THURSDAY, AUGUST 14, 1873

THE ENDOWMENT OF RESEARCH

V.

ALTHOUGH it is not within the purpose of these articles to propose an elaborate scheme in which the Endowment of Research in all its branches may be completely provided for, yet it may be reasonably expected that some suggestions should be now put forward to serve as an answer to those who urge the hopeless impracticability of the attempt, and as a foundation upon which a definite plan may be constructed, by the help of criticism, from those who can speak with authority in their own particular subjects.

In the first place, it is above everything important that the need of a systematic organisation of a central character with entire freedom of action should be at once recognised. It is absurd to suppose that the lack of pecuniary means can be the main difficulty which has hitherto, in the richest country in the world, hindered original investigation in the Sciences. The natural harvest of scientific discoveries which England ought annually to reap has rather been checked by the irregularity with which the labourers have been rewarded, and the comparative indignity with which they have been treated. For a certain class of scientific investigations of a strikingly practical character the public will always be willing to sanction large parliamentary grants; but for the permanent Endowment of Research, and the continuous support in a worthy position of the researchers, not only the aid of the nation at large, but the wealth and the prestige of our ancient Universities are required. There is, of course, no reason for any interference with the valuable work at present accomplished by the London Societies, but their work is of a different character. The new organisation would not grow into a monopoly, but would naturally take to itself those departments of knowledge which are least cared for, and in which the benefits of endowments will be most felt. Its wealth would enable it to be liberal, and its public position would impose just that amount of responsibility which should protect it from those dangers to which its wealth might render it exposed.

It is impossible to give a precise account of the actual manner in which the endowment should be distributed. To advance a crude scheme would be disadvantageous to the cause at heart, and to descend into detail would be to offer an unnecessary advantage to the enemy. Much must be left for the future to develope, and much must be left to the men to whom the administration is entrusted. If a scheme were to be worked out in detail in accordance with the demands of Science as understood at the present day, and if strict rules were to be adopted for its application, it might very well happen that before many years have gone our new Foundation would become an obstruction rather than a help to the advancement of Science. That a system may be vague, and yet eminently useful, and that its managers may safely be trusted with powers almost irresponsible, may be learnt from the example of the Smithsonian Institution in the United States. It is there found that to the Secretary of that institution, who at present is Professor Henry, may be confided the management of about 8,000*l*. a year, subject only to the nominal control of a board of American politicians, upon the trust to further "the advancement and diffusion of knowledge." Many incidental lessons may be gathered from the manner in which the funds of this Institution are applied. There are no professors, and no oral instruction of any kind: money is advanced to individual investigators, not to support them while engaged in their scientific labours, but merely to provide the apparatus and the materials necessary for their researches; but the largest part of the funds would appear to be devoted to the publication of the work which they have encouraged, and which under the title of "Smithsonian Contributions to Knowledge," are well known all over Europe. In this case, therefore, Research is indirectly endowed by means of a moderate pecuniary assistance to the investigators, whereas in Germany it is indirectly endowed through the professoriate; but our proposal is that nothing but a direct endowment will satisfy the peculiar wants of this country.

There is yet a further reason why any plan now put forward should be purposely indefinite and incomplete. The funds which the colleges will ultimately yield can only fall in very gradually. It is, according to the modern practice, quite impossible to make anything out of the present holders of fellowships, who are in most cases young men, who may retain their appointments if they choose up to the limit of their lives. It would also, for manifest reasons, be inexpedient to divert each several fellowship as it becomes vacant from its present destination. The machinery of the University organisation is so delicate that the occasions for introducing changes into it must of necessity be left to those who are best acquainted with the manner in which it works. Many years must elapse before that portion of the College revenues to which original research is now putting in a claim can be handed over to this account. In the meantime it is the duty of all those who support this claim not to dispute about details, but to force a hearing for that principle which they advocate in common, and which, when once publicly recognised, will render easy the remainder of the task.

It is not, however, difficult to point out roughly the lines in which the endowment will have to proceed, and so to meet by anticipation the apparent objections which are certain to be alleged. The form the endowment should take, the persons who are to be entrusted with the distribution, and the guarantee that the appointments shall not degenerate into sinecures, are all matters which require explanation. With regard to the first question, it is necessary to clear away a prevalent misunderstanding, which would seem to be based upon the existing system of Fellowships. It is not an essential part of the new scheme that a given number of Research Fellowships should be forthwith founded, to be awarded to young students who have passed successful examinations in Science. The very opposite course is the one which would commend itself to those who are aware of the evils of the present practice. The number of the new appointments should not be fixed; at first it should be small, but capable of increase as the suitable candidates come forward: and above all, the principle of selection should be other than that of competitive examination. The man with the peculiar talents and proved industry which are wanted for the post must be carefully sought for, and the place must be made for him, rather than the man manufactured for the place. The managing body must be allowed perfect liberty either to found a new Fellowship for the particular man, or to refuse to fill up a vacant appointment. All our Research Fellows will be, according to the German system, in extraordinary posts. From this it will follow that direct endowment of this kind, though the ultimate aim of our efforts, and by far the principal part of our scheme, is not the manner in which a beginning should be made. This form of endowment, so far as can at present be foreseen, must be comparatively exceptional, and therefore, when the right man is found, his position should be made one of handsome emolument, and it ought to be rendered impossible that he should be negligently passed over.

The other ways in which research should be endowed may be regarded in the ultimate scheme as chiefly subsidiary to this, but in the order of time they must come first. The funds of the Colleges which are not wanted for teaching purposes, may at once be utilised for our object in an infinite number of indirect ways. They ought to be regarded as an abundant reservoir, from which may be continually drawn generous encouragement and ready help for those who happen to be carrying on some special investigation in any branch of Science. The Colleges should take the place which was occupied in England some century ago by those noble and wealthy patrons to whom Science, Art, and Literature all owe so much. They should give in no grudging spirit, for they may be assured that an apparent waste in one direction will be amply compensated by the unlooked-for returns which they will reap in another. By throwing open their libraries, by building museums and laboratories, by supplying instruments or needful materials, by paying for laborious calculations or expensive publications, as well as by subsidising any particular investigation, they would breed up, so far as any artificial means can, that race of men from whom the selection must afterwards be made for their new Fellowships. To those who have had unfortunate experience of the management of college business, and of the sort of matters which come before a college meeting, such a reform as has been sketched out will doubtless appear as a visionary ideal; yet it might be realised with very little trouble if the richest Colleges would transfer some of the attention which they now bestow upon ecclesiastical and educational interests, to the cause of original research, and when realised, the result would be more nearly akin than the present, to that which the original statutes contemplated.

To answer the two other questions proposed need not take long, for an implicit reply to them has already been given. Fortunately, modern Science has taken such definite shape, and is pursued in such full publicity, that each branch has even now, at its head, certain acknowledged leaders, to whose judgments and recommendations in their special subjects, all deference is due. Until the Universities and the Colleges become sufficiently penetrated with the new scientific spirit, it will be natural that they should endow research under the guidance of the scientific societies, and of course it will be always necessary that they should be fully conscious of their responsibilities to the public for the appointments they confer upon the candidates, however selected. The analogy of the Smithsonian Institution will here again come in, for its assistance is never given in any case unless after a favourable report from a Commission of scientific men, who are experts in the particular matter submitted to them.

With regard to the objection that the plan will inevitably tend to the foundation of a new store of sinecures, it is not incumbent to say more than that scientific posts, where the duty itself is of absorbing pleasure, are the least likely to degenerate in the way suggested, and that the in sinuation comes with an ill grace from those who are the present recipients of benefactions which they do so little to deserve. C.

ON LOSCHMIDT'S EXPERIMENTS ON DIFFUSION IN RELATION TO THE KINETIC THEORY OF GASES

THE kinetic theory asserts that a gas consists of separate molecules, each moving with a velocity amounting, in the case of hydrogen, to 1,800 metres per second. This velocity, however, by no means determines the rate at which a group of molecules set at liberty in one part of a vessel full of the gas will make their way into other parts. In spite of the great velocity of the molecules, the direction of their course is so often altered and reversed by collision with other molecules, that the process of diffusion is comparatively a slow one.

The first experiments from which a rough estimate of the rate of diffusion of one gas through another can be deduced are those of Graham.* Professor Loschmidt, of Vienna, has recently† made a series of most valuable and accurate experiments on the interdiffusion of gases in a vertical tube, from which he has deduced the coefficient of diffusion of ten pairs of gases. These results I consider to be the most valuable hitherto obtained as data for the construction of a molecular theory of gases.

There are two other kinds of diffusion capable of experimental investigation, and from which the same data may be derived, but in both cases the experimental methods are exposed to much greater risk of error than in the case of diffusion. The first of these is the diffusion of momentum, or the lateral communication of sensible motion from one stratum of a gas to another. This is the explanation, on the kinetic theory, of the viscosity or internal friction of gases. The investigation of the viscosity of gases requires experiments of great delicacy, and involving very considerable corrections before the true coefficient of viscosity is obtained. Thus the numbers obtained by myself in 1865 are nearly double of those calculated by Prof. Stokes from the experiments of Baily on pendulums, but not much more than half those deduced by O. E. Meyer from his own experiments. The other kind of diffusion is that of the energy of agitation of the molecules. This is called the conduction of heat. The experimental investigation

* *Brande's Journal* for 1829, pt. ii., p. 74, "On the Mobility of Gases," Phil. Trans., 1863.
† Sitzb. d. k. Akad. d. Wissench, 10 März. 1870.

of this subject is confessedly so difficult, that it is only recently that Prof. Stefan of Vienna,* by means of a very ingenious method, has obtained the first experimental determination of the conductivity of air. This result is, as he says, in striking agreement with the kinetic theory of gases.

The experiments on the interdiffusion of gases, as conducted by Prof. Loschmidt and his pupils, appear to be far more independent of disturbing causes than any experiments on viscosity or conductivity. The inter-diffusing gases are left to themselves in a vertical cylindrical vessel, the heavier gas being underneath. No disturbing effect due to currents seems to exist, and the results of different experiments with the same pair of gases appear to be very consistent with each other.

They prove conclusively that the co-efficient of diffusion varies inversely as the pressure, a result in accordance with the kinetic theory, whatever hypothesis we adopt as to the nature of the mutual action of the molecules during their encounters.

They also show that the co-efficient of diffusion increases as the temperature rises, but the range of temperature in the experiments appears to be too small to enable us to decide whether it varies as T^2, as it should be according to the theory of a force inversely as the fifth power of the distance adopted in my paper in the Phil. Trans. 1866, or as $T^{\frac{3}{2}}$ as it should do according to the theory of elastic spherical molecules, which was the hypothesis originally developed by Clausius, by myself in the Phil. Mag. 1860, and by O. E. Meyer.

In comparing the co-efficients of diffusion of different pairs of gases, Prof. Loschmidt has made use of a formula according to which the co-efficient of diffusion should vary inversely as the geometric mean of the atomic weights of the two gases. I am unable to see any ground for this hypothesis in the kinetic theory, which in fact leads to a different result, involving the diameters of the molecules, as well as their masses. The numerical results obtained by Prof Loschmidt do not agree with his formula in a manner corresponding to the accuracy of his experiments. They agree in a very remarkable manner with the formula derived from the kinetic theory.

I have recently been revising the theory of gases founded on that of the collisions of elastic spheres, using, however, the methods of my paper on the dynamical theory of gases (Phil. Trans. 1866) rather than those of my first paper in the Phil. Mag., 1860, which are more difficult of application, and which led me into great confusion, especially in treating of the diffusion of gases.

The co-efficient of interdiffusion of two gases, according to this theory, is—

$$D_{12} = \frac{1}{2\sqrt{6\pi}} \frac{V}{N} \sqrt{\frac{1}{w_1}+\frac{1}{w_2}} \; \frac{1}{s_{12}^2} \qquad (1)$$

where w_1 and w_2 are the molecular weights of the two gases, that of hydrogen being unity.

s_{12} is the distance between the centres of the molecules at collision in centimetres.

V is the "velocity of mean square" of a molecule of hydrogen at 0° C.

$$V = \sqrt{\frac{3p}{\rho}} = 185{,}900 \text{ centimetres per second.}$$

* Sitzb. d. k. Akad., Feb. 22, 1872.

N is the number of molecules in a cubic centimetre at 0° *C.* and 76 cm. *B.* (the same for all gases).

D_{12} is the co-efficient of interdiffusion of the two gases in $\frac{(\text{centimetre})^2}{\text{second}}$ measure.

We may simplify this expression by writing—

$$a^2 = \frac{1}{2\sqrt{6\pi}} \frac{V}{N}, \quad \sigma_{12}^2 = \frac{1}{D_{12}} \sqrt{\frac{1}{w_1}+\frac{1}{w_2}} \qquad (2)$$

Here a is a quantity the same for all gases, but involving the unknown number N.

σ is a quantity which may be deduced from the corresponding experiment of M. Loschmidt. We have thus—

$$s_{12} = a\,\sigma_{12} \qquad (3)$$

or the distance between the centres of the molecules at collision is proportional to the quantity σ, which may be deduced from experiment.

If d_1 and d_2 are the diameters of the two molecules.

$$s_{12} = \tfrac{1}{2}(d_1 + d_2).$$

$$\text{Hence if } d = a\,\delta \; . \; . \; . \; \sigma_{12} = \tfrac{1}{2}(\delta_1 + \delta_2). \qquad (4)$$

Now M. Loschmidt has determined D for the six pairs of gases which can be formed from Hydrogen, Oxygen, Carbonic Oxide, and Carbonic Acid. The six values of σ deduced from these experiments ought not to be independent, since they may be deduced from the four values of δ belonging to the two gases. Accordingly we find, by assuming

TABLE I.

δ (H) = 1·739
δ (O) = 2·283
δ (CO) = 2·461
δ (CO_2) = 2·775

σ_{12}	Calculated $\frac{1}{2}(\delta_1 + \delta_2)$	Observed $\sqrt{\frac{1}{D}\sqrt{\frac{1}{w_1}+\frac{1}{w_2}}}$
For H and O	2·011	1·992
For H and CO	2·100	2·116
For H and CO_2	2·257	2·260
For O and CO	2·372	2·375
For O and CO_2	2·529	2·545
For CO and CO_2	2·618	2·599

NOTE.—These numbers must be multiplied by 0·6 to reduce them to (centimetre-second) measure from the (metre-hour) measure employed by Loschmidt.

The agreement of these numbers furnishes, I think, evidence of considerable strength in favour of this form of the kinetic theory, and if it should be confirmed by the comparison of results obtained from a greater number of pairs of gases it will be greatly strengthened.

