. This winter was observed and described by Cotte, one of the most celebrated French meteorologists. The frosty weather set in on November 25, and ended on January 13. On December 25 intervened a partial thaw. The end of January and February were relatively genial, and the frosty weather again set in on March 4, and kept on up to the end of the month. Frost was so intense that wine was congealed in cellars. The thickness of ice on the Seine was 18 inches, and the breaking of the ice happened only on January 20. Note was carefully taken of the minima observed in a large number of Continental cities. It was observed that the minimum of temperature happened in Germany on December 18, in France on the 31st, and in Russia only on January 5. During frosty weather the wind was almost always blowing from north-east with clear sky. Sometimes it was blowing from south, but then snow was falling, sometimes with great abundance.

THE quantity of snow which fell in Paris during the day of December 4 and the ensuing night, according to a calculation made by a member of the Municipal Council, amounts to 245,000,000 cubic feet for the interior of the fortifications. It has been estimated that the expense for removing by handwork and carting this immense quantity of snow, would be about 800,000 francs.

THE dates of the freezing of the Neva have been carefully observed from 1703. It has never frozen sooner than in 1805, on October 16, nor later than in 1740, when it froze on December 28. This year the date is November 15; the mean date is November 13.

SOME curious statistics of gas-lighting in Paris have been published recently. The greatest duration of public lighting is 14h. 30m., and smallest 5h. 25m. The cost of gas for public and private establishments is 2,000,000*l.*, about *one pound* per head for each inhabitant of Paris. The total consumption of gas is 6,500,000,000 cubic feet. In 1880 the Paris Municipality intends to enlarge its lighting expenses by 16,000*l.*, and 8,000*l.* for establishing new gas-lamps. No provision appears to be made for electricity.

THE excavations at Olympia under the auspices of the German Government have been resumed this winter with a force of 100 workmen. A statue of Nemesis, and heads of Titus, of a kneeling infant, and of Paionios' Nike have already been unearthed this season. The total number of works of art thus far excavated is sixty-seven, consisting of forty-one figures and twenty-six heads.

WE regret to have to record the death of Madame Louis Figuier, the wife of the well-known author of so many popular works in science. Madame Figuier has written a number of plays, and has been a fellow-worker with her husband in the publication of his "Théâtre Scientifique," which has appeared quite recently anonymously.

DR. H. TRIMEN, who leaves England to assume his appointment in Ceylon in January, is succeeded in the editorship of the *Journal of Botany* by Mr. James Britten, F.L.S., of the Botanical Department of the British Museum.

A METEOROLOGICAL station has been opened at Prato, thus connecting Fiesole and Florence with Pescia and Lucca.

TELEGRAPHIC communication between Paris and other cities of France and the Continent has been almost interrupted by snow. It is only in Germany that the telegraphic service has continued almost unimpeded, owing to the establishment of subterranean communications.

MESSRS. SAMPSON LOW AND CO. are about to publish Dr. August Weismann's "Studies in the Theory of Descent," with a prefatory notice by Charles Darwin, F.R.S., translated and edited, with notes, by Raphael Meldola. Part I.—On the Seasonal Dimorphism of Butterflies (with two coloured plates). Part II.—On the Origin of the Markings of Caterpillars; On Phyletic Parallelism in Metamorphic Species (with six coloured plates). Part III.—On the Transformation of the Mexican Axolotl into Amblystoma; On the Mechanical Conception of Nature. The German text, we are informed, has been carefully revised and brought down to date by the author, under whose supervision the chromo-lithographic plates have been accurately re-drawn and engraved.

WE understand that Mr. Anderson's long-promised work on Lightning Conductors will now be issued in a few days. Messrs. Spon, of Charing Cross, are the publishers.

THE well-known Boulak Museum at Cairo has been undergoing repairs, and the fine collection was deposited in a neighbouring warehouse under what seemed proper guardianship. But, the *Times* correspondent writes, robbers the other day broke in through the roof, and they must have been robbers of a certain rank of intellect, for some 80 or 100 scarabees of great value pecuniarily, and impossible to replace, as they related to the early dynasties, were abstracted, although they were things of no apparent worth to an ignorant person.

A CORRESPONDENT of the *North China Herald* understands that the director of the magnetic and meteorological observatory

connected with the Roman Catholic mission establishment at Sikawei, near Shanghai, has good reason to suppose, after a careful study of the typhoon of July 31, that the Chinese typhoons, like the cyclones of the Bay of Bengal, do not have their centre eight points to the right from the direction of the wind (the face being turned against the latter), as is generally supposed, but from nine to ten points. It is certainly of the utmost importance to navigators that this conclusion of Père Dechevrens should be carefully investigated, to which end the cooperation of ship-masters is invited. They should forward observations of the barometer and thermometer, force and direction of the wind, mentioning the latitude, longitude, and height above the sea-level of the spot where their observations have been taken, the description of instruments used, whether the thermometer is attached to the barometer, and what corrections, if any, are to be applied, with general description of weather, &c.

We have received the seventh edition (November, 1879) of Prof. E. Morren's "Correspondance Botanique." There is no alteration this year in the plan or scope of this useful botanical directory for the whole world; but the necessary corrections and additions seem very carefully made up to the date of issue. The only noteworthy additions to the list of names for each country are in the case of France, which requires two extra pages, and Italy, which takes one page more than last year.

The Associated *Soirée* of the Literary, Scientific, and Art Societies of Liverpool was held in St. George's Hall yesterday. The programme was of a varied character, both literature, science, and art, being well represented upon it. The idea of thus uniting the various classes of societies in a large town is a happy one, and deserves imitation.

We notice from the November number of the *University College of Wales Magazine* that numerous important additions have been made to the museum of that institution, which now contains collections of very varied character.

Science Gossip for December publishes a useful list of naturalists who are willing gratuitously to assist learners of natural history and others, personally when practicable, otherwise through the post.

Prof. Newberry has reprinted his article on the "Geological Survey of the Fortieth Parallel" (New York, Appleton) from the *Popular Science Monthly*. We have at various times referred to the volumes of this magnificent work; Prof. Newberry's paper gives a good *résumé* of the whole.

The *Colonies and India* calls attention to the fact that a small quantity of flax grown in West Australia, which recently fell into the hands of an English manufacturing firm, was found to be of such excellent quality that a large demand has suddenly sprung up in the colony for both indigenous and cultivated flax.

The additions to the Zoological Society's Gardens during the past week include three Pin-tailed Whydah Birds (*Vidua principalis*) from Africa, presented by Capt. T. H. Bowyer Bower; two Common Chameleons (*Chamæleon vulgaris*) from North Africa, presented by Capt. Burke; a Mississippi Alligator (*Alligator mississippiensis*) from the Mississippi River, presented by Mr. W. G. Marshall; a Slow-worm (*Anguis fragilis*), European, presented by Mr. W. A. H. Bernard Smith; two Red River Hogs (*Potamochærus penicillata*) from West Africa, two Elliot's Guinea Fowls (*Numida ellioti*) from East Africa, an Elephantine Tortoise (*Testudo elephantina*) from the Aldabra Island, deposited; two Prong-horn Antelopes (*Antilocapra americana*) from North America, a Slow Loris (*Nycticebus tardigradus*) from Malacca, a Laughing Falcon (*Herpetotheres cachinnans*) from Brazil, a Bar-tailed Godwit (*Limosa lapponica*), a Common Curlew (*Numenius arquatus*), two Pomatorhine Skuas (*Stercorarius pomatorhinus*), European, purchased.