Evidence, however, of a higher order may be furnished by a comparison between the results of experiments of entirely different kinds, as for instance, the coefficients of diffusion and those of viscosity. If μ denotes the co-efficient of viscosity, and ρ the density of a gas at 0° C. and 760 mm. B, the theory gives—

$$\frac{\mu}{\rho} = a^2 \sqrt{\frac{2}{w}} \; \frac{1}{d^2} \qquad (5)$$

so that the following relation exists between the viscosities of two gases and their coefficient of interdiffusion—

$$D_{12} = \frac{1}{2}\left(\frac{\mu_1}{\rho_1} + \frac{\mu_2}{\rho_2}\right) \qquad (6)$$

Calculating from the data of Table I., the viscosities of the gases, and comparing them with those found by O. E. Meyer and by myself, and reducing all to centimetre, gramme, second measure, and to 0° C.—

TABLE II.

Coefficient of Viscosity

Gas.	Loschmidt.	O. E. Meyer.	Maxwell.
H	0·000116	0·000134	0·000097
O	0·000270	0·000306	
CO	0·000217	0·000266	
CO_2	0·000214	0·000231	0·000161

The numbers given by Meyer are greater than those derived from Loschmidt. Mine, on the other hand, are much smaller. I think, however, that of the three, Loschmidt's are to be preferred as an estimate of the absolute value of the quantities, while those of Meyer, derived from Graham's experiments, may possibly give the ratios of the viscosities of different gases more correctly. Loschmidt has also given the coefficients of interdiffusion of four other pairs of gases, but as each of these contains a gas not contained in any other pair, I have made no use of them.

In the form of the theory as developed by Clausius, an important part is played by a quantity called the *mean length of the uninterrupted path of a molecule*, or, more concisely, the *mean path*. Its value, according to my calculations, is

$$l = \frac{1}{\sqrt{2}\,\pi s^2 N} = \frac{\sqrt{12}}{\sqrt{\pi}\,V}\frac{1}{\delta^2}* \qquad (7)$$

Its value in tenth-metres (1 metre × 10^{-10}) is

TABLE III.

For Hydrogen . .	965	Tenth-metres at 0° C. and 760 B
For Oxygen . .	560	
For Carbonic Oxide	482	
For Carbonic Acid	430	

(The wave-length of the hydrogen ray *F* is 4,861 tenth-metres, or about ten times the mean path of a molecule of carbonic oxide.)

We may now proceed for a few steps on more hazardous ground, and inquire into the actual size of the molecules. Prof. Loschmidt himself, in his paper "Zur Grösse der Luftmoleclüle" (Acad. Vienna, Oct. 12, 1865), was the first to make this attempt. Independently of him and of each other, Mr. G. J. Stoney (Phil. Mag. Aug. 1868), and Sir W. Thomson (NATURE, March 31, 1870), have made similar calculations. We shall follow the track of Prof. Loschmidt.

The volume of a spherical molecule is $\frac{\pi}{6}s^3$, where s is its diameter. Hence if N is the number of molecules in unit of volume, the space actually filled by the molecules is $\frac{\pi}{6}Ns^3$.

This, then, would be the volume to which a cubic centimetre of the gas would be reduced if it could be so compressed as to leave no room whatever between the molecules. This, of course, is impossible; but we may, for the sake of clearness, call the quantity—

$$\epsilon = \frac{\pi}{6}Ns^3 \qquad (8)$$

the ideal coefficient of condensation. The actual coefficient of condensation, when the gas is reduced to the liquid or even the solid form, and exposed to the greatest degree of cold and pressure, is of course greater than ϵ.

Multiplying equations 7 and 8, we find—

$$s = 6\sqrt{2}\,\epsilon\, l \qquad (9)$$

where s is the diameter of a molecule, ϵ the coefficient of condensation, and l the mean path of a molecule.

Of these quantities, we know l approximately already, but with respect to ϵ we only know its superior limit. It is only by ascertaining whether calculations of this kind, made with respect to different substances, lead to consistent results, that we can obtain any confidence in our estimates of ϵ.

M. Lorenz Meyer* has compared the "molecular volumes" of different substances, as estimated by Kopp from measurements of the density of these substances and their compounds, with the values of s^3 as deduced from experiments on the viscosity of gases, and has shown that there is a considerable degree of correspondence between the two sets of numbers.

The "molecular volume" of a substance here spoken of is the volume in cubic centimetres of as much of the substance in the liquid state as contains as many molecules as one gramme of hydrogen. Hence if ρ_0 denote the density of hydrogen, and $\mathfrak{b}$ the molecular volume of a substance, the actual coefficient of condensation is—

$$\epsilon' = \rho_0\,\mathfrak{b} \qquad (10)$$

These "molecular volumes" of liquids are estimated at the boiling-points of the liquids, a very arbitrary condition, for this depends on the pressure, and there is no reason in the nature of things for fixing on 760 mm. B. as a standard pressure merely because it roughly represents the ordinary pressure of our atmosphere. What would be better, if it were not impossible to obtain it, would be the volume at − 273° C. and ∞B.

But the volume relations of potassium with its oxide and its hydrated oxide as described by Faraday seem to indicate that we have a good deal yet to learn about the volumes of atoms.

If, however, for our immediate purpose, we assume the smallest molecular volume of oxygen given by Kopp as derived from a comparison of the volume of tin with that of its oxide and put

$$\mathfrak{b}(O = 16) = 2{\cdot}7$$

we find for the diameters of the molecules—

TABLE IV.

Hydrogen	5·8 tenth-metres.
Oxygen	7·6
Carbonic Oxide . .	8·3
Carbonic Acid . .	9·3

The mass of a molecule of hydrogen on this assumption is

$$4{\cdot}6 \times 10^{-24} \text{ gramme.}$$

The number of molecules in a cubic centimetre of any gas at 0° C. and 760 mm. B. is

$$N = 19 \times 10^{18}.$$

Hence the side of a cube which, on an average, would contain one molecule would be

$$N^{-\frac{1}{3}} = 37 \text{ tenth-metres.}$$

J. CLERK-MAXWELL

* The difference between this value and that given by M. Clausius in his paper of 1858, arises from his assuming that all the molecules have equal velocities, while I suppose the velocities to be distributed according to the "law of errors."

* Annalen d. Chemie u Pharmacie V. Supp. bd. 2, Heft (1867).

THE LAST GLACIAL EPOCH

On the Cause, Date, and Duration of the Last Glacial Epoch of Geology, and the Probable Antiquity of Man. With an investigation and description of a new movement of the Earth. By Lieut.-Colonel Drayson, R.A., F.R.A.S. (London: Chapman and Hall, 1873.)

THE author of this work allows the existence of the motion of rotation of the earth on its axis and its revolution round the sun. That motion, however, of the axis of the earth, to which is due the precession of the equinoxes, is to him a great stumbling block. He denies the possibility of this motion as generally accepted, and gives us a theory of his own, which is very novel, and the results of which are startling in the extreme.

Lieut.-Colonel Drayson either knows nothing of dynamics or despises the science: the one key he makes use of to unlock the secrets of astronomy is geometry; he does not believe in the existence of a change in the plane of the ecliptic, and apparently is not aware that the attractions of the other planets on the earth *must* produce periodic changes in the plane of the earth's orbit. In consequence of this he persuades himself that all astronomers teach (and perhaps believe) that while the pole of the earth is describing a circle round the pole of the ecliptic, the obliquity of the ecliptic, which is the angular distance between these poles, is constantly changing. He calls this a geometrical impossibility, and nobody would hesitate to agree with him that it is; but astronomers would at once deny that they either teach or believe anything of the kind. The popular belief is that the pole of the earth describes a circle of radius 23° 28′ round the pole of the ecliptic as a centre, and that the whole circle would be described in something over 25,000 years.

Lieut.-Colonel Drayson tells us that the true motion of the pole of the earth is in a circle whose radius is 29° 25′ 47″, and whose centre is at a distance of 6° from the pole of the ecliptic. He attempts to prove this, and, we believe, has succeeded in persuading himself that he has proved it. He does this by showing that this particular circle will satisfy all the necessary conditions, as he puts them, and also (we assume) as he understands them. The author next proceeds to deduce the consequences of this motion. His circle would be described in 31,840 years, so that at intervals of 15,920 years the obliquity of the ecliptic would vary as much as 12°. The consequence of this would be that about 13,700 B.C., Great Britain would have had during the winter an arctic climate, the sun in lat. 54° not being 1° above the horizon at the winter solstice, and during the summer a tropical climate. This is supposed to have been the last glacial epoch, and the author has such confidence in his theory that he promises us glacial epochs every 31,840 years.

The book, as a whole, we look upon as most unsatisfactory. Had the author mastered the principles of dynamics, he probably would not have been led by a mistaken interpretation of movements which he only partly understood, into the fatal error of attempting to solve one of the most abstruse problems in astronomy by mere geometry. The days of such attempts were, we hoped, past for ever.

The motion of the earth's axis is well illustrated by the motion of a boy's top when it is spinning with its axis inclined to the vertical. Every one has seen a top while spinning on its own axis, revolve round the vertical with approximately constant speed, while its axis remained inclined to the vertical at an approximately constant angle: but who has seen a top spinning so that its axis revolved with constant speed round a line inclined to the vertical at an angle of 6°, or any other angle? Till Lieut.-Colonel Drayson produces a top which will do this, thereby proving experimentally that such a motion is possible, or till he demonstrates by analysis the possibility of such a motion, we shall feel confident in rejecting his theory of the earth's motion, as the theory of a paradoxer, and in regarding the cause of the last glacial epoch as a secret still unknown.

DR. SMITH ON FOODS

Foods. By Edward Smith, M.D., F.R.S. (Henry S. King and Co.)

THE tendency during the last thirty years or so to the equalisation, throughout the country, of the prices of the several articles employed as food, has done much to make the subject of Foods one of much greater interest to a larger class of the community than heretofore. The products of a district being now scarcely, if at all, cheaper than those that can be obtained from a considerable distance, a knowledge of the relative nutritive value of foods becomes essential to a larger number. We therefore look with great interest to the results of Dr. Edward Smith's considerable experience, especially with regard to some of the articles of more modern introduction.

The classification adopted is the following. Foods are first divided into solid, liquid, and gaseous, an arrangement which has the disadvantage of separating closely-allied substances from one another, milk having to be considered removed from cheese and butter. The solid foods are then divided into animal and vegetable, and each of these are subdivided into nitrogenous and non-nitrogenous. The source, composition, and alimentary properties of each article are then discussed in detail. The analyses are mainly those of Fresenius, Frankland, Wanklyn, and other well-known chemists. The author in most cases is able to introduce the results of his own observations on the physiological action of each substance, which are also to be found in the Transactions of the Royal Society. Taking arrowroot as a fair example of the manner in which the subject is treated, after a short account of its origin we find that "the proximate elements in 100 parts are water 18·0, and starch 82·0; so that it is or should be free from nitrogen. There are 2,555 grains of carbon in 1 lb. . . . Ten grains of arrowroot when thoroughly consumed in the body produce heat sufficient to raise 10·06 lbs. of water 1° F., which is equal to lifting 7,766 lbs. one foot high." The author observes that when eaten alone on an empty stomach it gives no sense of satisfaction, but one of malaise. Eating 500 grains increased the emission of carbonic acid 0·154 grains per minute. The rate of respiration was somewhat lessened, and the pulse was increased four beats per second (*sic*). As each subject is similarly described, it is evident that there is a large amount of needless repetition, for the estimation of the heat of combustion is a simple calculation, which might have been made once for all with reference to each proximate principle, especially since the bare facts, as they are put, convey but little idea to the general reader. The chemistry of foods is very superficially and imperfectly treated, not nearly so full as it deserves; and the botany would have been better if a more thorough study of materia medica had been undertaken. There is one sentence we have in vain attempted to understand. When speaking of the sweet chestnut, the author, after remarking that at present it may be regarded as a luxury, says, "The first step to a great extension of its use would be to make the ordinary horse-chestnut a safe and agreeable food, since it grows in our climate, and could be obtained in large quantities." How this can be, seems extremely difficult to understand; as is well known, the two fruits having nothing whatever to do with one another.

The descriptions of the various methods that have been proposed for the preservation of meats which have to travel long distances and through hot climates is very complete and clear. The preference is given to the method of heating, and that adopted by Mr. Jones, in which the meat is heated in vacuo, to 280° F., in the cans, is fully described. It is shown, however, that by this process the meat is stewed, and over-stewed, not roasted nor boiled. In this, and all similar processes, it is found impossible to expel all the air without over-cooking the meat.

Another subject of particular interest which is discussed is the preservation of milk. Two methods, it appears, are adopted in America, one in which the milk is simply evaporated to one-fourth its original volume, when it will often keep for a month, and another in which sugar is added; by the latter process it remains good for an indefinite time, and contains about one-third of its weight of sugar. The author agrees sufficiently with Dr. Daly in his condemnation of the employment of this preserved milk for infants, to quote an article by him which appeared last year in the *Lancet*.

Extract of meat, especially Liebig's, occupies the greater part of one chapter, and we think the author has done good service in setting in a clear and unmistakable light the true value of that expensive luxury. He shows that its chief value depends on the meaty flavour it is capable of imparting, and that its nutritive value is *nil*. He remarks—"Its proper position in dietetics is somewhat more than that of a meat-flavourer, but all that is required for nutrition should be added to it. . . . Used alone for beef-tea it is a delusion." That this is correct is evident from a consideration of the method by which it is prepared, for "during the process, all the fat and as much of the gelatin and albumen as can be extracted are removed from the solution of flesh, whilst the fibrin, being insoluble, is necessarily left behind. Hence there remain water, salts, osmazone, and the extractives of flesh, or, in general terms, the flavouring matters and the salts of meat—thus leaving out all that is popularly (and correctly) regarded as nutritious."

Many tables are given to show the effects of different substances on the respiration, pulse, exhalation of carbonic anhydride and aqueous vapour. There seems to be a want of association between the great mass of facts, which must have been the result of long and continuous labour; and they are undoubtedly put forward in a way which is not best suited to convince the scientific student. For example, the effects on the pulse, &c., of tea dissolved in water is given in full, but under the head of water no mention is made of its physiological action, though decidedly, by itself it changes the pulse rate, if nothing else.

Several recipes of the fourteenth century are quoted from "Cury," a copy of ancient manuscript recipes of the master cook of Richard the Second. There are also many scriptural references, and a very inappropriate abstract of an incident which occurred at the Worship Street Police Court.

OUR BOOK SHELF

A Manual of Metallurgy. By George Hogarth Makins, M.R.C.S., F.C.S., &c. (Ellis and White, 1873.)

The present edition of this work presents a marked improvement over those which have preceded it, but it is still far from being all that even a small manual might be. In the preface the author expresses a hope that the volume, "in which the leading points connected with the principal metals are set forth, may be found useful," and as there are singularly few metallurgical works in the English language, we have but little doubt that this hope will be realised. Mr. Makins has long enjoyed the reputation of being a most accurate assayer, and the descriptions of the processes of assaying gold and silver are careful and valuable. The portion of the work which is the least satisfactory is that devoted to iron.