OUR ASTRONOMICAL COLUMN

Orbits of Binary Stars.—In addition to elements of O. Σ. 235, which apppear in the recently-published "Handbook of Double Stars," Dr. Doberck has lately investigated orbits for the binaries 4 Aquarii and μ^2 Herculis, stars for which no similar computation had been previously made. He assigns a period of 129·8 years for the former, the passage of the periastre at 1881·80, and for the latter a period of 54·25 years, the periastre at 1877·13. The elements give the following angles and distances:—

4 Aquarii.				μ^2 Herculis.			
		°	″			°	″
1880·5	Pos.	188·2	Dist. 0·32	1879·5	Pos.	241·1	Dist. 1·05
1885·5	,,	242·0	,, 0·22	1880·5	,,	247·1	,, 1·04
1890·5	,,	295·9	,, 0·32	1881·5	,,	253·4	,, 1·01
				1882·5	,,	260·1	,, 0·97

The extent of Dr. Doberck's investigations relative to the orbits of the revolving double-stars will be seen from the following nearly complete list of objects, for which we are indebted to him for the best systems of elements yet in our possession:—Σ 3121, μ^2 Hercules, O.Σ. 298, α Centauri, γ Coronæ Borealis, ξ Scorpii, Σ 3062, ω Leonis, p Eridani, Σ 1768, ξ Bootis, 4 Aquarii, τ Ophiuchi, η Cassiopeæ, λ Ophiuchi, 44 Bootis, μ^2 Bootis, 36 Andromedæ, γ Leonis, σ Coronæ Borealis, α Geminorum, ζ Aquarii, O.Σ. 235. It must be borne in mind, in order to appreciate the amount of labour involved in these researches, that in the majority of cases the orbits are not the results of rough or graphical approximations, but have been worked out with a degree of refinement, which exhausts the data actually at Dr. Doberck's command. He has made this subject as much his own as Prof. Julius Schmidt has in his case that of the variable stars.

Errors of the Lunar Tables.—Prof. Winnecke publishes observations of the moon made by Dr. Schur at the provisional observatory of the University of Strassburg in the year 1878, and the corrections required by Hansen's tables, and by the same tables as improved by Prof. Newcomb, who showed the large and increasing deviation of the tables would almost wholly disappear if, for the empirical term, an empirical alteration of the other term due to the action of Venus is substituted, and suitable alterations made in the elements of mean motion. The advantage derived by the introduction of Newcomb's corrections is seen to be very considerable, the signs alternating in the course of the year, and the corrections being generally small, while with Hansen unaltered there is a larger and uniformly negative correction throughout.

From the same observations there is deduced a correction to the mean semi-diameter adopted in Hansen's tables amounting to −1″·29. Soon after the appearance of these tables, Dr. Oudemanns, by a careful discussion of occultations and direct heliometric measures, inferred a correction of −1″·09. If the mean of these values be adopted, we shall have for the moon's mean semi-diameter, 15′ 32″·16. Dr. Oudemanns' paper will be found in vol. xxvi. of the *Monthly Notices* of the Royal Astronomical Society.

Re-Discussion of Ancient Solar Eclipses.—The publication of recent investigations on the motion of the moon, appearing to render a new discussion of the ancient eclipses of the sun desirable, the work has been commenced under the auspices of the Smithsonian Institution, by Mr. D. P. Todd, of the American *Nautical Almanac* Office. The computations so far relate to the eclipses of Thales, Larissa, Ennius, Agathocles, and Stiklastad, and to the two eclipses of the thirteenth century, which have formed the subject of an important memoir by Celoria, of the observatory at Milan. It is proposed to extend the original scope of the research to include a large number of ecliptic dates, and great facilities are expected from the use of Newcomb's Tables of Eclipses, which have recently appeared. We shall allude further to these tables in a future column. It will be seen that this interesting research is in excellent hands.

The Solar Parallax.—Mr. Downing, of the Royal Observatory, Greenwich, has made a determination of the sun's mean parallax from observations of Mars in declination at the observatories of Leyden and Melbourne, during the very favourable opposition in 1877, the same comparison-stars having been used at both stations. The observations were made between July and October, but Mr. Downing has only compared them on those days when planet and stars were observed at Leyden and

Melbourne on the same day or on the following day, so that the change in error of the places interpolated with second differences from the *Nautical Almanac*, has merely to be carried back for 9½ hours or carried forward for 14½ hours. The resulting mean solar parallax is 8″·96, and assuming that the probable error of a single observation of declination is 0″·5, the probable error of the result is ± 0″·051. The value obtained by Prof. Newcomb from similar observations in the year 1862 was 8″·855, nearly identical with that which Leverrier held to be pretty definitive, and which was given by the planetary theories, or 8″·86. In most of the national ephemerides, Newcomb's mean value, obtained in his paper on the sun's distance in the Washington Observations for 1865, or 8″·848, has been adopted; the *Connaissance des Temps* substitutes Leverrier's.

METEOROLOGICAL NOTES

Mr. E. Knipping, Tokio, has written a brief account of three typhoons which occurred in the China and Japan Seas in September, 1878. In twelve charts and one diagram he sets down the paths of the three storms and the weather of each day from the 15th to 21st, when the third and most violent of the typhoons occurred. The heaviest squalls and gusts of wind were met with in the front part of the typhoon, or with north-east and south-east winds, whereas they are hardly mentioned in the ship's logs with south-west winds in the rear of the storm. The path of the typhoon was to north-west from 15th to 19th, to north on 19th and 20th, when it recurved to the north-east, following a course midway between Japan and the continent. Its rate of progress was 10 miles an hour on the average, rising to 25, and falling to 2½ miles an hour. The diagram, which summarises the author's views regarding the behaviour of the winds, seems to raise questions which call for further inquiry. Thus the south-east wind shows, near the centre of the hypothetical typhoon, an in-curving tendency, which becomes less and less on receding from the centre, till, towards the outskirts of the storm, it is represented as blowing outwards. On the other hand, the north-east wind, immediately contiguous, very decidedly in-curves near the outskirts of the storm, but on approaching the centre the incurvation becomes less and less till it disappears. The statement is made that at a distance of 900 miles from the centre, with a north-east wind, the centre of the typhoon bears right ahead, but with a south-east wind the centre bears south. For a satisfactory examination of the points here raised, and other points, such as the remarkable changes in the form of the typhoon while off the coast of Shanghai, fuller data are required, so that the positions of the centre at different times be more accurately ascertained. The publication of details of the data in an appendix to the work is equally necessary.

Prof. Nipher's *Missouri Weather Service Report* for October last is to hand, and is of more than usual interest. The returns show the weather of that State to have been unprecedently warm for the season, the mean temperature of St. Louis, viz., 63°·1, being the highest for any October of the past forty years. At the same time the rainfall was only 0·57 inch, being, with the single exception of 1872, when the rainfall was 0·29 inch, the driest October in forty years. The rainfall was unusually small over no inconsiderable portion of the State, extending to north-west of St. Louis, and in the extreme north-east it amounted only to about a ¼ inch, whereas, on the other hand, within a limited district immediately to southward round Cuba, and over a pretty extensive region in the west, lying to north and south of Kansas City, it exceeded 4 inches. The service is being ably and vigorously worked, eighteen new stations being added in November, so that there are now seventy-three stations, the results of whose observations are quickly sent broadcast over the State and beyond it, reaching Europe even in the third week of the following month. We observe with much satisfaction that the efficiency of this weather service is to be greatly enlarged by the active co-operation of the directors of the principal railroads, who have intimated their readiness to make meteorological observations a regular part of the duties of their station agents at points selected by Prof. Nipher himself.

In connection with the meteorological work proper of the Missouri Weather Service, Prof. Nipher has been carrying out a magnetic survey of the State during the summers of 1878 and 1879, the expense of the survey having hitherto been met by private subscriptions. The results of this survey are given on a valuable map which accompanies the October Report, showing the lines of equal magnetic variation, and attention is directed to the tendency of the needle to set at right angles to those river-valleys which do not run north and south. A report on the climatology of Missouri is in course of preparation by Prof. Nipher, at the request of the State Board of Agriculture. It is with some surprise we learn that the expense of organising and carrying on this service has been wholly borne by two of the directors and Prof. Nipher. But this state of things the Americans are too sharp-sighted to allow to go on, it being in the interests of the State to provide that a service which is so energetically and effectually working out the climatologies of its various agricultural centres does not run the risk of being starved out for want of the few dollars required to meet its working expenses.