LETTERS TO THE EDITOR

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

The Huemul

The Huemul of Chili and Patagonia, referred to in Nature, pp. 253 and 263, was *first* recognised in modern scientific literature by MM. Gay and Gervais, who in the *Annales des Sciences Naturelles* for 1846 (v., p. 91), showed that the so-called *Equus bisulcus* of Molina, was a species of Deer (*Cervus*), which they proposed to call *Cervus chilensis*.

In Gay's "Fauna Chilena" (plates 10 and 11), the female and skull are figured. Concerning the nomenclature of species, I have published some remarks in the last volume of the "Annals of Natural History" (ser. 4, vol. vi. p. 213), to which I beg leave to refer such of your readers as are desirous of further information on this subject. P. L. Sclater

11, Hanover Square, W., Aug. 6

Perception and Instinct in the Lower Animals

In answer to Mr. George J. Romanes (Nature, August 7) I beg to say that I particularly inquired of my friend whether he had been to or near his old house on the day the dog returned, or shortly before, and he assured me that "he had never been near it since he left." I ought to have stated this in my account of the circumstance.

I shall make no further remarks on the subject, because I believe that nothing satisfactory can be arrived at till experiments of the nature indicated in my last letter have been systematically carried out. Alfred R. Wallace

Collective Instinct

The writer of one of the books on Indian sport relates how he saw a herd of antelopes, driven backwards and forwards by four wolves, which surrounded the herd, each guarding a different side, until at length the antelopes passed over a ditch in which a fifth wolf lay concealed. This wolf, jumping up as the antelopes crossed, secured one of them, upon which his four companions joined him, and assisted in making a meal of the captured animal.

A civilian of the N.W.P.* told me that he witnessed a very similar occurrence in Oudh. He saw two wolves standing together, and shortly after noticing them was surprised to see one of them lie down in a ditch, and the other walk away over the open plain. He watched the latter, which deliberately went to the far side of a herd of antelopes standing in the plain, and drove them, as a sheep dog would a flock of sheep, to the very spot where his companion lay in ambush. As the antelopes crossed the ditch, the concealed wolf jumped up, as in the former case, seized a doe, and was joined by his colleague.

Here are two well-authenticated instances of an action or series of actions requiring the exercise of combined sagacity of a high degree on the part of two or more individual animals, being performed in exactly the same way by different members of the same species. Was the method employed by the wolves to secure their food, which they could not have caught single-handed, the result of separate experience or of inherited habit? The identical character of the stratagem employed in the two cases points to the latter.

I have noticed some similar instances of collective action on the part of other animals which I believe to be as much inherited as the habitual actions of individual animals. I have constantly seen a flock of pelicans when on the feed form a line across a lake, and drive the fish before them up its whole length, just as fishermen would with a net. The capture of the fish is rendered doubly easy by this method. I have witnessed exactly a similar plan pursued by a large number of Ganges crocodiles which had been lying or swimming about all day in front of my tent, at the mouth of a small stream which led from some large inland lakes to the Ganges. Towards dusk, at the same moment, every one of them left the bank on which they were lying, or the deep water in which they were swimming, and formed line across the stream, which was about twenty yards wide. They had to form a double line, as there was not room for all in a single line. They then swam slowly up the shallow stream, driving the fish before them, and I saw two or three fish caught before they disappeared.

Where a large number of individuals constantly repeat in continuation the same action, it is possible that the younger members may merely copy the older members of the species, and so carry on the habit generation after generation. This is less likely where few are concerned, as in the case of the wolves. A pair of wolves are probably of the same age. It is a marked habit of some species of birds to hunt in pairs, and assist each other in the capture of their prey. The *wokhab*, or common eagles of the Indian plains, hunt in this way. When one of the pair misses in its swoop, the other descends on the victim before it has time to make a fresh attempt to escape. The circumstance that some species of birds of prey are in the habit of combining for the capture of their food, while others hunt singly, would tend to prove that the combined habit is as much inherited as the habits of individuals are known to be.

Gregarious actions, which require combination of purpose on the part of two or more individuals, entail the exercise, if not of a higher degree of intelligence, at any rate of a greater number of intelligent qualities than the isolated actions of single individuals. This class of actions possesses, therefore, a special interest. Those instances in which different individuals perform totally different acts for the attainment of the same end, as in the case of the wolves, are the most interesting, as requiring the most intelligent qualities. I should be glad to learn if any of your readers have ever witnessed or heard of the stratagem described above being employed by wolves for the capture of their prey.

Allahabad, June 29 E. C. BUCK

* Mr. Elliott, B.C.S., now Secretary to Government, N.W.P.

Ants and "the Taint of the Hand"

IN NATURE, July 24, Mr. James D. Hague, writing on the habits of ants, attributes their dislike to the place across which a finger has been drawn to "the taint of the hand."

Now, Sir, I have frequently drawn a line with a piece of chalk across the track of ants, and observed in them the same symptoms of dislike as Mr. Hague's ants showed to the finger-mark.

I have also drawn a small circle with chalk round one or more ants, who will seek a spot untouched by the chalk through which to make their escape; but should there be no such opening, they will presently cross the circle. If, however, this enclosure be made upon a perpendicular wall, &c., they will frequently drop to the ground rather than walk across the line.

Now, as I have never observed this same dislike—exhibited by dropping—of the "taint" when ants have been running over my hands, and as the chalk-line has the same effect as the finger-mark, may it not be something else than the "taint of the hand" to which the ants object when their usual track is interfered with?

Stamford, Aug. 8 G. E. C.

Venomous Caterpillars

WITH reference to a paper published by Mr. Murray in NATURE, vol. viii. p. 7, on Venomous Caterpillars, I wish, in corroboration, to add my testimony from personal experience, that a species of caterpillar has the power of inflicting a very painful sensation (I will not say wound, as such was not visible) by its sting.

In 1868, when travelling in company with Capt. Street in the Burmese forests on a botanical trip, and whilst in the act of detaching a specimen plant of *Dendrobium farmerii*, from the naked branch of a tree, I felt a severe and painful sting on my thumb. On examination I noticed I had seized hold of a large caterpillar lodged amongst the roots of this orchid. It was about two inches long, clothed with erect hairs; its colour was a reddish brown, the lower part of the abdomen being darker, with well-developed legs.

My thumb continued painful for three days; it was considerably swollen, the skin having a drawn glazed appearance.

The Burmese told me that this kind of caterpillar was exceedingly venomous, and one fellow was particularly consoling by informing me that unless the pain subsided in three days the sting might prove fatal. I am inclined to think that the caterpillar for self-protection has the power of detaching these hairs; whether any propelling force is present at the time of detachment it would be difficult to prove.

I found steeping my thumb in Eau de Cologne gave me the greatest relief.

Whether these hairy caterpillars have a special venom or otherwise I do not feel qualified to express my opinion either one way or the other; but I lean towards the conclusion that the irritation is set up by the mechanical action of the spine during its penetration of the skin, and my reason for inclining towards this opinion is because we have a somewhat parallel case in the irritation caused by the hairs of the prickly pear.

I was present when an officer was thrown off his horse into a prickly pear hedge; he suffered the greatest pain, and could not bear the parts, where these minute spines had penetrated the skin, to be touched. On his being placed in a warm bath the relief was almost immediate, especially to those parts capable of total immersion, and this I attribute to the prickles or hairs floating and becoming removed from the skin by the oscillatory motion of the water.

Madras, July R. BENSON

Abnormal Ox-eye Daisy

IN 1868 I gathered among the ruins of Pompeii a very curious monstrosity of the common ox-eye daisy. The flower and flower-stalk were confounded into a strap-shaped mass which was fringed with the florets. I showed it to Prof. Wyville Thomson, who told me it was an instance abnormal in this species, of the form of inflorescence which is normal in the coxcomb.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Aug. 1

Canarese Snakes

FAM. *Erycidæ*, Gen. *Gongylophis*? Sp. ?—Captured in Mangalore, December 2. Gape wide; fangs in sup. and inf. maxillaris.

Body moderate, tail short, obtuse scales, smooth, 48;—ventrals narrow, 197, terminating with three rows of scales between last ventral and anal; latter entire. Subcaudals single, 24, last forming conical point.

Head flat, not very distinct from neck, scaled, with following exceptions:—Rostril, anterior frontals; nasals (double, with the nostril between); mental; upper (12) and lower labials.

Gular depression; small groove anterior to orbit; orbit surrounded by scales; eye small, pupil vertical, iris silver grey, with dark longitudinal streak.

Rudimentary hind limbs, scales small, greatly increasing in size as they approach ventrals; colour above greyish brown, vertebral series of dark brown irregular spots, confluent towards neck; lateral series of dark brown spots. Belly whitish, mottled with dark brown; post orbital dark brown streak.

Length of specimen 21 in. A sand snake of sluggish disposition, especially during day-time.—Did not attempt to bite when handled.

Fam. *Elapidæ*. Gen. *Ophiophagus*. *O. Elaps*.—The Hamadryad, a male specimen caught by snake charmers at Agumbi, Western Ghauts, South Canara. Since dead, the skin having been secured by a member of the Basil Mission. I measured the snake when alive, and found it to be 10 ft. 6 in. but it was probably more, as it strongly resisted being stretched out. Colour brownish black, with about thirty bands on fore part of body, formed by dull yellowish interstitial skin. A yellow V mark with the apex towards head on upper part of hood: dark band beneath hood.

The Canarese call the snake "Kalinga havre," and state it to be common in the jungles along the Ghauts. I hope before long to procure a live specimen.

Fam. *Crotalidæ*. Gen. *Trimesurus*. Sp.—Scales 21, ventrals 153, subcaudals 58. Head scales strongly heeled. Colour dark reddish brown, irregularly marked with pale reddish brown, forming pale centred lateral ocelli. A series of pale yellow irregular dots arranged in a lateral stripe. This specimen has been forwarded to Dr. J. Shortt, F.L.S.

A specimen of the *Daboia elegans*, the Tic Polongo of Southern India and Ceylon, was lately brought me having the belly pure white, unmarked with the usual brown spots.

A Tahsildar in a Northern Talug reports the occurrence of a large venomous snake, black above and red beneath. This I think will prove to be *Callophis* (*Elaps*) *nigrescens*.

Mangalore. E. H. PRINGLE

BRITISH MEDICAL ASSOCIATION.—ABSTRACT OF DR. SANDERSON'S ADDRESS ON PHYSIOLOGY

IN his address on Physiology before the British Medical Association, Dr. Sanderson gave a *résumé* of the most important physiological work that has been done during the past year. Commencing with the circulation of the blood, he considered it to be resolved into several constituent processes, such as arterial pressure, velocity of blood-current, and contraction or relaxation of muscular fibre. He referred to a very elegant method adopted by Dr. Marey of Paris, and illustrated by him to the members of the Association, by which the influence of arterial resistance on the heart's rapidity may be demonstrated on the excised heart of the tortoise, the number of pulsations being proved to vary inversely as the *resistance* and not as the blood pressure, a fact previously known, but not before so clearly illustrated. He then referred to the observations of Mr. Dewar and Dr. M'Kendrick, in which they have shown that the normal electromotive force in the optic nerve is reduced in intensity when it is receiving the impression of light, a "negative variation" of the current being the result. Dr. Jackson's and Dr. Ferrier's pathological and physiological studies as to the localisation of the sources whence originate some of the voluntary movements in certain parts of the surface of the brain were shown to have a very important bearing on the progress of cerebral physiology; Dr. Ferrier having arrived at a method by which one at least of the highest functions of the nervous system can be brought under the control of experimental investigation. With reference to the part played by Bacteria in the living organism, Dr. Sanderson remarked that observations respecting them were, though very numerous, not sufficiently connected to allow of a ready summary; the facts added during the year being, first, that in certain persons apparently healthy, and in many animals, organisms belonging to this class are always found in the blood; secondly, that in all acute inflammations which are attended with the destruction of living tissue, Bacteria are to be found in the exudation liquids; and thirdly, that in relapsing fever living beings are present in the blood, which exhibit characteristic forms.

Dr. Sanderson in the latter part of his address gave many reasons in favour of the combination of the study of medicine with that of physiology. It has been said that theoretical physiology has led to injurious medical treatment, *e.g.*, to the over-feeding and over-stimulating treatment of disease; to the unreasonable disuse of venesection; to the neglect of antimony and other so-called antiphlogistics, and to the purgative treatment of cholera. But are the theories on which these changes of treatment have been based, physiological in the proper sense? Decidedly not. Taking the action of mercury as an example. It has been proved to have no influence in increasing the secretion of the liver; nevertheless, blue-pill is of undoubted value in certain well-defined disturbances of the digestive organs. From these facts, however, it is not right to assume that mercurial remedies are useless, or that they act beneficially by exciting the secretion of bile; such inferences are not physiological, but result from the manner in which practical men throw undeserved discredit upon Science by attempting to apply its facts without any sufficient knowledge of their bearing. Therefore it is highly desirable for the welfare of both Medicine and Physiology that a distinct line of demarcation should be drawn between them.

The speaker then entered upon subjects of a more purely medical nature, giving an excellent *résumé* of the present position of our knowledge respecting the nature of fever and pyrexia generally.

LAKES WITH TWO OUTFALLS

SOME years ago a discussion took place concerning the possible or actual existence of lakes possessing outlets into two distinct watersheds, so as to render one watershed continuous with the other. If even one such lake could be shown to exist, the question would of course be resolved in the affirmative. I have frequently heard mentioned as an instance a certain lake at the summit of the Romsdal in Norway, and having lately spent a day or two at each end of this lake, I have taken advantage of the opportunity to examine each of the outlets with care. I have thus convinced myself that it ought not to be quoted as a proof of the natural existence of such lakes.

The piece of water in question is called the Læsöskougens Vaud, or sometimes the Lesje Værks Vaud; it lies between the posting stations of Mölmen and Lesje Jernværks, at an elevation of 1,992 Norwegian feet, or 2,050 English feet above the sea level, occupying, for a length of about seven miles, the highest part of the great valley which in its south-eastern part is known as the Gudbrandsdal, and in its north-western part as the Romsdal. There can be no doubt that from the eastern extremity of the lake flows a small stream, which forms one of the sources of the Laagan or Logen River, while from the western extremity descends a much larger stream, which is the principal source of the river Rauma. Since the Logen, after passing through Miösen Lake, becomes a part of the great river Glommen, and thus falls into the Skaggerat at Frederichshald, while the Rauma reaches the sea through the Romsdal Fjord, it follows that the whole of the south-western part of Norway is encircled by water.

On examining the eastern exit of the lake, however, it soon becomes apparent that the outflow is artificially regulated. The water is retained at this end by a great barrier of boulders, gravel, and sand, which has doubtless been heaped up by glacial action. At the north-eastern extremity this barrier is narrowed until it resembles an artificial embankment, and at this point a channel has apparently been cut for the purpose of supplying water power to the works situated immediately below. The actual stream of water forming the first source of the river Logen had a depth at the time of my visit of three feet, with a width of about six feet; it flowed through a rectangular channel, paved at the bottom and sides with large boulders, and sustained by timbers. Although these timbers are now nearly rotted away, it is evident that the channel had at some time or other been carefully formed. The water power is at present used for a saw-mill, but it was, no doubt, originally employed to furnish the blast for an old iron furnace, which has given the name of Lesje Jernværks to this place. The furnace has been abandoned, as I was informed, for the last eighty years, and from the dates upon the ironwork of a neighbouring house I think it likely that the works were erected at least 150 years ago, a length of time which would perhaps be sufficient to account for the natural appearance of the stream below the works.

I also examined the western exit of the lake with care. The first break in the level of the water occurs at a wooden bridge which slightly restrains the outflow. The stream flows strongly here, with a width in all of about 45 ft., a maximum depth of about 2 ft. 9 in. at the time of my visit, and an average depth of about 2 ft. After falling about 9 in. at this point, the river flows in a steady deep stream through a perfectly natural channel for about an English mile, with a very slight fall, after which its descent becomes gradually accelerated. I have no doubt that this considerable stream forms the natural outlet of the lake, but that a lowering of the water in the lake to the extent of three or four feet would stop this outflow altogether.

Now when we speak of a lake with two outfalls, I presume we mean one with two natural and permanent outfalls, and in this sense the Læsöskougens Vaud cannot be adduced as an instance at the present day. It is just possible that the lake had a natural outlet at Lesje Værks before the artificial channel was cut, but it is highly improbable, and we should require good traditional or documentary evidence to that effect before we could assume it to be so. Such evidence would probably be very difficult to obtain, and could only be obtained by some person intimate with the Norsk language Moreover, I judge from the nature of the outfall at this end, that if it were not looked to from time to time, the stream would eventually widen and deepen the channel through the barrier of loose sand and gravel, and finally lower the level of the water by many feet, so as to destroy the outflow into the river Rauma.

I write the above without having previously entered into the subject, and without being able to refer to any information about it. On *à priori* grounds it seems very unlikely that there should exist any lake with two distinct outflows. For in order that such a state of things should exist permanently, either there must be no erosion of the channels whatever, or the erosion must proceed with exact equality, otherwise one stream will augment at the expense of the other, and its eroding power being thus increased, it will more and more tend to sap the supplies of the other stream. The condition of things would, in fact, be that of unstable equilibrium, which could not long continue to exist.

Colonel George Greenwood, who is, I presume, the same as the former active correspondent about this subject, visited this lake last summer, as appears from the entry of his name in the day books. I am not aware that he has since published any opinion, but the lake seems, so far as I can judge, to support his view of the matter.

W. STANLEY JEVONS

THE NEW BIRD OF PARADISE

AT the last scientific meeting of the Zoological Society of London for the past session, I had the pleasure of exhibiting and describing specimens of a new Bird of Paradise recently discovered by Signor Luigi Maria D'Albertis, in New Guinea. As it will be some time before the part of the Society's "Proceedings" containing the record of the business transacted at the meeting on June 17 can be issued, and as I am informed that some knowledge of the existence of this singular bird has been obtained in another quarter, I am anxious to secure to Signor D'Albertis the honour of his discovery by a somewhat earlier publication of such a description and figure as will enable the bird to be recognised by other naturalists.

Drepanornis albertisi*, as I have proposed to call this fine bird, in honour of its energetic discoverer, belongs to the long-billed or Epimachine section of the Paradiseæ, and is, perhaps, more nearly allied to *Epimachus* than to any other described form. But it is very distinct from *Epimachus* as regards its long, thin, and much curved bill, shorter legs, and shorter, squarer tail, not to speak of the peculiar tufts of feathers which are characteristic of the male sex only. The general colour of the plumage of the male *Drepanornis* is brown above, and lavender-grey below. The naked rim round the eye, and a bare space at the back of them on each side, are of a bright blue. On each side of the front before the eye rises a short tuft of bright, coppery, metallic green feathers. A large patch of similar scaly feathers covers the chin and throat. Two large tufts of feathers spring from each side of the breast, and form conspicuous ornaments when erected. The upper pair of these peculiar tufts have a mass of brilliant coppery red at the base of their feathers, terminated by a dark band. This metallic colour is only exposed when the plumes are raised. The lower pair of tufts, which are much lengthened, and in a state of repose reach beyond the lower third of the tail, are margined by a splendid purple band. The lower part of the breast is likewise crossed by a narrow band of bright green. The middle of the belly and vent are white, the tail of a nearly uniform pale chestnut.

The above description will give some idea of the special peculiarities of the male *Drepanornis* in full plumage. The female, as is the case in all the true Paradiseæ, is very different in colour, though alike in form. Her plumage is above of a nearly uniform bright brown or rufous, below paler, and crossed on the throat, breast, and sides of the belly, by numerous small irregular black wide cross-bars. The naked space round and behind the eye is coloured bright blue, as in the full-plumaged male. The beak, in the single specimen sent, is still longer than in the male, but this may be an individual peculiarity. The whole length of the male *Drepanornis*, from the tip of the bill to the end of the tail, is about 14 in., that of the wing, from the carpal joint, 6 in., of the tail, from the base, 5½ in., the outer tail feathers being about 1 in. shorter than the middle pair. The bill measures 3¼ in. from the front along the curvature, the tarsus 1¼ in.

The figure of the *Drepanornis* herewith given is reduced from the lithograph prepared for the "Proceedings" of the Zoological Society, which will form the 47th plate of the volume for 1873, and will be published as soon as the second part is ready.

Signor D'Albertis obtained his examples of this remarkable bird during his recent excursion into the interior of New Guinea, at a place called Atam, which is situated at an elevation of about 3,500 feet above the sea-level in the Arfak mountains. In an account of his journey

* The name originally given at the Zoological Society's meeting of June 17 was *Drepanephorus* (δρεπανήφορος) *falcem gerens*. (See NATURE, viii. p. 195.) But this term having been previously applied by Sir Philip Egerton to a genus of fossil fishes, I proposed (NATURE, viii. p. 192) to convert the bird's name into *Drepanornis* (δρέπανον *falx et* ὄρνις *avis*).—P.L.S.

recently published in the *Sydney Mail*, he speaks thus of the present species:—

"Among other birds obtained at Atam, I may mention a new species of Bird of Paradise-bird which perhaps may even prove to be of a new genus. I secured only a male and female, which have been transmitted to the Zoological Society of London by the last April mail steamer, and they are unique specimens. It is evidently a very rare bird, for many of the natives did not know it, but others called it *Quama*. The peculiarity of this bird consists in the formation of the bill, and the softness of the plumage. At first it does not apper to have the beauty usually seen in the birds of this group, but when more closely observed, and under a strong light, the plumage is seen to be both rich and brilliant. The feathers that arise from the base of the bill are of a metallic green and of a reddish copper-colour; the feathers of the breast, when laid quite smooth, are of a violet-grey, but when raised, form a semicircle round the body, reflecting a rich golden colour. Other violet-grey feathers arise from the flanks, edged by a rich metallic violet tint; but when the plumage is entirely expanded, the bird appears as if it had formed two semicircles around itself, and is certainly a very handsome bird. Above the tail and wings the feathers are yellowish, underneath they are of a darker shade. The head is barely covered with small round feathers, which are rather deficient behind the ears; the shoulders are of a tobacco-colour, and underneath the throat of a black blending into olive colour; the feathers of the breast are violet-grey, banded by a line of olive, and those of the vent white. The bill is black, eyes chestnut, and the feet of a dark leaden colour. The

The new Bird of Paradise, *Drepanornis Albertisi*. Upper figure, Male; lower figure, Female.

food of this bird is not yet known, nothing having been found in the stomachs of those I prepared but clear water."

Besides this Paradise-bird, M. D'Albertis procured from the natives, in the vicinity of Orangeri Bay, on the western coast of New Guinea, opposite to Salawatty, two imperfect skins of a second apparently new species. This is a true Paradisea, nearly allied to the Greater and Lesser Birds of Paradise (*P. apoda* and *P. papuana*), but having the long lateral plumes more of an orange-red, as in *P. rubra*. These skins were likewise exhibited at the Zoological Society's meeting on June 17 last, and the species, in accordance with M. D'Albertis' wishes, was proposed to be called *Paradisea raggiana*, after the Marquis Raggi.

As the collection of birds which contained these two new Paradise-birds only reached me on the morning of the same day as the meeting of the Society, it was not possible to make an accurate examination of all of them before the meeting, and the two Paradise-birds, being the most remarkable among the novelties, were alone described. But I have now had time to examine the whole series carefully, and find that it contains 70 specimens referable to 53 species. Twelve of these (besides the two Paradise-birds) appear to be new to Science, and will be described and named at the first meeting of the Zoological Society in the autumnal session. Besides these novelties there are examples of several other birds recently described by Dr. Schlegel from Rosenberg's collections, and of other rare species.

P. L. SCLATER

ON THE SCIENCE OF WEIGHING AND MEASURING, AND THE STANDARDS OF WEIGHT AND MEASURE *

II.

IT has already been mentioned that the gravitation or weight of bodies varies with their density, and the density of the medium in which they are placed. In order to ascertain the true relative weight, as well as the actual weight of standard weights differing in density when they are weighed in air, it is necessary to allow for the weight of air displaced by each. It thus becomes necessary to reduce these weighings to a vacuum, *by deducting from the apparent weight in air the weight of the volume of air displaced by each standard.*

But the weight of a given volume of air is necessarily more or less according to its temperature, the pressure of the atmosphere, and other conditions affecting it; and

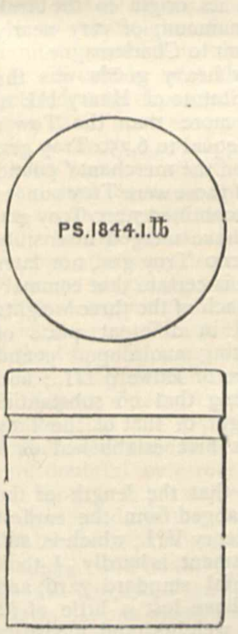

FIG. 1.—Imperial Standard Pound of Platinum.
Diameter = 1·15 inch.
Δ = 21·1572.
Displaces 0·403 grains of air.

Upper Surface of Platinum Standard Pound shown.

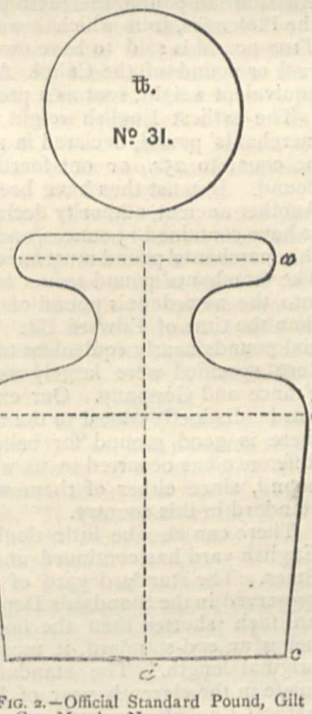

FIG. 2.—Official Standard Pound, Gilt Gun Metal. No. 31.
Size: Diameter at *a* = 1·25 inch.
" *b* = 1·65 "
" base *c* = 1·47 "
Height *d* = 2·2 inches.
Δ = 8·5144
Displaces 1·001 grain of air.
Upper Surface of Gilt Gun Metal Standard Pound shown.

the following data are requisite for ascertaining the weight of air displaced by each standard.

1. The mean temperature of the air during the weighings.
2. The mean barometric pressure reduced to 32° Fahr. and corrected for the pressure of vapour and of carbonic acid gas in the air.
3. The density of the metal of which each standard weight is composed.
4. The co-efficients of expansion of the metals and of air.
5. The relative weight of each standard.

From data 1 and 2 the ratio of the density of the air to the maximum density of water must be ascertained. This ratio is also affected by the height above the mean level of the sea, and the latitude of the place where the comparison is made, as the force of gravity differs accordingly. But in practice the determination of the weight of air displaced in weighing is easily and quickly effected, either by the more accurate mode of making the computations from the above-mentioned data, with the aid of a logarithmetical formula and tables for reduction of weighings, or approximately by special tables showing the mean weight of ordinary air displaced by standards of various densities. The mean ordinary air taken as the standard air in this country is of the normal temperature of 62° Fahr., the barometer being at 30 inches, with the mercury reduced by computation to the temperature of 32° Fahr., the amount of aqueous vapour in the air being assumed to be two-thirds of the quantity in saturated air, and the amount of carbonic acid contained in it being taken at 0·0004 of its volume.

The actual mode of ascertaining the weight of air displaced by standard weights when compared by weighings in air, will be described more at length afterwards. But some illustrations may here be given of the effect of the difference of density in standard weights, upon their weight in ordinary air. The following 1lb. avoirdupois weights are of the actual form and size:—

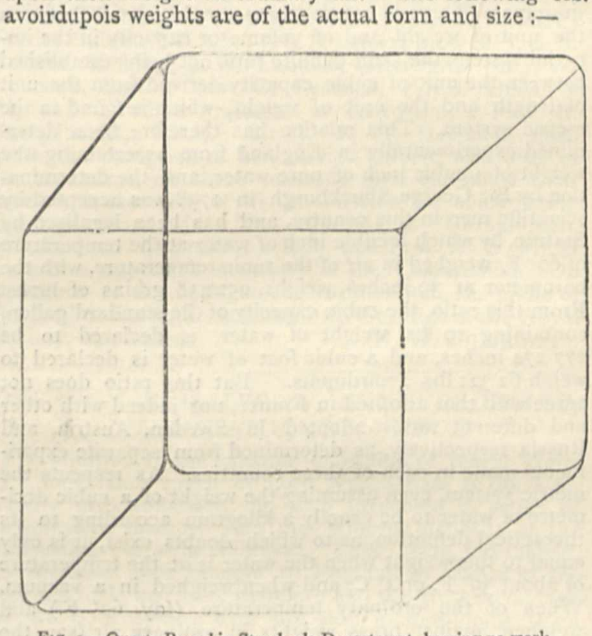

FIG. 3.—Quartz Pound in Standards Department, bearing no mark. Size = 2·17 inches cube, edges rounded. Δ = 2·6505. Displaces 3·216 grains of air.

It may here be seen that the difference of air displaced by the imperial standard lb. P.S. (Fig. 1), and the gilt gun metal lb. No. 31 (Fig. 2), is 0·598 gr.; and if they were equal in weight when in a vacuum, No. 31 would be 0·598 gr. lighter in air of the given density. No. 31 is one of the gilt gun-metal secondary standard weights, intended to regulate the weighings in air of all commercial weights. As the primary platinum standard P.S. from its greater density displaced so much less air than ordinary brass and iron weights—the density of cast-iron being about 7·408, and a cast-iron lb. displacing about 1·150 gr. of air—the weight of all the gilt gun-metal lbs., of which No. 31 was one, was referred by Prof. Miller to a theoretical commercial standard lb. of brass of the average density of brass and bronze weights (Δ=8. 143), and thus displacing 1·047 gr. of standard air. This commercial standard lb. denoted as W was assumed to be of the same weight in a vacuum as P.S., and consequently in standard air P.S. was 0·644 gr. heavier than W.