Capt. Toynbee, in the *Journal* of the Meteorological Society for October, gives an interesting comparison of the temperature of the Atlantic during the Decembers of 1877 and 1878 from observations made on the temperature of the sea every four hours of these months by Capt. Watson, of the Cunard steamer *Algeria*. The result shows that for the outward and homeward passages to America the part of the Atlantic traversed by the *Algeria* was 3°·2 warmer in December, 1878, than in December, 1877. A comparison is also made of the mean temperature of the British Isles, and from observations at about forty stations it is shown that the December of 1878 was 8°·0 colder than that of 1877, "in spite of the fact that the sea to the westward was more than 3°·0 warmer." The higher temperature of the sea in December, 1878, would appear not to have extended far to northward, seeing that on the west of Scotland the sea was half a degree colder than in 1877, and in Farö 1°·7 colder, whilst on the north-west of Iceland the sea during December, 1878, was 0°·2 warmer. The interest attached to such an inquiry centres in the point that 8°·0 greater cold over the British Isles during 1878 as compared with 1877 may have been brought about in consequence of the fact that the Atlantic to west-south-westward was more than 3°·0 warmer. It is, for example, possible that this abnormal distribution of temperature in the Atlantic was more or less immediately connected with the more southerly course taken by our European storms since the end of October, 1878, from which have inevitably resulted the unusual prevalence of easterly and northerly winds and the cold weather we have had since. An inquiry more practically important could scarcely be suggested to meteorologists than an investigation of the point suggested many years ago by Sabine as to there being a possible connection between the temperature of the tropical and subtropical waters of the Atlantic during the autumn months and the severity or mildness of our European winters; and certainly no more suitable period could be selected for the inquiry than the last two years, a twelvemonth's warm, fine weather having set in during October, 1877, and a period of cold weather, exceptionally protracted and severe, having commenced in the end of October, 1878.

GEOGRAPHICAL NOTES

At the meeting of the Geographical Society, on Monday evening, Mr. Wilfrid S. Blunt read a paper entitled "A Visit to Nejd," in which he gave an interesting account of a journey made last winter in company with his wife, Lady Anne Blunt, from Damascus southwards to Jôf and the Jebel Shammar in Central Arabia. The results of Mr. Blunt's expedition may be thus briefly summed up. The oases of Kâf and 'Ittery have now been visited and the Wady Sirhan explored by Europeans for the first time. By taking barometrical observations along its entire length, Mr. Blunt ascertained that the Wady Sirhan from Ezrak to Jôf lies on nearly a uniform level of 1,800 feet above the sea, from which he thinks that it was formerly an inland sea, and is miscalled a Wady or valley. Along the whole distance he roughly surveyed the pilgrim road, marking the position of the wells and the reservoirs made by Zobeyde. Mr. Blunt has also constructed a map of the Jebel Shammar district. The most interesting outcome of his journey, probably, is the collection of a series of facts relating to the physical condition of the great sand desert of Nefud, and in some material respects his observations are at variance with those of Mr. Palgrave. Mr. Blunt appears to be the first to call attention to the deep horse-shoe hollows, called by the Arabs *fulj*, with which the whole surface of the plain is pitted.

In the present critical state of affairs between China and Japan in regard to the suzerainty of the Loochoo Islands, much

interest attaches to an official document issued in the latter country on the subject. All the Loochoo Islands, the Japanese maintain, are connected by certain geomantic signs in the earth with the Japanese province of Satsuma. The forty-eight characters of the Japanese alphabet are in use there, having been communicated to the islanders by Minamotonotametono. As regards language, they use a mixture of Chinese words and the Japanese alphabet in their literature. They call their own kingdom Okina, or otherwise, Okinawa. As regards religion, they worship Yi Shih, the Great Spirit of Japan, besides other divinities. In many of their domestic customs, too, the Japanese maintain that their practice indubitably indicates their origin.

THE new number of *Les Annales de l'Extrême Orient* contains some ethnographical notes on Thibet by the Abbé Desgodins, illustrated by a map of that country and the neighbouring regions.

THE just published part of *Le Globe* contains a paper by Dr. E. Dufresne, entitled "Une station d'hiver pour les phthisiques dans les Hautes-Alpes," and a third article by M. Venuikof on geographical discoveries in Asiatic Russia.

THE *Bulletin* of the Antwerp Geographical Society contains the text of the "Résolutions et Vœux," presented by the section of the late Commercial Geography Congress at Brussels, and adopted by the general meeting.

AT the last sitting of the Paris Society of Geography a letter from M. Sibiriakoff, one of the promoters of Nordenskjöld's North Asiatic Expedition, was read. This generous gentleman proposes to the Society to send a handsome subscription, in case a French expedition is sent to these parts. But it does not appear likely this suggestion will be taken into consideration.

M. HERTZ, the founder of *L'Explorateur*, the first popular journal of geography established in Paris, died a few days ago at the age of fifty. He was a member of the Council of the Geographical Society and one of the promoters of the Commercial Geographical Society.

U.S. NATIONAL ACADEMY

THE National Academy of Sciences held its semi-annual meeting at Columbia College, New York, October 28th–30th. Prof. W. B. Rogers presided. The meeting was welcomed by Prof. F. A. P. Barnard (President of Columbia College), as being the first use that has been made of the new building recently constructed and not yet quite finished, on the western front of the college grounds; thus appropriately inaugurating it in the interests of science. Prof. Rogers opened the meeting with a few brief but eloquent remarks, descanting on the far-reaching character of the researches which are now most prominently before the scientific world. As instances he cited the proofs brought by Prof. Whitney of the discovery of human remains in the pliocene; the evidence adduced by Mr. Lockyer, showing that in the sun many of the elements may prove to be compounds; the marvellous expositions of "radiant matter" in Mr. Crookes's experiments; and the striking discoveries in the uses of electricity and the telephone. Prof. Rogers is not ready to accept all the new theories which accompany these novel conceptions, but he feels assured that we are on the road toward new truths. The present age, like that which preceded the Newtonian era, has brought together a vast and somewhat chaotic mass of observations, out of which great principles shall be determined. In this work it is to be expected that some of the members of the Academy will bear an active part.

Dr. Henry Draper read a paper on the photography of star spectra, which we gave at p. 83.

Prof. C. A. Young contributed some "Spectroscopic Notes." He showed the want of true achromatism in the ordinary achromatic object-glass. By special arrangement of apparatus and the use of high dispersive powers, he has divided several spectral lines hitherto regarded as basic. The abundance of double lines in the spectrum has a meaning that needs to be investigated; as a curious fact, it is comparable to the excessive number of double stars that the telescope reveals. Prof. Young is prepared to indulge in a doubt as to whether the dark lines are really produced by absorption.

Dr. J. J. Woodward, Surgeon, U.S.A., read an elaborate paper on original researches reported in the second medical volume of the "Medical and Surgical History of the War of the Rebellion." This is a work published by the U.S. Government in several large quarto volumes. In preparing the work, Dr. Woodward consulted 124 different authors. His studies were aided by the use of the very large number of specimens in the pathological collection of the U.S. Army Museum. For various representations, *e.g.*, showing the cicatrices of diphtheritic ulcers, photography and the heliotype were employed. The special researches applied chiefly to diseases of the internal organs, such as dysentery and intestinal catarrhs. The minute changes indicating the beginnings of disease were closely studied. Dr. Woodward's conclusions tend to confirm the more recent and advanced views of pathology.

Dr. J. C. Dalton presented some observations on the structure of the human brain. He divided all brain matter, including the part which extends into the spinal column, into two kinds, the white and the gray. He proceeded to show that the gray kind was in three deposits, which are connected with one another—the spinal cord, the cerebral ganglia, and the extension into the outer sheath of the brain. The connection between these portions was shown to be continuous. The true shape of the corpus striatum and its connection with, as a part of, a circular organ called the surcingle, was demonstrated; and it was also shown that the lobes of the brain presented the appearance of being lapped together and doubled over around the crus cerebri. In the discussion that followed, Dr. Woodward stated that the brain had been so prepared by a peculiar process, that a single one was sawed into 1,000 slices for microscopical examination.