The standard pound of quartz (Fig. 3) displaces 3·217 grains of air. It was constructed as an auxiliary standard on account of the invariability of quartz, and its apparent

* Continued from p. 270.

weight in air was made intermediate between that of a pound of platinum and a pound of brass, being 0·401 gr. lighter than P.S., and 0·232 gr. heavier than W. in standard air.

As the determination of the density of bodies has thus been referred to the maximum density of an equal volume of water, it was evidently necessary to determine the absolute weight of a normal measure of water at its maximum density, in order to determine the true weight in air of a given volume of any substance, the density of which has been ascertained. It is claimed to be one of the important advantages of the decimal metric system, that this relation may be at once ascertained from the circumstance of the unit of weight, the kilogram, having been determined by its being the weight of a cubic decimetre of pure water at its maximum density. Thus the volume of any body expressed in cubic decimetres, or the measure of capacity of liquids expressed in litres, the litre being the measure of a vessel holding a cubic decimetre of water at its maximum density, when multiplied by its density, at once gives the weight in kilograms; or, if expressed in centimetres, the weight will be given in grammes. There is not the same simple relation between the unit of weight and of volume or capacity in the imperial system, the same definite ratio not being established between the unit of cubic capacity derived from the unit of length and the unit of weight, which is found in the metric system. This relation has therefore been determined experimentally in England from ascertaining the weight of a cubic inch of pure water, and the determination by Sir George Shuckburgh in 1798 was accepted by scientific men in this country, and has been legalised by Statute, by which a cubic inch of water at the temperature of 62° F. weighed in air of the same temperature, with the barometer at 30 inches, weighs, 252·458 grains of brass. From this ratio, the cubic capacity of the standard gallon, containing 10 lbs. weight of water, is declared to be 277·274 inches, and a cubic foot of water is declared to weigh 62·321 lbs. avoirdupois. But this ratio does not agree with that adopted in France, nor indeed with other and different ratios adopted in Sweden, Austria, and Russia respectively, as determined from separate experiments made in each of these countries. As respects the metric system, even assuming the weight of a cubic decimetre of water to be exactly a kilogram according to its theoretical definition, as to which doubts exist, it is only equal to this weight when the water is at the temperature of about 39° F. or 4° C, and when weighed in a vacuum. When of the ordinary temperature (say 62° F.) and weighed against brass weights in ordinary air (say, the barometer at 30 inches), it would weigh not a kilogram or 1,000 grammes, but about 999·012 grammes, the difference being the loss of weight by the weight of air displaced by a cubic decimetre of water. According to the English ratio, the cubic decimetre of water would weigh in air 999·515 grammes. And if the French ratio were applied to our imperial measures a cubic inch of water would weigh 252·336 grains, the capacity of the gallon would be 277·141 inches, and the cubic foot of water would weigh 62·291 lbs. But in point of fact, a new and authoritative international determination of the weight of a standard unit of water is very much needed, in order that its true weight may be satisfactorily ascertained and uniformly adopted in all countries.

II.—*Standards of Imperial Weight and Measure*

The English standard units of weight and length, the pound and the yard, have come down to us from the Saxons. The Mint pound of the Tower of London, which continued to be the legal unit of weight up to the time of Henry VIII., was the old pound of the Saxon Moneyers in use before the Conquest; whilst the earliest recorded standard of length in this country was the yard or *gird* of the Saxon kings, kept at Winchester. King Edgar is recorded to have decreed, with the consent of his Wites, the standard." No change was made by the Normans in the system of weights and measures established in England, and by a statute of William the Conqueror it was ordained that the measures and weights should be true and stamped in all parts of the country, as had before been established by law.

The old Tower pound was the ancient pound sterling of silver, containing 20*s.*, each of 12*d.* or pennyweights. It was also divided into 12 ounces, and was thus used as the apothecaries' weight. The Tower pound was less than the Troy pound by 15 dwt., and contained 5,400 Troy grains. It was discontinued by law in the 24th year of Henry VIII., the Troy pound, which appears to have been first introduced into this country from France at the close of the reign of Edward III., being substituted for it. The mark of 8 ounces was $\frac{2}{3}$ of the Tower pound, and was identical in weight with the ancient unit of money weight in Germany, known as the Cologne Mark. The Tower pound was also nearly identical in weight with the ancient Alexandrian pound, the 125th part of the Great Talent of the Ptolemies, from which it was probably derived. The Troy pound is said to have owed its origin to the Arab *roth* or pound of the Caliph Almamoun, of very nearly equivalent weight, sent as a present to Charlemagne.

The earliest English weight for heavy goods was the merchants' pound, declared in a Statute of Henry III. to be equal to 25*s.*, or one-fourth more than the Tower pound. It must thus have been equal to 6,750 Troy grs. Another ancient authority declared the merchants' pound to have contained 15 ounces, and if these were Troy ounces this merchants' pound must have contained 7,200 Troy grs. The merchants' pound seems to have merged insensibly into the avoirdupois pound of 7,000 Troy grs., not later than the time of Edward III. It is certain that commercial pounds nearly equivalent to each of the three weights here specified were largely used in different parts of France and Germany. Our existing avoirdupois pound can be distinctly traced to the time of Edward III.; and there is good ground for believing that no substantial difference has occurred in its weight, or that of the Troy pound, since either of them was first established as a standard in this country.

There can also be little doubt that the length of the English yard has continued unchanged from the earliest times. The standard yard of Henry VII., which is still preserved in the Standards Department, is hardly $\frac{1}{100}$th of an inch shorter than the imperial standard yard, and being an end-standard, it must have lost a little of its original length. The standard weights and measures made in the eleventh year of Henry VII., which are the earliest English standards now known to exist, are all declared to have been taken from the older standards of the Exchequer, as were also the later standards of Queen Elizabeth, which continued to be the legal standards of the country up to the year 1824. Although there is no direct evidence of the origin of the Saxon yard, it is highly probable, from its length agreeing very nearly with that of double the natural cubit (of about 18 English inches) and from its third part, the foot, being very nearly identical with the ancient Egyptian and Greek foot, that these two English unit measures of length owe their origin to the cubit of a man, the earliest known standard measure of length recorded in ancient history.

The Troy pound was the standard unit of weight in this country from the time of Henry VIII. up to the year 1855, when the imperial pound avoirdupois was made the legal standard of weight. The actual primary units of imperial weight and measure are now the standard pound avoirdupois and the standard yard in the custody of the Warden of the Standards, and deposited at the Standards Department, Old Palace Yard, Westminster. They were constructed under the superintendence of the Standards Commission, appointed in 1843 for the restoration of the standards of weight and measure which had been or Council, that "the measure of Winchester should be placed in the custody of the Clerk of the House of Commons, and were destroyed by the burning of the Houses of Parliament on October 11, 1834. The members of this Standards Commission had previously given their services as a preliminary committee, having been appointed in 1838 to consider the steps to be taken for restoring the standards, the Act of 1824 (5 Geo. IV. c. 74), under the authority of which the lost standards had been legalised, having directed that, in the event of their loss or destruction, new standards should be constructed in accordance with provisions contained in the Act, by reference to an invariable natural standard.

These provisions were as follows:—In regard to the Standard of Weight, it was recited in § 5 of the Act, that a cubic inch of distilled water, weighed in air against brass weights, at the temperature of 62° Fahr. the barometer being at 30 inches, had been determined by scientific men to be equal to 252·458 grains, of which the Standard Troy pound contained 5,760; and if this Standard were lost or destroyed, a new Standard Troy pound was to be constructed, bearing the same proportion to the weight of a cubic inch of water, as the Standard pound bore to such cubic inch of water.

It will thus be seen that the new unit of weight was declared to be dependent upon the new unit of length, it being based upon the capacity of the cubic inch, or the cube of the thirty-sixth part of the Standard yard.

With respect to the Standard unit of length, § 3 of the Act recited that the Imperial Standard yard, when compared with a pendulum vibrating seconds of mean time in the latitude of London, in a vacuum at the level of the sea, had also been determined to be in the proportion of 36 inches to 39·1393 inches, and it was provided that if lost or destroyed, a new Standard yard should be constructed bearing the same proportion to such pendulum, as the Imperial Standard yard then bore to it.

After long deliberation, the Committee made a very full Report, dated December 21, 1841, and declared their opinion that the several elements of reduction of the pendulum experiments referred to in the Act of 1824, were doubtful or erroneous. It was evident, therefore, that the course prescribed by the Act would not necessarily reproduce the Standard yard. It appeared also that the determination of the weight of a cubic inch of water was still doubtful, differences being found between the best English, French, Austrian, Swedish and Russian determinations amounting to about $\frac{1}{1200}$ of the whole weight, whereas the results of the mere operation of weighing might be determined within $\frac{1}{1000000}$ of the whole weight. The Committee were fully persuaded that with reasonable precautions, it would always be possible to provide for the accurate restoration of Standards by means of material copies which had been compared with them. And they had ascertained that several measures existed which had been most carefully compared with the former Standard yard; and several weights, which had been most accurately compared with the lost Standard pound; and by the use of these, the values of the original standards could be restored without sensible error.

They recommended that no change should be made in the values of the primary units of the weights and measures of the kingdom, or in the meaning of the names by which they were commonly denoted; that the construction of the Standards be entrusted to a Committee of scientific men, under certain instructions contained in the Report, and by comparison with the most carefully selected specimens; that the Parliamentary standard of length be one yard, there appearing no sufficient reason for departing from the length hitherto adopted for the standard; and that the Avoirdupois pound be adopted instead of the Troy pound as the Parliamentary standard of weight, the avoirdupois pound being invariably known and generally used, and the Troy pound being wholly unknown to the great mass of the British population, and comparatively useless. They also recommended that no new specific standard of capacity be established, the unit of capacity, the gallon, being continued to be defined by its containing 10 lbs. weight of distilled water, as specified in the Act of 1824.

Many other important recommendations were also made by the Committee in relation to the official Secondary Standards, and the verification and legalising of local Standards for the use of Inspectors of Weights and Measures throughout the country, and for the Colonies, in order to secure the requisite uniformity in commercial weights and measures, and their accordance with the scientifically constructed primary standards.

For more effectually carrying out these recommendations for the construction of the new Standards, the Standards Commission was appointed on June 20, 1843, and continued their labours until 1854, their definitive Report being dated on March 28 in that year.

The preliminary Committee was composed of the following scientific men:—G. B. Airy, Astronomer Royal, Chairman (now Sir G. B. Airy, K.C.B., and President of the Royal Society); F. Baily, V.P.R.S.; J. E. D. Bethune; Davies Gilbert, V.P.R.S.; J. G. S. Lefevre (now Sir J. G. S. Lefevre, K.C.B.); J. W. Lubbock (afterwards Sir J. W. Lubbock, Bart.); Rev. G. Peacock, F.R.S. Dean of Ely and Lowdian Professor of Astronomy; Rev. R. Sheepshanks, F.R.S.; Sir J. F. H. Herschel, Bart. With the exception of Mr. Davies Gilbert, who died in the meantime, all these scientific men continued their services as members of the Commission for constructing the new Standards. The Marquis of Northampton, P.R.S., Lord Wrottesley, F.R.S., and Prof. W. H. Miller were also appointed members of the Commission. On the death of the Marquis of Northampton, the name of the Earl of Rosse, his successor as President of the Royal Society, was added.

H. W. CHISHOLM

OREODON REMAINS IN THE WOODWARDIAN MUSEUM, CAMBRIDGE

IN addition to the valuable collection of recent skeletons lately given by Lord Walsingham to the University of Cambridge, he also presented a series of mammalian remains from the Miocene deposits of the Mauvaises Terres in Nebraska. These were, fortunately, for the most part brought to England in masses of the original rock, and have therefore had the great advantage of Mr. H. Keeping's care and skill in developing them from the matrix. His long-continued labour has resulted in the most interesting collection of fossils referred to in this notice, and now deposited in the Woodwardian Museum. Professor Hughes has entrusted me with the examination and determination of the remains, and has afforded me every possible assistance. The species revealed, some of which may possibly require the establishment of a new genus, at any rate appear to be new to science, and much larger than any hitherto described in America. We have thought that, pending the preparation of a complete description, your readers would be interested in a general account of the fossils; and especially it has been thought desirable that an account of the skull and dentition should be given in as simple a form as possible; for I have not yet seen any description of the skull other than the complete one of Prof. Leidy. At any rate, fresh interest will be excited in the Oreodontidæ now that so splendid a series of remains can be seen in an English Museum.

A summary of our fossils may be thus given:—

1. A large nearly complete skull, with lower jaw attached; the zygomatic arches being, however, almost destroyed.

2. The greater portion of a large skull preserving very completely one zygomatic arch with posterior crest.

3. Another skull of the same species showing the part anterior to the bifurcation of the sagittal crest.

4. Another large skull of the same species, wanting the greater part of the face.

5. A nearly complete skull of another species.

6. The greater part of two skulls of *Oreodon Culbertsoni* (the original and typical species), smaller than any of the above.

7. Half of the frontal region of an individual larger than any of the others.

8. Casts of the brain of a large and of a small species, with determinable parts of bones attached.

9. Many pieces, more or less complete, chiefly parts of upper and lower jaws with teeth, including a number which show the canine and incisor teeth.

10. Portions of limb bones, and a number of vertebræ.

Besides these, the collection includes Carnivorous, Rodent, and other very interesting remains.

"The deposits of the Mauvaises Terres," says Prof. Leidy, "are remarkable for the great quantity of fossil remains of mammals and turtles they have yielded without further exploration than picking them up from the surface of the country. Detached from the neighbouring soft and readily disintegrating rocks, the fossils lie strewn about, and have often attracted the attention of the least curious of those who have traversed the district. Many of the loose fossils have gradually been collected by travellers and others, so that few of a conspicuous character, I am told, now remain. Of those collected, by far the greater part have been submitted to my investigation, and these have amounted to the enormous quantity of between three and four tons in weight." The first description of fossils from the Mauvaises Terres, was by Dr. Prout, who, in 1846 and 1847, described a jaw of a large animal supposed to be a Palæotherium, in the *American Journal of Science and Art*. Gradually specimens came to light, many of which were described by Prof. Leidy, who collected and completed his descriptions in 1852, when he published, in the Smithsonian Contributions, "The Ancient Fauna of Nebraska," of 126 pages, and 24 splendid plates. In succeeding years the Mauvaises Terres were further explored by Dr. David Dale Owen, Dr. John Evans, and Dr. F. V. Hayden, who brought to Philadelphia large collections of fossils. Altogether Prof. Leidy supposes that he has seen entire skulls or portions of skulls of about 500 individual Oreodonts, a very large proportion of which belong to one species, *Oreodon Culbertsoni*. In 1869 the results of his twenty years' labour were published as the seventh volume of the second series of the "Journal of the Academy of Natural Sciences of Philadelphia," under the title of the "Extinct Mammalian Fauna of Dakotah and Nebraska," 472 pages, and 29 plates, large quarto. This great work includes also a synopsis of the entire mammalian remains of North America, with the most complete references and the author's valuable critical opinions. The interest is not merely in the artiodactyle ungulates, but also in the perissodactyles, including the famous Hipparion and Anchitherium, as well as the Rhinoceros, Machairodus, Mastodon, and Edentate remains. Quite recently Prof. Marsh has described a new medium-sized species of Oreodon in the current number of the *American Journal of Science and Art*.

The family Oreodontidæ is characterised by the possession of an elongated massive skull, of which the portion in front of the articulation of the lower jaw constitutes more than three-fourths. The upper surface slopes gradually from behind forwards. Posteriorly is a high sagittal crest ($1\frac{1}{2}$ in. at the greatest height in large species), reaching far back, so as to project on a level considerably behind that of the occipital condyles. The crest is flanked by large and wide temporal fossæ, their floor being chiefly formed by the squamous bone, which is internally strongly convex, and bears a blunt ridge proceeding from behind forwards, downwards, and outwards. The sagittal crest bifurcates anteriorly to form the postero-lateral sides of a nearly flat lozenge-shaped frontal region, whose lateral angles overarch the completed bony orbits. The upper surface of the face is terminated by elongated convex nasals, which extend, I think, quite to the level of the front of the premaxilla, and project further in the middle line than at the sides. The nasal cavities are very large, high at the anterior opening, and do not open laterally on the face near the orbit. They have complicated turbinals. The frontal region is alternately gently convex and concave, being more convex near the lateral angles. The frontals have, near the middle line on each side, a considerable supra-orbital foramen, appearing at about the level of the posterior boundary of the orbit.

On the lateral aspect of the skull there is first to be noticed the lateral occipital crest which extends outwards and backwards, as the outer margin of the post-occipital fossa, which varies in size. It then bifurcates, giving an inferior branch continuing the margin of this fossa, and a lateral branch which passes far outwards, bounding the great temporal fossa. This ridge rises higher as it recedes from the occipital region, and external to the articulation of the lower jaw developes into a curved crest, which is remarkably large and thick in one specimen. Further forward this crest does not exist. The widest part of the skull is just in front of this; in one of our species the width at this point is twice as great as the distance from the occipital to the orbit. The zygomatic process of the squamosal comes forward to the under part of the orbit, and is received into a long concavity of the malar. The latter passes above this process, to join the post-orbital process of the frontal, and bound the large oval or circular orbit. The malar is often of great vertical depth, and joins a prominence of the maxillæ above the alveoli of the posterior molars. Inside and above this elevation, the lachrymal occupies a considerable space on the face, and has an antorbital fossa of varying size. Anteriorly the face continues comparatively high, generally convex, and nearly vertical.

The base of the skull presents the occipital condyles, which have their anterior and posterior portions obliquely bent upon each other at an acute angle; they approach very close to one another in the median line below. The basi-occipital has a strong raised median ridge, which gradually dies away on the basi-sphenoid. The basi-cranial axis is set at an angle of about 40° to the palatine axis. Externally there is a large nipple-shaped post-glenoid process of the squamosal (the transverse diameter being the greater). Immediately on its inner side is a large auditory bulla, somewhat compressed; and applied to its external surface, and at the same time nearly touching the post-glenoid process is a long and strong paroccipital. The external meatus opens obliquely upward in front of the paroccipital.

Between the teeth, the palate is of almost uniform width, is regularly concave, and smooth. It extends for some distance behind the molar teeth, being narrowed; and has a concave posterior margin of different form in the various species. The pterygoid continues the lateral part of the concavity to the alisphenoid region.

The horizontal ramus of the mandible is of moderate height, each half being separated slightly from the other in the specimens. The symphysis is considerable, and shows serrated sutures. The anterior end of the mandible is very little diminished in height, has less of the spatulate form than ordinary ruminants, and is somewhat expanded in consequence of the size of the canines. The rami are very nearly parallel throughout their whole extent. The ascending ramus is high, with a small coronoid process, and a transversely elongated condyle.

The dental formula is—

$$\text{i.}\frac{3-3}{3-3}\ \text{c.}\frac{1-1}{1-1}\ \text{p.m.}\frac{4-4}{4-4}\ \text{m.}\frac{3-3}{3-3}=44.$$

In the middle line above there are six small somewhat chisel-shaped incisors, increasing in size from within outwards. Next succeeds a large curved conical canine, flattened on its external aspect, and bearing a slight median longitudinal groove. There are seven teeth in the molar series, of which the first four appear to be premolars. These teeth present characters common to most ruminant genera, the premolars showing one double crescent, and the true molars two double crescents; the convexity of the crescents being turned inwards as in the upper jaw of all ruminants. They are very square in general shape, and the crescents are very convex. The junction of the anterior and posterior crescents externally is raised into a strong column, and a similar column projects as a third lobe on the posterior molar.

In the lower jaw eight teeth appear in front; the six middle ones of about the same size as the incisors of the upper jaw, but more cylindrical. The extreme tooth on each side, homologically a canine, is considerably larger and more chisel-shaped. The upper canine bites immediately behind this tooth; and behind this again is a long curved caniniform tooth similar to the canine of the upper jaw. Three premolars and three true molars succeed. They are generally similar to those of the upper jaw, but have the convexities of the crescents turned outwards. Throughout the series of teeth there is no diastema, except just as much as will allow the canine teeth to fit compactly above and below.

The following are, roughly, the dimensions of the large skull No. 1:—Length on upper surface, 13½ or 14 inches; height posteriorly 8½ inches; anteriorly, nearly 6 inches; length of lower jaw, 10½ inches; length of molar series of upper jaw, 6 inches.

A brief comparison with some other skulls will assist in giving an idea of the affinities of the Oreodonts. The Peccary presents perhaps the greatest number of resemblances. The sagittal ridge and frontal surface are somewhat alike, but the sagittal ridge is much longer and higher in Oreodon. The part of the squamosal (with the high crest) posterior to the glenoid cavity is similar, but not nearly so elevated or so widely diverging from the middle line. The supra-orbital foramen is on the level of the anterior, and not the posterior of the orbit. The post-occipital fossa and the condyles are very much alike; so is the narrowing of the palate behind the molars; but the palate is wider and not so long proportionally in Oreodon. The posterior edge of the mandible is similar.

But the differences between Oreodon and the Peccary are many and important; the characters of the teeth are very different: the Peccary has a large diastema; the mandibular rami are not parallel, the nasal cavities are smaller in proportion; there is no lachrymal fossa; the orbit is incomplete; there is scarcely any post-glenoid process of the squamosal.

The pig exhibits somewhat more likeness to Oreodon in the relations and size of the par-occipital and the auditory bullæ; but differs still more importantly in the wide separation of the two temporal fossæ by the intervening flat parietals.

The Camel agrees with Oreodon in the large size and close proximity of its temporal fossæ, which are separated by a sagittal crest, but the latter is low, and the floor of the temporal fossa is exceedingly convex. There are vast differences in the face, teeth, mandible, and auditory bullæ.

In the ordinary Ruminant, as the sheep, it is the face which presents most resemblances to our specimens. These consist in the shape of the nasals, the nearly vertical maxillæ, the complete orbits, the antorbital fossa of the lachrymal, the Ruminant molars, and the form of the palate between the molars. But the posterior part of the skull is very unlike. Even in the molar teeth, while the type is the same there are considerable differences which will be hereafter fully described.

The Llama is much less like Oreodon than the camel is.

The casts of brains and the limb and trunk-bones and vertebræ promise to afford very interesting matter, but I have not yet made a careful examination of them.

G. T. BETTANY

ASTRONOMICAL ALMANACS,

A COMPARATIVE HISTORY OF THE "CONNAISSANCE DES TEMPS," THE "NAUTICAL ALMANAC," AND THE "JAHRBUCH" OF BERLIN.*

I.—*The "Connaissance des Temps" of Picard and Lefebvre.*

IN 1666 a celebrated bookseller of Paris, Jean de la Caille, at the sign of the "Fontaine d'or," in the Rue Jacob, published, at his own expense, the "Astronomical Ephemerides" of Hecker, the Astronomer of Dantzig. These Ephemerides were calculated on the observations of Tycho Brahe and Kepler, according to the rules given in the Rudolphine tables—tables constructed at the expense of Rudolph II., Emperor of Germany, by Tycho Brahe, Kepler and himself. Their title was, "Johannis Heckeri Motuum Cælestium Ephemerides, ad anno 1676, ad annum 1680, ex observationibus correctis nobilissimorum Tychonis Brahei et Johannis Kepleri. Hypothesibus Physicis, tabulisque Rudolphinis ad meridianum Uraniburgicum in freto Cymbrico."

These tables gave for the meridian of Uranibourg (island of Heven, between Copenhagen and Elsinore)—which derived considerable importance from the immortal observations of Tycho Brahe—and for each day the longitudes and latitudes of the sun, of the moon, of Mercury, Venus, Mars, Jupiter, and Saturn; the longitudes in degrees and minutes for the planets and the sun, in degrees, minutes, and seconds for the moon; the latitudes in degrees. They contained, moreover, an announcement of the eclipses of the sun and of the moon for the whole period indicated, and a table of geographical co-ordinates (latitude and longitude reckoned from Uranibourg) of the principal towns.

These Ephemerides, the best that then existed, stopping at the year 1860, Picard, the creator of exact astronomy, resolved to continue them. But on account of a voyage which King Louis XIV. was about to undertake, and during which the work which Picard proposed might be useful, the French astronomer decided to advance by a year the date of his publication, and to commence with the year 1679.

The Ephemerides of Picard are thus titled:—"La Connaissance des Temps ou Calendrier et Ephémérides de lever et coucher du soleil, de la lune et des autres planètes, avec les éclipses, pour l'année 1679, calculées sur Paris, et la manère de s'en servir pour les autres élévations†; avec plusieurs autres tables et traités d'astronomie et de physique, et des Ephémérides de toutes les planétes en figures."

This work contains the following information:—1. The time, almost to the minute, of the rising and setting of the sun and moon at Paris, for every day of the year. 2. The time of the rising and setting of the sun (every fortnight) and of the moon (every ten days) for Calais, Paris, Lyon, and Marseille. From these tables the preceding time could be calculated for every point of France. 3. Announcement of eclipses of the sun and moon. 4. The time of the passage of the moon across the meridian and the right ascension of the sun for every day of the year. We have thus the time of the tide. Be-

* Translated from *La Revue Scientifique*, July 19.

† The word *élévation* is synonymous with *latitude*.

sides, the solar dials could be used to obtain the hour during the night by the shadow of the moon; and indeed the time at night could be obtained by observation of the fixed stars. The same table contains the value of the equation of clocks and pendulums, what we now call the "equation of time." 5. A summary of the movements of all the planets for the year, containing little but an indication of the epochs when they were visible and of the constellations through which they passed. 6. A plate in which the preceding data were graphically traced. 7. A table of the latitudes and longitudes (adjusted to the meridian of Paris) of the principal cities of France. 8. An appendix, relating to physical questions, containing an account of the winds which prevailed in Paris for every day of the preceding year, and an exact account of barometric indications for the same period.

In 1680, Picard completed his volume by the following additions:—A note on the inquiry into longitudes (*recherches des longitudes*) by means of clocks and pendulums; a table of lengths of the pendulum corresponding to an increasing number of vibrations per second, and intended for the regulation of clocks; a table of declinations of the sun for each day (by degrees and minutes); and lastly, a table indicating the weights of the unit of volume (a cubic foot) of different substances.

These Ephemerides, although less complete, so far as pure astronomy is concerned, than those of Hecker, were, however, superior to them from a practical point of view, by the substitution of the right ascension of the sun and moon for the longitude and latitude of these bodies; it is, in fact, the right ascension and declination which are directly useful to astronomers.

Picard, who published the "Connaissance des Temps" at his own expense and his own risk, was naturally interested in the success of his work. Thus, after having sought to satisfy the wants of astronomers and mariners, he added to this publication a list of the days on which the posts to the various towns of France set out from Paris. The custom of adding to the astronomical tables physical or statistical data altogether foreign to astronomy, has been continued to the present time in the "Annuaire du Bureau des Longitudes."

Still the great labour required in editing these Ephemerides soon tired the Abbé Picard, who tried to find a successor. There was then at the college of Lisieux, at Paris, a professor of rhetoric named Pierre, who was a good astronomer, and on that account was intimate with all the astronomers of his time. The learned Abbé asked him one day if he knew any one capable of assisting him, and afterwards of carrying on the "Connaissance des Temps;" Pierre proposed Jean Lefebvre, weaver at Lisieux, who, in the intervals of leisure which his work allowed him, amused himself by reading some books on astronomy, and was familiar enough with that science to be known to Pierre, originally of the same town: he had sent the latter, among other things, calculations of eclipses which quite agreed with observation. Pierre and Picard then asked Lefebvre to calculate a table of the passage of the moon across the meridian, and this having been accurately performed, they offered him an academician's annuity to come to Paris and continue the "Connaissance des Temps." We owe to his calculations the volumes from 1684 to 1702. Profiting by the new tables of the equation of the sun of Picard and Cassini, he was able to calculate the "Connaissance des Temps" with more accuracy than had ever been done before.

To Lefebvre also are due several additions and modifications. Thus in 1686 he added a table of the exact positions of the planets, the sun, and the moon for every ten days; in 1690 he gave the immersions and emergences of the first satellite of Jupiter; in 1691 maxims in reference to the movement of a ship, a list of ports and coasts, &c. In 1692 he added a table of refractions from 0° to 90° of apparent height, calculated to a minute up to 48° and to a second from 48° to 90°, as well as a value of the declination of the needle according to the observation of La Hire.

In 1693 Lefebvre, having left Paris to take part in the geodetic operations of Picard, one of his colleagues of the Academy, Lieutaud, edited the *Connaissance des Temps* in 1693 and 1694; but on his return he resumed the editorship, and continued it without interruption till 1702.

At that time, in consequence of an incident curious enough to bear relation, the publication of the *Connaissance des Temps* was taken up by the Academy of Sciences.

The son of De la Hire, a very popular academician, who had considerable influence among his colleagues, published, for 1701, a collection of Ephemerides intended to rival those of Lefebvre, in which he said, "I hope, at least, that there will not be found here errors (*éloignements*) of calculation so great as are seen in certain popular and much praised Ephemerides," &c. Wounded to the quick by such a reproach, altogether untrue, Lefebvre wrote in the preface of the *Connaissance*, for 1701, "I cannot avoid replying to the invectives of a certain small novice [De la Hire *fils*], supposed author of an annual Ephemerides published a short time ago. This new author, filled with a spirit of vanity, presumption, and falsehood . . . We reply to this youthful novice . . ."