Prof. A. Guyot presented some remarks on a new map of the Catskill Mountains, and on the topographical relations of that mountain group to the adjacent regions of the Appalachian system. The excellent work that has been done by Prof. Guyot in the survey of the Catskill region was described some months ago in a paper read before the New York Academy of Sciences: copies are now furnished of the original map that was then exhibited. The object of the present paper was to call attention to the geological problems exhibited by the Catskill plateau. The author did not regard the carving of the mountains as glacial work, though the evidence of glacial scratches was not wanting. The process which had taken place, he thought, was an elevation of the whole district. But at the time of that rise the Adirondack formation was already in position, and by it the Catskill plateau was squeezed as it rose. The mountains which now occupy the place of that plateau were left by erosion, their valleys being carved out by the rivers. Prof. James Hall, in the discussion which followed, expressed himself as delighted with the adhesion of so good an observer as Prof. Guyot to this theory of the formation of mountains by erosion, and not by their separate upheaval. Prof. Rogers described an instance where one of the Shenandoah Mountains could scarcely have been formed by a separate upheaval, for all its strata were horizontal from bottom to top; but the surrounding region was full of the evidences of disturbance.

Prof. James Hall exhibited some new and remarkable forms of crinoids from the Lower Helderberg formation. These specimens were obtained partly in New York State, and partly in Tennessee. They were from three to four inches in diameter, and of varying shapes, no two alike, though mostly spheroidal; some were hemispherical or much flattened; others were turbinated. It was at first suspected that these were expansions of the bulbous root of crinoids, but subsequent observations indicated that these are the summits of the animal. They are made up of polygonal plates, but the arrangement is not distinctly radial, and its stellate character is greatly obscured. The specimens, which are now quite numerous, seem to be overgrowths, and present great difficulties in classification.—Prof. Hall read also a paper upon another Silurian fossil, *Lycopoditis vanuxem*. This has been regarded as a plant, allied to the ferns: a more thorough study of the subject has convinced Prof. Hall that this fossil was an animal form. It is found in quantities that cover many acres with a thickness of five to fifteen feet. The attention of the Academy was also called to the question as to the classification of *Stomatophora*, a coral found upon masses of favosite, and in the same horizon as the curious crinoids. In the discussion which followed, Prof. Newberry called attention to the sponge-like appearance of the crinoid specimens, suggestive of a missing link between crinoids and sponges.

Prof. Asaph Hall read a brief paper on this year's observations on the satellites of Mars. The discrepancies of position of Deimos are very small. It is found that Phobos comes to its

greatest elongation 44 minutes before the place as computed: its period as now ascertained is 7h. 39m. 13·996 sec.

A paper by Prof. Joseph Le Conte on the old river-beds of California, was read in the absence of its author, and attracted much attention. These river-beds are now in process of being washed out by hydraulic mining, in the search for gold; and it is in them that some of the earliest traces of prehistoric man are alleged to have been discovered. Prof. Le Conte does not regard the hydraulic method of attack as promising to yield many fossils in good preservation; it is more likely to destroy all traces. The mode of formation of the old river-beds, which are found in Middle California, is peculiar. Their rivers had been completely displaced and have formed new channels, sometimes parallel, and sometimes even at right angles to the old ones. The new channels are cut perpendicularly through 2,000 to 3,000 feet of slate rock. The old channels are filled with boulders and pebbles; capped with a conglomerate layer, described as "trifaceous," the product of a volcanic overflow, with few pebbles. Under ordinary circumstances the tendency of rivers to clear their own channels is effective, though sometimes operating at long intervals. If the load of detritus is too heavy, it is deposited; but eventually there comes a time when the river is no longer overloaded, and then it proceeds to tear up and remove its previous deposits. Thus at the present time the Colorado River is underloaded, and is cutting its channel, while the Platte is overloaded and filling up; the Yuba River has filled a depth of 15 feet within the past 20 years. But in the old river-beds under consideration, the deposit has been capped and protected by a volcanic overflow. We find evidences of this lava flood over a vast district, but not extending to the British possessions. Prof. Le Conte is inclined to fix the period of the lava flow as at the boundary between the tertiary and quaternary. Whitney and other geologists have referred the gravel of these river-beds to the pliocene; Prof. Le Conte thinks that the fossils indicate the approach of a change to the quaternary, and that the passage from the pliocene to the glacial epoch was gradual. To review the whole procedure, he begins with the elevation of the Sierras, when a general drainage system was constituted without much tendency to erosion. Glaciers formed and were melted, and thus were provided the boulders and gravel. Then came the lava flow, which destroyed the old drainage system, and compelled the rivers to seek new channels. The further elevation of the Sierras had renewed the glacial operations, which in some instances had wholly swept away the lava and replaced it by a different class of deposits. The paper elicited a very lively discussion, in which all the geologists present took part. Prof. O. C. Marsh is inclined to give full weight to the views of Prof. Whitney and Clarence King, who have been long in the field and have studied the subject very thoroughly. Prof. Marsh said that he himself has picked out fossil remains from these river-beds, which were unquestionably pliocene, and of animals living in a tropical climate. The volcanic outbreak certainly took place in the pliocene, and before the glacial epoch; of this he had assured himself by observing the position of layers of basalt. We find the remains of man in this position—in the pliocene, along with remains of sloths and other tropical animals. We concede that these animals were there in that era. Why must we suppose that the remains of man were brought thither by some accident? It seems more reasonable to believe that man was there in that warm climate, in which he could live, than that he came in with the cold and the glacial era.

"Our Memory for Colour and Luminosity," was the subject of an essay by Prof. O. N. Rood. He proposed to give a few results from a series of experiments recently begun and not yet completed. It is generally supposed that while we have a distinct memory of different colours, such, for instance, as those which are called "primary," we do not remember with definiteness, particular shades of colour or specific mixtures of white and black. Nearly all optical instruments in which there is a provision for comparing either colours or amounts of luminosity, are constructed with great care so as to bring as nearly as possible into contact the colours or shades to be compared. The prevailing notion seems to be that we do not retain for ten seconds an exact memory of a given shade or tint. Prof. Rood exhibited the apparatus by means of which he tested the correctness of this notion. Two disks were so arranged that either one could overlap the other in any required proportion. The disks were of different colours, which blended into a given tint when the disks were rapidly revolved—a tint having a known percentage of each of its components. Let us suppose that this tint was obtained by thus blending 43 parts of yellow with 57 parts of red. Prof. Rood wished to ascertain how near to that proportion he would get when he reproduced that tint from memory. So he took a glance at it while the disks were revolving. An assistant then disarranged the disks, and afterwards proceeded to rearrange them, making the blended tint more or less yellow as directed by Prof. Rood, until the colour attained corresponded to the latter's recollection of the original tint. The original having 43 per cent. of yellow, the reproduced colour had—on an average of many trials—42·6 per cent. of yellow. This was when only a minute elapsed between looking at the tint and reproducing it. The largest variations from the mean were not over ½ of one per cent., a difference of tint so slight as to be just barely perceptible when it is shown by direct contrast and the superposition of the differing shades. When an hour was allowed to elapse before the colour was reproduced from memory, the tint obtained averaged 45·2 of yellow, showing an error of 2·2 per cent. error. Reproductions 24 hours afterwards gave 47·5; *i.e.* 4½ per cent. Equally near results followed in testing the memory for other mixtures of colours, such as yellow with green, and blue with green. The amount of error in several of these instances was exhibited to the Academy by means of the apparatus, and was scarcely distinguishable. This power of memory for colours might, however, be peculiar to this experimenter; to test that point, a similar set of observations were made upon his assistant's memory, with as good results. There was a single and curious exception. During one of the experiments a cord in the apparatus snapped; this incident so distracted the assistant's memory of a given tint that his reproduction of it was utterly at fault; but immediately afterwards he regained his usual average of correctness. The reproduction of grays, that is, mixtures of white and black, is attended, as might be supposed, with a somewhat larger average of error; but the experiments on this point are not yet complete. From what has thus been shown it is evident that the memory of definite tints is fairly accurate, so that it can be depended upon within certain limits. Hence the juxtaposition of tints to be compared in spectroscopes and other optical instruments is not always necessary. The instruments themselves can be made far less complicated and costly where this feature of cons ruction is not required. Observers can be trained to an accurate memory of tints and even of differences of luminosity. Prof. Rood showed also some apparatus for obtaining a quantitative analysis of the effect of contrast upon adjacent colours. It was shown, for instance, that the colour of a small disk on a large ground was overwhelmed by its background to the extent of 12 per cent. In the discussion on this paper, Prof. Trowbridge, of Columbia College, stated that his students in drawing, preparatory to a course of engineering, were required first to make a draught from a model, and then, the next day, to reproduce the draught from memory. Several of these drawings, with the duplicates from memory, were exhibited; they gave conclusive proof that the memory of form under such circumstances may be cultivated to a high pitch of accuracy.

Prof. S. P. Langley gave a brief account of a portion of his researches on the radiation of the solar atmosphere. These have demonstrated the decline of heat-radiating power from the centre to the edge in a certain series; and also a decline of light-radiating power in a totally different series, the light near the centre having a blue tinge while that of the outside edge is chocolate red. The apparatus used in these researches was exhibited. About thirty years ago Secchi ventured the assertion that there was a marked difference of temperature between the northern and southern hemispheres of the sun. Prof. Langley afterwards disproved this by experiment, and placed the facts before the French Academy. Somewhat recently two Frenchmen, Messrs. Cruls and Lacaille, announced to the Academy, (through the Emperor of Brazil, who is a corresponding member) that they had verified the original observations of Secchi. They stated that the heat of the northern hemisphere of the sun was to that of its southern, as 100 to 75. Prof. Langley has since carefully repeated his experiments, and is satisfied that there is not a demonstrable difference in the heat of the two hemispheres. In the course of 400 observations he has found only fractional differences of less than one per cent., and since there is no systematic relation between these, they are to be ascribed to such errors as we may reasonably expect.

A second paper from Dr. Joseph Le Conte was read, on the glycogenic function of the liver, being a continuation of a paper on the subject read at a previous meeting and since published. The theory which is advanced in these papers and

supported by certain experiments, is as follows:—Food passing into the liver is there changed into materials fitted for the blood, the albumenoids into nitrogenous and saccharine substances, the amyloids into glycogen or "liver sugar." In preparing sugar for the blood, the liver exercises its chief function by supplying easily combustible fuel. The combustion of this fuel takes place in the capillaries, whither oxygen is also carried by the blood. With regard to the place of combustion being in the capillaries, in contact with tissue, there is no longer a question; the novelty claimed by Dr. Le Conte is in respect to the preparation by the liver of the fuel for this combustion. He does not concede that the tissues are themselves burned in the process. He regards the liver as a sort of storehouse, and asserts that the fuel it provides one day may not be consumed till the next day in the capillaries. Many arguments were brought to bear in support of these views. The paper elicited a brilliant discussion in the meeting, for although the main point, the alleged function of the liver, was cheerfully conceded, a question was raised as to the use of the word "combustion" in describing vital processes; such use of the term being ably opposed by Dr. J. Lawrence Smith, who regards oxygen as serving an alimentary rather than a destructive purpose in the animal economy, while Dr. G. F. Barker argued that a true combustion was performed where the oxygen united with carbo-hydrates and the process was accompanied by evolution of heat.

A paper delivered by Dr. George F. Barker had for its title "On Arago's Experiment." It bore reference to the theory which asserts that a wire becomes a magnet during the passage of electricity. This was called in question about fifteen years ago by Prof. Franklin Bache, of Philadelphia (brother of the late Alexander Dallas Bache of the U.S. Coast Survey). He found that when the magnetic field was cut in two by means of a disk of cardboard, a wire that had previously supported a quantity of iron filings, suddenly dropped them. He inferred that the support of the filings had not been due to the wire being a magnet during the passage of the current, since the current was still passing when they dropped. Their previous support, before the interference of the cardboard, was therefore to be attributed either to their magnetic adhesion to one another, or to the direct influence of currents circulating in the magnetic field which were cut in twain by the cardboard. Dr. Barker has been experimenting with a very powerful magneto-electric machine of the Wallace pattern. It was capable of heating a quarter of an inch gas pipe, three feet long, to bright cherry redness in a minute. Its current was used with a copper wire in Dr. Barker's experiments: the question at issue being whether this copper wire became a magnet during the passage through it of the electric current. A five inch iron spike was held under and close to the wire; the gravity of the spike was lessened, but not sufficiently to support it, even when it was brought within the 1000th of an inch of the wire. But as soon as the spike actually touched the wire, it stuck fast, was wholly supported, and arranged itself transversely to the wire. When the spike was withdrawn from the wire by only the 1000th of an inch, it fell, being no longer sufficiently attracted. Dr. Barker regards this as showing that the attraction in the wire is greater than that in the field. The wire was then passed perpendicularly through a hole in a glass plate on whose upper surface iron filings were sprinkled; these, when the current was passed through the wire, arranged themselves on the plate in concentric circles around the wire, thus indicating that such was the direction of the currents in the magnetic field. When the spike was placed near the wire and parallel to it, but suspended by the upper end, the lower end moved in the direction of the field-currents, throwing the spike out of perpendicular. These observations were regarded by Dr. Barker as evidence that the wire becomes a magnet in the experiment of Arago.

Prof. J. S. Newberry delivered a paper on the vegetation of the Atlantic coast of North America in the cretaceous period. He began by briefly sketching the position of the cretaceous in the United States (and specially the lower cretaceous), along the eastern base of the Appalachian chain. A large collection of fossil leaves from this horizon, obtained in the green sands of New Jersey, was exhibited; it included many leaves from trees of the salix family, in great variety; and leaves and twigs of conifers; the specimens were of remarkable beauty and clearness of detail. These fossils indicate that the dawn of the cretaceous period in this country was attended by a temperate climate. It seems probable that the plants of that period spread from America to Europe before the tertiary age, and were destroyed by the glacial epoch, after which, an Asiatic flora, spreading westward, filled the void. In a discussion upon this paper, Prof. Marsh stated his belief that these fossil leaves were older than the lowest cretaceous marls of New Jersey, in which we find crocodilian and other remains indicative of a warm climate. A similar question had arisen about fossils from Dakotah; animal remains at first regarded as cretaceous, but now known to be Jurassic. Local proximity of formations differing widely in age, is not uncommon at the West. Within fifteen or twenty feet of a place where he picked out remains of dinosaurs, crocodiles and the like, he had found at fifty feet lower depth, the ichthyosaurus. Dr. Newberry said that the clays referred to in New Jersey underrun the marl beds, and are a shore deposit, probably a freshwater one. Prof. Marsh hoped that these localities would be very thoroughly explored. Up to the present date we know of no cretaceous mammal; this is the most serious break in our palæontological record. Prof. Rogers mentioned that certain fossils obtained in Virginia sandstones had been classed as Wealden, but he was inclined to consider them as on the border line between cretaceous and Jurassic. He regarded the position of the New Jersey fossils as yet open to question. Prof. Newberry sketched on the blackboard a sectional view of the strata in the New Jersey locality. Prof. Marsh suggested that these conifers and willows may have grown in elevated positions, on mountain sides, where they would have a temperate climate though it was tropical at the base of the mountains; and that these forests might have been dislodged by flood or avalanche, and carried down into the swamps at the base. It was long supposed in Europe that there was no angiospermic flora below the miocene, and when Prof. Marsh picked up there the leaves of an angiosperm in the cretaceous, the specimen was regarded as a great curiosity. In this country such fossils were abundant; but as to the Jurassic flora we know too little to speak with any certainty. Prof. Rogers stated that an investigation of Virginia and Maryland clays, now in progress, would probably solve this question; and Prof. Newberry expressed a similar hope in regard to certain researches on the shores of Buzzard's Bay, Mass.