De la Hire, himself, was not spared. At this uncouth reply the enemy's camp winced, and resolved on revenge; success was easy, for Lefebvre was by no means a general favourite. Little by little the meetings of the Academy were rendered insupportable to him, and when he had absented himself for a certain number of meetings, his name was struck out of the lists of that body. Deprived of his Academician's pension, Lefebvre could no longer continue the *Connaissance des Temps.* The Academy then took possession of the publication, which became a public undertaking; so that the volume of 1702, instead of being, like the previous ones, dedicated to the king, is published "by order of the Academy of Sciences." The old title is changed, and it is simply called "Connaissance des Temps, pour le Méridien de Paris."

(*To be continued.*)

NOTES

In reference to the meeting of the British Association at Bradford, the Reception Room will be opened on Monday, September 15, at 1 P.M., and on the following days at 8 A.M., for the issue of tickets to members, associates, and ladies, and for supplying lists and prices of lodgings, and other information, to strangers on their arrival. No tickets will be issued after 6 P.M. On and after Monday, September 15, members, and persons desirous of becoming members or associates, or of obtaining ladies' tickets, are requested to make application in this room. In the Reception Room there will be offices for supplying information regarding the proceedings of the meeting. The "Journal," containing announcements of the arrangements for each day, will be laid on the table on Wednesday, September 17, and the following mornings, at 8 A.M., for gratuitous distribution. Lists of members present will be issued as soon as possible after the meeting, and will be placed in the same room for distribution. The first general meeting will be held on Wednesday, September 17, at 8 P.M. precisely, when Dr. Carpenter, LL.D., F.R.S., &c., will resign the chair, and the President Elect will assume the presidency, and deliver an address. On Thursday evening, September 18, at 8 P.M., a Soirée; on Friday evening, September 19, at 8.30 P.M., a Discourse; on Monday evening, September 22, at 8.30 P.M., a Discourse; on Tuesday evening, September 23, at 8 P.M., a Soirée;

on Wednesday, September 24, the concluding General Meeting will be held at 2.30 P.M. We omitted to mention in last week's number that the President of Section D, Biology, is Prof. Allmann, M.D., F.R.S.

SIR HENRY RAWLINSON has received a letter dated Khartoom, July 2, from Sir Samuel Baker. Sir Samuel expresses a hope that he will be in England in September. In reference to the oneness of Lakes Tanganyika and Albert Nyanza, he says:—"The envoys sent by M'tése all assured me that the Tanganyika is the M'wootan N'zizé (Albert Nyanza) and that Ujiji is on the eastern border; that you can travel by boat from Ujiji to the north end of the Albert Lake; but you must have a guide, as some portions are very narrow and intricate. From my experience of the high-water grass, I should expect islands and floating vegetation in the narrow passes described. I am by no means fond of geographical theories, but the natives' descriptions were so clear that I accepted as a fact that the Tanganyika and Albert Lakes are one sheet of water, with marshy narrow straits overgrown with water grass, through which you require a guide."

THE Session of the British Medical Association in London during the last week seems in all respects to have been most successful: a great many papers were read, and a great quantity of pleasuring hurried through. Many of the papers were valuable from a medical point of view, and some of importance even from a general scientific standpoint. This week we give a short abstract of Dr. Sanderson's address.

AT the annual general meeting of the Royal Botanical Society, on Monday, the Council congratulated the Fellows on the fact that since the last anniversary meeting the progress which had characterised the operations of the society during the last few years had been maintained. The number of new Fellows elected during the year was 114, being an increase of ten above that of last year; few resignations had occurred. The total number of Fellows and members at the present time was 2,502, the largest on the books of the society since its commencement. The total amount received in subscriptions was 250*l.* in excess of that of last year, and considerably above the average of the last few seasons. From the auditor's report it appeared that the total receipts for the year, including the balance of 529*l.* from the previous year, amounted to 13,434*l.* 6*s.* 11*d.*, and the payments, exclusive of the balance in hand, 2,170*l.* 9*s.* 4*d.*, to 11,263*l.* 17*s.* 7*d.* The report of the secretary was also read, and was equally satisfactory with the other reports. The Council for the next year was elected by ballot.

PROF. G. SCHWEIZER, Director of the Moscow Observatory, died on July 5, after a long illness.

THE death of Sir Francis Ronalds in his 86th year, at Battle, in Sussex, has just been announced. Sir Francis was well known, many years ago, for his experiments in electricity. In 1823 he published a pamphlet containing an account of some of his experiments, and explaining, with the help of illustrations, his plan of an electric telegraph. He had erected in his own garden, first at Highbury and then at Hammersmith, a number of poles supporting eight miles of wire, and through this wire he sent his messages. Each message was read at the further end by means of two needles moving on a dial plate, a plan much the same as that which afterwards came into general use. The spark in his telegraph system was however created by an electrical machine, and not, as in existing systems, by a galvanic battery. In recognition of the value of his discovery, the Government bestowed on him the honour of knighthood in 1870, when the same mark of appreciation had been conferred on Sir Charles Wheatstone for his improvement of the telegraph. Sir F. Ronalds superintended for a short time the Meteorological Observatory at Kew on behalf of the British Association, and the Government conferred upon him a small pension for his services to Science. For some years he lived in the north of Italy, studying the works of Italian writers on electricity. Lately he was engaged in his home at Battle in preparing a catalogue of the published books and papers on electrical science, which we believe is quite ready for print, and will be of great value to students.

To the notice which appeared some few weeks back stating that the large female Octopus had deposited a quantity of spawn on the rock-work of her tank, we have now to add the still more interesting intelligence of the successful development and escape of the perfected embryos. It will be remembered that the first of these eggs were deposited on June 19, and as the earliest arrivals of the young Octopods into the outer waters of their tanks took place on Friday the 8th inst., we have just eight weeks as the period of incubation. Mr. Saville Kent, having personally witnessed the congress of the two sexes in April last, we are also in a position to record an almost similar period occupied during the process of gestation, and which together constitute an important addition to our previous knowledge of the habits of the Cephalopoda. Since Mr. Saville Kent's resignation of the Curatorship, the Brighton Aquarium has unfortunately lost the older and tamer example of the two porpoises, commented upon by that gentleman in NATURE for July 17, as also the unique specimens of the Sturgeon and John Dorée, which have likewise received a share of attention from the same pen in the pages of this journal.

THE Lords of the Committee of Council on Education are about to appoint a keeper of the Natural History Department of the Edinburgh Museum of Science and Art. The salary will be 350*l.*, rising to 450*l.* per annum. Candidates should apply to the Secretary, Science and Art Department, South Kensington.

THE German African Exploration Society has received a despatch, dated July 1, announcing the arrival of Professors Bastian and Goeschen at Cabinna Clougd, for which place Dr. Guesfeldt had started on June 28 from Sierra Leone. Dr. Falkenstein, Dr. Anatoin, physician, and Herr Linder, engineer, are hourly awaiting, at Berlin, further intelligence, on receipt of which they leave to join the expedition.

Xanthorræa australis, one of the grass gum trees of Australia, is coming into flower for the first time in Europe, in the succulent-house at Kew. There is also a fine plant of *Agave jacquiniana*, removed to the palm-house for the sake of space, which is now in full flower.

DR. PETERMANN has sent us advanced sheets of some of the articles to appear in the forthcoming number of his *Mittheilungen*. One of these gives an account of the *Polaris* Arctic Expedition under the unfortunate Capt. Hall, and points out the main scientific results, which Dr. Petermann rightly regards as of the highest importance. He animadverts with considerable severity on the conduct of the English for the last nine years with regard to Arctic exploration; we, he says, having during that time endeavoured to depreciate the efforts of others, while we ourselves have done nothing. Even the expedition of the daring Hall, he declares, we sneered at when it set out, and since its fate was known, have spoken slightingly of the results. We must acknowledge that Dr. Petermann's taunt as to our inaction during the last nine years in the direction of Arctic exploration is to some extent justified by facts; that inaction, however, is not due to the apathy of English men of Science but to the parsimony of the British Government. We have done much in the way of private effort for discovery, but no amount of private effort is equal to the fitting out of an adequate Polar Expedition. It is, we believe, the earnest desire of all classes that Government should provide the means of enabling this country to take that foremost part in Arctic exploration which was formerly hers without dispute, by fitting out a thoroughly equipped expedition, an expedition which should have for one of its aims the finding of the Pole. As to Captain Hall's expedition, so far as we are aware, the high value of its results has been everywhere in this country gratefully acknowledged, as well as the indomitable bravery and enthusiasm and high intelligence of the leader; one of its most important results, for which all men of Science must be thankful, is that it has left the most practicable path to the Pole no longer questionable. That the *Polaris*, however, was ill suited for ice-navigation, and that there was a want of that thorough discipline on board, without which no expedition of the kind can hope to be perfectly successful, we still maintain is borne out by what was elicited during the official investigation. We sincerely hope with Dr. Petermann that the magnanimity and liberality of the American Government will be the means of putting an end to the "mere talk of Englishmen," and of inducing our Government at last to set about organising on the most liberal scale an expedition to leave our shores in the spring of 1874. Other papers in the forthcoming number are "With the Russian Army against Khiva," being two letters to Dr. Petermann from Lieut. Hugo Stumm, of the Westphalian Hussar Regiment, and a paper by Dr. D. Sievers, dated Tiflis, May 7, full of geographical information of great importance. The same number will contain the conclusion of Baron von Richthofen's account of his travels from Pekin to Sz'-tshwan.

THE last issued number (vii.) of Petermann's *Mittheilungen* contains the conclusion of Ernest Marno's Travels in High Sennaar; the Results of the Observations made during the voyage of the *Albert* in November and December last, by Prof. Mohn, Director of the Norwegian Meteorological Institute; and a well-constructed map of the Chinese Province of Kuang Tung, from native and foreign authorities, by Dr. Hirth, with accompanying description.

PROF. AGASSIZ, in his address to the students, at the opening of the American School of Natural History, on Penikese Island, said:—"Our chief work will be to watch the aquarium. I want you to study principally marine animals. The only way to do that properly, is to have them alive by your side. In a very few days I shall place at your disposal a series of these appliances. I have ordered one for every person admitted to the school, so that each of you will have means to make these investigations. I have never had, in my own laboratory, better opportunities for work than I place at your disposal. Our way of studying will be somewhat different from the instruction generally given in schools. I want to make it so very different, that it may appear that there is something left to be done in the system adopted in our public schools. I think that pupils are made too much to turn their attention to books, and the teacher is left a simple machine of study. That should be done away with among us. I shall never make you repeat what you have been told, but constantly ask you what you have seen yourselves." The following men of science will, it is said, assist Prof. Agassiz in the conduct of his new charge:—Dr. Burt G. Wilder, of Cornell; Dr. A. S. Packard, of Peabody Academy of Science, Salem; Count Pourtales, of the Coast Survey; Prof. Waterhouse Hawkins, of England; Paulus Roetter, artist of the Museum at Cambridge; Prof. Mitchell, of the Coast Survey; Prof. Joseph S. Lovering, of Harvard University; Prof. F. W. Putnam, of Peabody Academy of Science, Salem; Prof. N. S. Shaler, of Harvard; Prof. Arnold Guyot, of Princeton, N. J.; Prof. Brown-Séquard.

ACCORDING to the *Melbourne Argus*, H.M.S. *Basilisk*, Capt. Moresby, while cruising in Torres Straits and neighbourhood for the suppression of the Polynesian labour traffic, has added a valuable fact to the knowledge we possessed of the geography of New Guinea by the discovery of a new port and harbour in lat. 9° 30′ S., lon. 147° 10′ E., about 38 miles east of Redscar Bay, on the south-eastern coast. The discovery was made in February, when Captain Moresby, while searching for a river supposed to flow into the sea east of Redscar Bay, entered an inlet which proved to be the entrance to a magnificent harbour, with an outer and inner anchorage, to which the names of Port Moresby and Fairfax Harbour have been given. The natives are much lighter complexioned than those of the opposite coast, and are evidently of a much more friendly disposition.

A GREAT earthquake occurred at Valparaiso early on the morning of July 8. There were six shocks in succession. Many families took refuge in the streets, the damage to private houses as well as to the public buildings being considerable; and many deaths were reported. A statue lately erected to Lord Cochrane was wheeled half round on its pedestal. The earthquake was observed to come from the east, and was felt as far south as Curico.

THE *Telegraphic Journal* intends to offer to its students from time to time prizes for the best and most carefully considered paper on a given subject. The first of these students' prizes is one of 25*l.* to be awarded to the author of the best paper on "The Evidence of the Theory of Correlation of Physical Forces as applied to Electricity and Magnetism," received by the editor of the journal on or before January 1st, 1874. The funds for this prize have been kindly given by Mr. Edward Sabine, C.E. The prize paper will be printed in the columns of the *Telegraphic Journal*.

WE understand that 1,000*l.* has been generously presented to the Oldham School of Science and Art, by Mrs. Platt, widow of the late John Platt, M.P., who was its founder in 1865, and life-president. Since the opening, its artisan students have gained four Whitworth Scholarships of 100*l.* each for three years (two have been awarded this year); two Whitworth Fellowships of 25*l.* each; one Studentship at the Royal School of Mines; three gold, six silver, and five bronze Queen's Medals (the Medallists of 1873 are not yet announced). Twenty-four artisan students were examined by the Department last May, in Inorganic Chemistry—eighteen passed (nine first class, nine second class)—and twelve in Laboratory Practice. The Committee have granted funds to enlarge the Chemical Laboratory, also to establish one for practical work in Heat, Steam, Light, and Acoustics. Mr. J. T. Hibbert, M.P. for Oldham, has given a Local Scholarship of 25*l.* for the coming session. We have received a well-arranged time-table of Classes under the direction of Mr. Phythian, C.E., and Mr. Philip, M.A.

IN accordance with the resolution passed at the meeting, noted in last week's NATURE, for the promotion of technical education, at which H.R.H. the Prince of Wales presided, the Haberdasher's Company have sent to Lord Lawrence, for distribution by the London School Board, the sum of 20*l.* as their contribution towards the purchase of tickets of admission to the International Exhibition.

DURING the month of October, we learn from the *Journal of the Society of Arts*, notwithstanding the Anarchical State of Spain, an exhibition is to be held at Madrid, of national products and manufactures, of agriculture, mines, chemicals, industries, and graphic arts. Foreign products will be received by the executive at Madrid if carriage paid. Goods will be sold by the executive on a small commission charge. This is to be the first of a proposed series of Spanish exhibitions.

PROF. COPE sends us, as No. 14 of his "Palæontological Bulletins," the description of two new mammals from the tertiary "of the plains." One, *Aelurodon mustelinus*, is only known from some teeth of the molar series; the other, *Aceratherium megalodus*, is represented by a perfect cranium with dentition of both jaws nearly complete, with other bones of other specimens. The wording of the description is intricate and short.

A PAPER entitled "A Study of North American Noctuidæ, by A. R. Grote, was read on July 2 before the Buffalo Society of Natural Sciences, declaring that six new genera (Ufeus, Ablepharon, Ommatostola, Argillophora, Harveya, Spiloloma) and twenty-seven hitherto undescribed species (Agrotis, 7; Ufeus, 2; Mamestia, 1; Dianthœcia, 1; Oncocnemis, 3; Hadena, 1; Ommatostola, 1; Cucullia, 1; Xylina, 1; Heliothis, 6; Argillophora, 1; Harveya, 1; Spiloloma, 1), occur in the N. American Insect Fauna.