A second paper by Prof. Newberry was descriptive of some interesting deposits of gold and silver ores in Utah and Colorado. Specimens were shown of sulphate of baryta with ruby silver. The Horn silver mine of Utah had $20,000,000 of ore in sight; the footwall was limestone; the sandstones are full of the impressions of plants, the plants themselves being replaced by horn silver. Such impregnation by a metal is rare, but there are parallel instances with copper, in New Jersey, in porous sandstone. Near the Horn silver mine is one of a conglomerate rock containing a rich argentiferous galena, going down at least 200 feet, and yielding $50 to $60 to the ton. A similar class of deposits has been found in Colorado, in the district of the Silver Cliff mine, a region of trachytic rock like that of the Horn silver district. It would appear that when the trachyte had been heated so as to be softened, while in the shape of balls of various sizes, the ores had coated them and filled their crevices. The ground is covered with this rusty-looking rubbish. At depths of 150 feet in it, silicified wood is sometimes found, and occasionally free gold, or "wire" gold. A man named Bassick, a sailor who had been round the world, and was quite penniless, picked up one of the rusty trachyte lumps and succeeded in having it assayed; the yield was $50 to the ton. He was thus led to the discovery of what is now known as the Bassick mine, which he eventually sold for $1,000,000. Silver Cliff is distant about six miles; it is a hill of shattered rock—breccia which has been cemented together; the mining operations there have gone 250 feet below the surface, into a zone of oxidized ore; the rock of the hill itself is worth $50 to $60 per ton, and its quantity is simply enormous. From other mines specimens were exhibited containing large quantities of arsenic, the ore being also accompanied by veins of orpiment and realgar. Specimens from Leadville mines showed the progress of change from carbonate to galena ores. The limestone surface had been eroded, and then porphyry was poured over it; the fissure veins were formed in this contact. The famous Leadville deposits are not so rich as had been supposed; specimens picked out for assay were very choice; in general the ore contains iron and a great deal of silica. There are two gold mines in Leadville, one of which is ferruginous quartz. The town itself is vile. Its climate is repulsive. It is at an elevation of 10,500 feet, and water is scarce, so that the whole place is covered with at least 5 inches of dust. There is no sewerage, and this dust is the filth of the town; the air is full of it, and it

must be inhaled with every breath of the dwellers there. But every man in Leadville believes himself potentially rich, and has a mine or a claim for sale. Speculation in claims, and mere gambling in fractional ownerships, is the principal business. Prof. Newberry had seen the law papers in the examination of a mining property where no less than 14 claims overlapped one another. There is really valuable mining property in abundance, not yet developed, in Colorado and Utah ; but the properties that are put on the market for sale in New York are generally worth little or nothing, and will tend to discredit investment in all Western mines.

Prof. J. Lawrence Smith gave an informal account of some recent researches for new elements. A few years ago he found a field of research in the cerium and yttrium minerals, and was well satisfied that he had obtained a new substance, which he named mosandrum, in the cerium group. Since then he has been studying the components of samarskite, and has found, he believes, two new elements, one of which he calls columbium, and the other he proposes to name in honour of his friend and the instructor of his youth, Prof. William B. Rogers. But having much other business requiring his attention, Prof. Smith has done little in that line of research, since then, except to purify some mosandrum. Not wishing to delay the progress of discovery, he turned over a mass of the earthy material to Messrs. Lafontaine and Lecoq Boisbaudran, who have since announced several discoveries. The new elements are not yet separated ; the supposition of their existence is based upon observations on their absorption spectra. Prof. Smith has great doubts whether this method is trustworthy. He found that a given solution showed a different spectrum the second day from that of the day before. The addition of nitric acid in greater or less strength was found to alter a spectrum to an extent fully as great as would be considered indicative of the presence of a new metal. But in nitric acid itself there is nothing to provide these new spectra. Hence a doubt is thrown over all discoveries that rest exclusively upon absorption lines. There are probably 8 or 10 new earths in the yttria group. Of the newly announced metals, Prof. Smith thought philippium was more likely to prove real than most of the others. In the discussion that followed, Dr. Barker pointed out that the colour of a solution affected its spectrum. He regarded the discoveries based solely on absorption spectra as not to be trusted until supplemented by chemical tests.

The other papers read at the meeting were as follows: "On the Mean Pressure of the Atmosphere over the United States at Different Seasons of the Year," by Prof. Elias Loomis ; "Questions as to a very Direct and Simple Method of Ascertaining the Ellipticity of the Terrestrial Spheroid," and "The Completion of the Theory of Parallel Straight Lines," by Prof. Stephen Alexander.

The meeting closed with a brief address by its presiding officer, Prof. Rogers. In the course of his remarks he expressed a wish that hereafter some measures should be taken for a more general and widespread invitation to the public to be present at the meetings of the Academy. This suggestion will probably be adopted.

WM. C. WYCKOFF

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following Statutes, which the University of Cambridge Commissioners contemplate making for the University, having been communicated to the Council of the Senate, the Vice-Chancellor hereby gives public notice thereof in the University.

"The University shall have power to adopt as an affiliated College in any place within the United Kingdom or in any part of the British Dominion any institution founded for the education of adult students, with such conditions as to the provision of lectures, and as to the rules and arrangements for the students, as may be determined from time to time by Grace of the Senate. Students of the institution who shall have continued members of it for such length of time, not less than two years, and shall have attended such lectures, and passed such examinations, as may be required from time to time by Grace of the Senate shall, if admitted as members of the University, be deemed to have kept already three of the terms required for any degree."

"Students in Science, who having already taken a degree in Arts, Law, Medicine, or Surgery, have given proofs of distinction in Science by some original contribution to the advancement of Science, and having done all that is required by the statutes and Ordinances of the University, may be admitted to the title of Doctor designate in Science, and shall afterwards be created Doctors at the time prescribed by the University."

"The management and regulation of the Botanic Garden, together with the appointment and removal of the Curators, Superintendents, Officers, and servants employed therein, shall henceforth be vested in a Syndicate consisting of the five Governors and Visitors appointed by Dr. Walker, that is to say, the Chancellor, or in his absence the Vice-Chancellor of the University, the Master of Trinity College, the Provost of King's College, the Master of St. John's College, and the Regius Professor of Physic, together with such other persons as may be appointed from time to time by Grace of the Senate."

The Syndicate appointed on May 31, 1877, to consider how to encourage students to read for honours in more than one tripos, in consequence of urgent representations on the part of head masters of public schools, have made a sixth and final report, leaving the Board of Natural Science Studies to propose the necessary and more than formal changes required in the regulations. With this exception, the Syndicate consider the duties committed to them to have been completely discharged.

Lord Rayleigh, we are glad to learn, has consented to become a candidate for the Chair of Experimental Physics at Cambridge ; the election takes place to-morrow.

Mr. E. B. Tawney, F.G.S., Assistant to the Woodwardian Professor, who has made most valuable donations to the Woodwardian Museum, has had the degree of Master of Arts conferred upon him. Every geologist and palæontologist who knows Mr. Tawney will be glad to see this recognition of his merits.

THE number of matriculated students attending the University of Edinburgh this season is 2,510, the number of students in medicine being 1,138, in law 363, and in divinity 74. There is an increase, as compared with last year, in all the faculties, that in medicine being 96, and the total increase 178.

THE Court of Assistants of the Cordwainers' Company being impressed with the importance of the City Guilds employing part of their funds in the establishment of a central institution for the promotion of technical education, have, in addition to a grant of 250*l.* per annum already made, voted a donation of 500*l.* towards the building fund, on condition that the total sum agreed to be subscribed for that purpose be in their opinion adequate to the satisfactory fulfilment of the object contemplated.

SCIENTIFIC SERIALS

Gazetta Chimica Italiana, fasc. viii. and ix.—On cimene of cuminic alcohol, by SS. Paterno and Spica.—Decomposition of chlorhydrates of ethylamine by means of heat, by SS. Fileti and Piccini.—Gasometric analysis and methods, by SS. Amalo and Figuera.—Artificial improvement of leaves of indigenous tobacco by means of the sap of exotic leaves, by S. De Negri.—On phenoltolylates, by Dr. Mazzara.—On meta-amido-cinnamic acid, by the same.—Synthesis of phenyl-cumarine, by Dr. Ozliaboro.—On sulph-acids of cumene and on a new cumophenol, by Dr. Spica.—On insecticide powders from the flowers of *Chrysanthemum cineriæfolium*, Trev., by Prof. Dal Sie.—Artificial production of the oligiste of Vesuvian lava, by S. Coppola.—Researches on the products of oxidation of alcoholic derivatives of natural and synthetic thymol, by SS. Paterno and Canzoneri.—On a new organic acid, lithobilic acid, found in oriental bezoar, with lithofellic acid, by Dr. Roster.—On a new method of preparing phenolglycolic acid and on pyrogallotriglycolic acid, by Dr. Giacosa.—Resistance of seeds (especially clover) to prolonged action of gaseous and liquid agents, by S. Giglioli.—On lapacic acid, by S. Paterno.

Journal of the Franklin Institute, November.—We note here the following :—A general differential equation in the theory of the deformation of surfaces, by Mr. Craig.—Future water supply of Philadelphia, by Mr. Bukinbine.—A new illustration of persistence of vision, by Prof. Tobin.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 27.—"On the Structure of Serous Glands in Rest and Activity." By J. N. Langley, M.A., Fellow of Trinity College, Cambridge. Communicated by Prof. Michael Foster, M.D., F.R.S.

The Parotid Gland of the Rabbit.—The alveoli of the gland can be observed in the living state without serious interference with the blood circulation. When the gland has been quiescent for several hours, the alveolar-cells are granular throughout, and the outlines of the cells are only faintly marked as clear lines without granules. When the gland secretes, the granules disappear from the outer borders of the alveolar-cells, that is, from that portion of the cells nearest the basement membrane. After prolonged secretion, very few granules are left in the cells; those that do remain in any cell form a thin layer at its inner portion, that is, at the portion bounding the lumen, and stretch outwards, also as a thin layer, along the cell-sides a variable distance from the lumen.

In an alveolus during secretion, the cells separate from one another slightly near the lumen; thus the lumen stretches out for a short distance between the cells; it becomes larger, at the same time, by the diminution which takes place in the size of the cells.

The above described changes occur whether the secretion is induced by giving food to the animal, or by giving it pilocarpin, or by stimulating the sympathetic nerve running to the gland. The two zones of the fresh state are not preserved by alcohol and other reagents.

Osmic acid shows some considerable differences between the resting and the active gland, the chief amongst which is the more equal staining of the substance of each alveolar-cell in the active state.

The Parotid Gland in the Rat, Cat, and Dog behave in rest and activity like the parotid of the rabbit in a corresponding condition. The living condition in these cases, however, has not been observed in the glands with intact blood-circulation.

In one case where the sympathetic nerve of a dog was stimulated, a saliva was obtained from the parotid, of unusual character. The saliva clotted readily, and contained 8·3 per cent. of solids, of which 7·8 per cent. were organic substances. Jacobson's nerve was uncut. The much more rapidly flowing saliva following subsequent injection of pilocarpin had a slightly lower percentage of salt than the slowly secreted sympathetic saliva. In several cases in other glands I have also seen a diminution in percentage of salts, notwithstanding an increased rate of secretion of fluid.

The Sub-maxillary Gland of the Rabbit undergoes changes in activity similar in the main to those which occur in the parotid. The changes are, however, less marked; the granular condition of the gland has a less direct relation to the state of hunger of the animal.

The sub-maxillary gland has one very characteristic feature, the transition- and some of the ductule-cells contain, in life, granules more distinct and larger than those contained in the alveolar-cells. How far these disappear during secretion is uncertain.

As in the parotid so in the sub-maxillary, reagents do not preserve the normal appearances. The secreting gland treated with osmic acid shows alveolar-cells much more evenly stained throughout than does the resting-gland.

The deep black staining of the transition-cells with osmic acid described by Nussbaum does not take place if the gland be treated with osmic acid only; the deep coloration is the result of a subsequent treatment with alcohol. With osmic acid alone, the ducts stain darker than any other part of the gland.

I must uphold my previous objection to Nussbaum's view that ferment is formed in the transition-cells and not elsewhere. Briefly my objections were that the ductule-cells, in their method and depth of colouring behave like the transition-cells, and that the black coloration of the transition-cells with osmic acid does not occur if the gland is previously treated with absolute alcohol, in which the ferment is said by Nussbaum to be insoluble.

I can in the main confirm Bermann's description of a "tubular gland" in the sub-maxillary of the rabbit.

The Infra-orbital and Lachrymal Glands of the Rabbit show an outer clear and an inner granular zone in activity even more distinctly than the parotid. In both these glands osmic acid preserves more nearly the living appearances. The two zones if present normally, are also present after treatment with osmic acid.

In the *Mucous Glands* during secretion the changes in life are less readily followed, but they are probably similar to those mentioned above. In rest the alveolar-cells form granules like the alveolar-cells of a serous gland; but in the former case the granules are of nearly the same refractive power as the surrounding substance and so not conspicuous. In activity the granules are used up, and disappear first from the peripheral parts of the cells.

"Report on Phyto-Palæontological Investigations on the Fossil Flora of Sheppey." By Dr. Constantin Baron Ettingshausen, Professor in the University of Graz, Austria. Communicated by Prof. Huxley, Sec. R.S.

Physical Society, November 22.—Prof. W. G. Adams in the chair.—New Members, Prof. Reilly and Prof. Heath, of Cooper's Hill Engineering College.—Prof. Guthrie exhibited a new photometer in its crude form and demonstrated its action to the meeting. It consists of two fixed plane mirrors inclined to each other at an angle. The rays from the two sources of light to be compared, are allowed to fall on these mirrors, those from one source, say that on the right hand, falling on the right hand mirror, and those from the left hand source on the left hand mirror. These rays are again reflected from the mirrors at right angles to their former paths and thrown upon a semi-transparent screen where their relative intensities can be compared by the eye of the observer between the mirrors and each source of light; a revolving shutter is interposed. These shutters are formed of brass disks and they are both mounted on the same axis which can be turned by hand or otherwise. They would completely screen the light from the mirrors were it not that each is provided with four radial apertures or slots through which the rays can pass. The slots on the side at which the brighter source of light is placed are narrower than those on which the weaker source is placed. The latter slots are made adjustable in size by sliding blinds and a scale is added to measure the degree to which they are closed. On revolving the shutters the reflection of the rays to be compared are seen side by side and (owing to persistence of images on the retina) continuously on the screen placed in front, and they are brought to equality of brightness by closing or opening the blinds of the adjustable shutter. When this is so the ratio of the respective orifices of the shutter as given by the scale is the inverse ratio of the luminous intensities compared. Prof. Adams remarked that the speed of rotation should be such as to produce a uniform field of light on the screen, a result which hand-turning was not very conducive to. Prof. Foster observed that the use of this new photometer might be less fatiguing to the eye than those photometers which presented a steady beam to the eye undiluted with intervals of darkness during which the light is cut off, as on the instrument before the meeting. —Prof. Reinhold then read a paper by Prof. Rücker of the Yorkshire College, Leeds, on a suggestion as to the constitution of chlorine offered by the dynamical theory of gases. If a gas of density δ consists of molecules each of which possesses *no* degrees of freedom, and if also the inter-molecular forces are negligable, the specific heats at constant pressure (Cp) and at constant volume (Cv) are connected by the two well-known equations,

$$(1)\quad (Cp - Cv)\ \delta = \cdot 0694$$

$$(2)\quad \frac{Cp}{Cv} \ldots \frac{1+2}{m+e}$$

where e is a quantity which depends upon the potential energy of a molecule; hence if Cp is given by experiment Cv can be calculated from the first equation, and then $m + e$ is known from the second. Regnault determined the specific heats at constant pressure of 35 gases, and from the experiments of E. Wendemann and of Wullier it appears that his values are correct within 6 per cent., and that $m + e$ can be calculated very approximately from the above equations if Cp is given. One of the chief difficulties of the thermo-dynamic theory of gases has been to attribute to m and e values which would at once lead to the observed ratios of Cp and Cv and satisfy any rational supposition as to the interior mechanism of a molecule. Kundt and Warhng proved that for mercury $\frac{Cp}{Cv} = 1{\cdot}666$, which is consistent only with the supposition that the atoms of mercury are smooth rigid spheres; and Boltzman and Bosanquet have pointed out that for a smooth rigid surface of revolution $\frac{Cp}{Cv} = 1{\cdot}4$, a number agreeing closely with the experimental value for air, O, N, H, CO and NO. The molecules of these gases may therefore be constituted of two spheres rigidly united, or, as Prof. Rücker suggests, bound together by forces which prevent their separation of their surfaces while leaving them otherwise free to move. The principal object of Prof. Rücker's paper was to point out an interesting fact connected with the application of this theory to chlorine.

The maximum number of degrees of freedom which a molecule composed of n smooth rigid spheres could possess would be $3n$, but the forces in play between the spheres might reduce this number. Thus the value of $m + e$ could not exceed but might be less than $3n + e$. When the molecule consists of two atoms $e = o$ but for complexer molecules we should, *cæteris paribus*, extract its value to increase with the number of molecules. From two tables of results calculated by him, Prof. Rücker, however, finds that for a number of simple and complex gases and vapours the value of $m + e$ is for each substance less than $3n$ (or the maximum possible value of m), while for the majority of chlorine compounds examined the reverse statement holds good, that is, the value of $m + e$ is generally greater than $3n$. This difference may be explained by supposing that for chlorine e is abnormally large, and that the spheres are not necessarily in contact; or that n has been taken too small, that the symbol Cl_2 is incorrect, and that the chlorine atom contains a larger number of sub-atoms than has been supposed, a supposition which accords with the recent researches of Prof. Victor Meyer on the vapour density of chlorine. Prof. Rücker also finds that the ratio of the specific heats of bromine and one of its compounds studied (C_2H_2Br), agree with those of chlorine and the corresponding chlorine compounds. Dr. Shettle, of Reading, then read a paper on the influence of heat upon certain forms of induction coils considered more especially in relation to the inductive power which the blood exercises on the various structures of the body. The author found that when a copper and a zinc wire were insulated from each other by parchment paper and paraffined silk, and wound in close proximity to each other, an (induced) current was indicated on a galvanometer whose terminals were connected to the neighbouring ends of the zinc and copper wires respectively, the other ends being left free. When the latter were connected across the deflection was *nil*. On raising the temperature of the two wires by causing hot water to flow inside the coil into which they were wound the deflection was largely increased. These experiments lead Dr. Shettle to imagine there is a similar action in the animal body. The heart is made up of nerves and muscular fibres winding spirally, and some of these wind round each other so as to form a spiral cord round which the blood capillaries also wind. Dr. Shettle compares these nerve and muscle bundles to the coils of zinc and copper wire in his experiments, and infers that electric currents may be induced in them as in the wires. The flow of the warm magnetic blood would also tend to produce currents in them. Dr. Shettle further drew attention to the fact that animals live and move in a magnetic field, and that electricity must be generated in them by their movements internal and external.—Mr. Emmott exhibited Crossley's form of microphone, which consists of four short rods of carbon jointed loosely into four blocks of carbon so as to form a square. It is used as a transmitter for telephones, and Mr. Crossley regularly transmits the services of a church with it to several hearers. Its speaking, singing, and whistling powers were successfully demonstrated to the meeting.

PARIS

Academy of Sciences, December 1.—M. Daubrée in the chair.—The following papers were read:—Observations on M. Trecul's last note relative to chlorophyll, by M. Chevreul. He asks whether chlorophyll is a constituent part of the organ, or is only accessory and without organic activity.—On some properties of glucoses, by M. Peligot. By action of alkalies on glucose, he obtains a crystalline substance (which he calls *saccharine*), having the composition of ordinary sugar, or saccharine, not yet sugar. In presence of yeast it does not ferment; its taste is not that of sugar, but almost *nil*, with a slight after-bitterness. The common view, that saccharine matters should be regarded as polyatomic alcohols, is not (M. Peligot thinks) confirmed by production of this new substance. In the action of lime on glucose, a true saponification occurs.—Note on the crystalline form and optical properties of saccharine, by M. Des Cloizeaux. The optical phenomena do not enable one to conclude with certainty whether saccharine belongs to the rhombic or the clinorhombic system.—Questions relative to phylloxera addressed to M. Thenard, by M. Fremy.—Reply to these questions by M. Thenard. This relates to the use of sulphide of carbon, and its effects on vines.—Demonstration, by means of elliptic functions, of a theorem in the theory of the libration of the moon, by M. Gyldén.—Note on the measurement of quantities of electricity, by M. Hirn. He calls attention to M. Villari's demonstration that the action of the spark of Leyden batteries on the magnetic needle is proportional to the quantities accumulated, and seeks to show that this law is in harmony with those he himself has indicated as to the effect of continuous currents; (he expresses a wish that M. Villari's important memoir might be published *in extenso* in French).—Periodic movements of the ground revealed by spirit levels, by M. Plantamour.—This gives results of a year's observations at Secheron from October 1878. The east side went down with decreasing temperature until June, (there being a pretty exact parallelism between the curves); then the east rose until the beginning of September, in a much greater proportion than the exterior temperature. From 32·8mm. the greatest depression to the east, on January 15, to the maximum of elevation 19·5 mm. on September 8 gives 52·3mm. as the total amplitude of oscillation during the year, (or 28·08s). There was generally besides a daily movement, with amplitude on September 5, of 3″·2. The minimum is usually between 6 and 7·45 a.m. the maximum twelve hours later. In the meridian direction, the movements of the ground are much less; the total amplitude for the year was only 4″·89. They show an unexplained anomaly relative to the movements east and west. The daily movements in the meridian are very rare, irregular, and small. It seems, then, that at Secheron there are periodic movements of rise and sinking of the ground, and that, generally, they are determined by the exterior temperature. Perhaps the configuration and nature of the ground have also some influence.—Establishment of scientific and hospital stations in Equatorial Africa, by M. de Lesseps. It has been decided by the French Committee of the African Association to establish such stations between Zanzibar and the Gaboon; the Chambers have voted 100,000 fr. for the purpose.—Astronomical junction of Algeria with Spain; international operation under General Ibañez and M. Perrier, by the latter.—Note rectificative of M. Viallanes's opinion regarding phylloxeric spots in the environs of Dijon.—M. Lamarre described an electric phenomenon lately observed by him during a fall of snow at Cherbourg. Luminous *aigrettes* appeared at the points of his umbrella.—Determination of curves and surfaces of two surfaces which have double or stationary contacts with each other, by M. Zeuthen.—On series relative to the theory of numbers, by M. Lipschitz.—On a dynamometric brake regulated automatically, by M. Carpentier.—Separation of phosphoric acid from sesquioxide of iron and alumina, by M. Derome.—On the constitution of stag's horn, by M. Bleunard. It is an inferior homologue of coagulated egg-albumen. It is more hydrated than albumen.—Determination of chlorine in different grains and forage plants, by M. Nolte. Chlorides form part of all vegetable food.—Rhythmic contraction of muscles under the influence of salicylic acid, by M. Livon. A rhythmic tetanic period with contractions decreasing in intensity, precedes exhaustion.—On the mode of distribution of phosphates in muscles and tendons, by M. Jolly.—Influence of different colours on the development and respiration of infusoria, by M. Fatigati. The respiration is more active in violet than in white light, and less active in green than in white.

CONTENTS