SIR HENRY RAWLINSON's presidential address at the last anniversary meeting of the Geographical Society has been published in a separate form by Messrs. Clowes and Sons. We are glad to see it reproduced in a handy and well-printed form, for it contains a masterly summary of the progress of geographical knowledge during the past year.

WE have received the prospectus of what promises to be a handsome and valuable work, "The Fenland, Past and Present: its History, Geography, Geology, Natural History, Scenery, Antiquities, Climatology, Drainage, Agricultural Produce, and Sanitary Condition; illustrated with Wood Engravings, Maps, and Diagrams; by Samuel H. Miller, F.R.A.S., Fellow of the Meteorological Society; and Sydney B. J. Skertchley, F.G.S., H.M. Geological Survey." It will be published by Leach and Son, Wisbech; and Longmans, Green, and Co. London. Under the head "Fenland," the authors include that area of low, once marshy lands, in which the rivers Witham, Welland, Nene, and Ouse interlaced, including nearly 2,000 square miles, and roughly bounded by a line drawn from Lincoln by Bourn and Peterborough to Cambridge on the west; from Lincoln to Skegness on the north; from Cambridge and St. Ives to Brandon on the south; and from Brandon to Lynn on the east (thus including Boston, Sleaford, Spalding, Croyland, Thorney, Wisbech, March, Huntingdon, Ely, besides the border towns.)

A VERY deserving institution has recently been established in Cincinnati, under the title of the Cincinnati Acclimatisation Society, its object being to effect the introduction of such foreign birds as are worthy of note for their song or their services to the farmer or horticulturist. The society announces that during last spring it expended 5,000 dols. in introducing fifteen additional species of birds, and that it had already successfully accomplished the acclimatisation of the European sky-lark, which is stated to be now a prominent feature of the summer landscape in the vicinity of Cincinnati. Among the species which it is proposed to introduce is the European titmouse, considered abroad as one of the most successful foes of insects injurous to vegetation.

THE addditions to the Zoological Society's Gardens during the past week include a Harnessed Anntelope (*Tragelaphus scriptus*), a Double-crested Pigeon (*Lopholæmus antarticus*), two Senegal Touracous (*Corythaix persa*), two Chilian Tinamous (*Rhynchotus perdicarius*), a White-fronted Dove (*Leptoptila jamaicensis*), a Glossy Ibis (*Ibis falcinellus*), a Mauge's Dasyure (*Dasyurus maugæi*), a Barbary Ape (*Macacus inuus*), and others.

SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie Neue Riehe, Band xci. Heft 2 und 3, June 14. This number begins with communication No. 83 from the Griefswald Laboratory, the subject of which is Phenathren, by M. Hayduck. The author describes several of the compounds of this body.—From the same laboratory we have a notice on the compound $C_{14}H_8S_2$, by C. Pauly.—B. Rathke contributes a paper on the chloro-sulphides of carbon, and another on the compounds of the amides with that body. One of these chloro-sulphides has the formula $CSCl_4$—perchloromethylmercaptan, another the formula $CSCl_6$, several of their compounds are described. The same author also contributes a short paper on the changes nitro-compounds undergo in sulpho-acids.—Messrs. Maunder and Tollens communicate a paper on β Bibromopropionic acid, in which they give an exhaustive account of this body and its compounds.—Messrs. Caspary and Tollens have converted β Bibromopropionic acid into acrylic acid and give an account of the process, and of the salts of acrylic acid.—Mr. B. Tollens communicates a paper on the constitution of the allyl and acryl derivatives.—Prof. Max. von Pettenkofer has a paper on "Nourishment in general, and on flesh extract as an essential portion of human nutriment in particular."—Messrs. Lieben and Paterné have a paper on the dry distillation of calcic formate.—J. Wislicenus communicates a paper on the optically active lactic acid of flesh extract, and on paralactic acid. The same author also communicates some observations on ethyl-lactic acid. The next paper is by C. E. Groves on the formation of naphthaquinone by the direct oxidation of naphthalene, which has already appeared in the March number of the Chemical Society's Journal. Messrs. Hlasiwetz and Kachler, in a postscript to their paper on a new derivative of sulpho-carbaminic acid, mention the discovery of the body in question by Zeise in 1842. H. Ranke finishes the number with some experimental proofs of the possibility of the spontaneous combustion of hay.

Reale Instituto Lombardo di Scienze e Lettere Rendiconti, serie ii. vol. vi. Fascicoli x.—We notice papers on *Pelobates fuscus*, by Prof. Emelio Cornalia; on the Italian earthquake of March 12, by A. Serpieri; on some geological theories, by G. Cantoni; on the inversion of currents in electromotors, by A. Ferrini. Besides these there are papers on Manzoni and on Kant's philosophy, the first by A. Buccellati, and the second by C. Cantoni. Fascicolo XI. contains only social papers, none of scientific interest. In Fascicolo XII., S. A. Lemoigne contributes a paper on the mechanism of rumination, and J. A. Serpieri one on the earthquake of March 12; S. A. Cantoni has a paper on the molecular movements of gases. The rest of the number is devoted to the section of moral and political science.

IN the *Annali de Chimica applicata alla Medicina* for June is a paper on the cremation of the dead, which practice is strongly advocated. The author, who is anonymous, states that in Belgium 7,500 hectares (1 hectare = 2·47 acres) are unproductive of food, through being used as cemeteries. He estimates the value of this land at from 38 to 40 millions (lire?).

SOCIETIES AND ACADEMIES

LONDON

Royal Horticultural Society, July 16.—Scientific Committee.—Dr. M. T. Masters, F.R.S., in the chair.—A letter was read from the locomotive superintendent of the Brighton Railway stating the results of the company's experience in using a mixture of chalk with coal for fuel. It was found that used for any other purpose than that of saving the fire-bars from Welsh coal (for which it is admirably suited) or for reducing the area of heating surface it increases the ordinary consumption of fuel considerably.—The Rev. M. J. Berkeley showed female flowers of *Lychnis diurna*, in which the calyx was reduced by arrest of development to a mere rim.

August 6.—General Meeting.—W. B. Kellock in the chair.—The Rev. M. J. Berkeley commented upon the fruits and vegetables exhibited. He mentioned the remarkable improvement in the quality of W. Indian pines owing to the introduction from England of the better cultivated kinds.—Prof. Thiselton Dyer pointed out that a curious cucurbit which had lately been introduced, rather as a curiosity than for any useful purpose, under the name of Sooly Qua, was a form of *Luffa ægyptiaca*, the common washing gourd. Another cucurbit known as the Toong Qua appeared to be identical with *Benincasa cerifera*.—A new method of propagating ipecacuanha had been devised in India by Mr. Jaffray, and promised to be of great importance. It simply consisted in striking the leaves upright in pots. These produced roots and the most superficial of these eventually produced buds.—As an interesting fact bearing upon the distribution of plants, an extract of a letter from Mr. Moseley, naturalist on board H.M.S. *Challenger*, was read. A vessel laden with grapes was wrecked on the coast of Bermuda a short time ago.

The boxes of grapes were washed ashore, and the seeds germinated in abundance, so that the governor was able to collect plants for his garden.

BERLIN

German Chemical Society, July 28.—O. Liebreich, vice-president, in the chair.—A. Laderburg described a simple way of obtaining zinc-methyl and its action on silicic ether. The result is a liquid boiling at 150° of the formula $SiCH_3(OC_2H_5)_3$, to which he gives the name ortho-silico-acetic ether. The same chemist, conjointly with Demole, has transformed chlorhydrine into acetochlorhydrine of glycol. The latter by treating oxide of ethylene with aniline has obtained a single base of the formula of phenylated mono-oxyethylene-amine $CH_2OHCH_2NHC_6H_5$.—O. Jacobsen has been able to investigate human bile obtained from a fistula of a strong and healthy man. It contained no taurocholic acid, while other human biles obtained from patients contained both glyocholic and taurocholic acids in variable proportions.—A. Faust has transformed monochlorinated phenol into resorcin (and not, as Peterssen communicated lately, into hydrochinon.—H. Limpricht has compared sulfo-ortho-tolindinic acid, and many of its derivatives, with those of sulfo-pseudo-toluidinic acid.—Thomas Dykes Barry described several derivatives of propiophenone $C_6H_5COC_2H_5$: viz., two isomeric mononitro-propiophenones, amido-propiophenone, and secondary propyl-benzol-alcohol $C_6H_5CH.OH.C_2H_5$.—G. Goldschmiedt, in treating benzol and bromal with sulphuric acid obtained diphenyl-tribrom-ethane $(C_6H_5)_2CH.CBr_3$. This treated with potash yields diphenyl-dibrom-ethylene $(C_6H_5)_2C_2Br_2$, and heated with zinc powder, it is transformed into stilbene $C_{14}H_{12}$.—P. Liechto has determined the atomic weight of molybdenum = 95·86, and describes the following chlorides:—$MoCl_2$, $MoCl_3$, $MoCl_4$, $MoCl_5$, and $MoO(OH)_2Cl_2$.—A. Michaelis and G. Köthe find that iodide of lead treated with sulphite of sodium yields sulphite of lead and iodide of sodium, and that the salt formerly described by Zinero $I_2SO_2(ONa)_2$ does not exist.—A. Michaelis and O. Schifferdecker describe the following compounds of sulphur:—SCl_4, existing only at temperatures below −20°, $S_2O_3Cl_4$, (a solid body obtained by treating SO_3HCl with SCl_4), and its product of decomposition by moist air $S_2O_5Cl_2$.—A. Mitscherlich described a new method of organic analysis. He replaced oxide of copper by that of mercury, weighs the reduced mercury, CO_2 and H_2O in the ordinary way and thus determines the oxygen contained in the substance, as well as the Cl, I, Br retained by the mercury or the sulphur and phosphorus transformed into sulphate and phosphate of mercury.—A. Borodin in treating valeric aldehyde with solid caustic potash at 0° obtained aldolic products of condensation of the following formula; $C_{10}H_{18}O$ $C_{20}H_{38}O_3$. The former left for three years with diluted soda yielded crystals of the composition

$$C_{20}H_{42}O_5 = (C_{10}H_{20}O_2) + H_2O.$$
(polymeric valeral)

C. Engles, by treating monochlorinated acetonitrile $NC.CH_2Cl$. with aniline replaced Cl by NHC_6H_5, thus obtaining a base, anilido-acetonitril.—A. Emmerling and C. Engles have obtained from acetophenone the corresponding pinacone and secondary alcohol.—E. Baumann, by treating cyanamide with sulphuric acid and water, has obtained a body of the composition of urea, but hygroscopic giving a nitrate of a different crystalline form, and a double salt with chloride of platinum, in fact differences that seem to indicate that this body is a new compound isomeric with urea.—E. Mulder described several derivations of uric acid and of urea.—C. Tiemann compared two methods for determining nitric acid in water. The wells of Berlin yield water containing terrific quantities of nitric acid, viz. 17 in 100,000 instead of 0·4 which is generally admitted to be the maximum quantity allowed for drinking purposes. It should be known, however, that the water-works supply the town with river water of good quality.—C. Biedermann showed beautifully coloured salts of mononitrophenol with alkalis and alkaline earths.—W. H. Pike, of London, has succeeded in obtaining some of the higher homologues of oxaluric acid by heating a molecular mixture of urea or sulpho-carbamide with an anhydride of a dibasic acid. The acids already obtained are succincarbaminic acid $NH_2—CO—NH—CO—C_2H_4—COOH$., succin-sulpho-carbaminic acid $OH_2—CS—NH—CO—C_2H_4—COOH$, and citracon-sulpho-carbaminic acid $NH_2—CS—NH—CO—C_3H_4—COOH$.—The next meeting of the society will take place the 13th of October.

PARIS

Academy of Sciences, Aug. 4.—M. Bertrand, president, in the chair.—The following papers were read:—A further portion of M. Hermites' paper on the exponential function.—A reply to M. Vicaire's theory of the sun, by M. Faye. The author controverted the statement that the sun is a cold mass of combustible matter burning at the surface only, in an atmosphere of oxygen.—On the determination of the wave-lengths of the lines in the ultra-violet, and also in the ultra-red parts of the spectrum by means of phosphorescence, by M. Ed. Becquerel.—On the action of armatures applied to compound magnets, by M. Jamin.—On the reciprocal displacements between the hydracids, by M. Berthelot. The author has been investigating the heat phenomena produced by these reactions.—Note on the cubic capacity and on the volume of air requisite to insure the healthfulness of inhabited places, by General Morin. The general gives the results of observations on barracks and hospitals. As regards the former, he thinks that 16—20 cubic metres of space are required per man, equal to 565—706 cubic feet.—The fourth part of M. A. Ledieu's paper on thermodynamics was then read.—An analysis of Dewalgnite from Salm Chateau, Belgium, by M. F. Pisani.—On the Cocuyos of Cuba, by Señor de dos Hermanas. The cocuyo is a luminous insect, said by M. Blanchard, at the conclusion of the paper, to belong to the genus *pyrophorous*, to which also a Mexican insect of the same name belongs.—Memoir on cerebral localisations, and on the functions of the brain by Dr. Fournie.—On polychromic photography, by M. L. Vidal. This was a description of a recently patented method of obtaining coloured prints by the use of various pigments, as in carbon printing.—M. Lichtenstein communicated a paper on the present state of the Phylloxera question, and M. Signoret one on the evolution of the Phylloxera.—Fourth note on the maximum resistance of magnetic coils, by M. T. du Moncel.—On electric condensation, by M. Neyreneuf.—Studies on nitrification, II., by M. Schlœsing.—On the corundum of North Carolina, Georgia, and Montana, by Mr. Laurence Smith.—On Roman essence of chamomile, by M. E. Demarçay.—On the characteristics of the true polyatomic alcohols, by M. Lorin.—On the variation in the amount of urea excreted under normal nourishment, and under the influence of tea and coffee, by M. E. Roux. The author found that these substances very largely increase the amount of both urea and chlorine voided in the urine, if they be taken after abstinence from them, but that when continuously used, the quantity gradually returns to its normal amount. Hence he regards this action as that of the washing out of accumulated urea.—On the uniformity of the action of the heart when that organ is free from external nervous influences, by M. Marey.—On some effects produced by lightning at Troyes, on July 26, 1873, by M. E. Parent.

PAMPHLETS RECEIVED

ENGLISH.—Improved Method of Recording Telegrams: Richard Herring.—Report of the Radcliffe Observer to the Board of Trustees, read at their meeting at Oxford.

FOREIGN.—Medizinische Jahrbucher heraus geben von der K. K. Gesellschaft der Arzte, redigirt von S. Stricker, Jahrgang 1873, Heft i. and ii. (W. Braunmuller, Wien.).—Ofversigt af Kongl. Vetenskaps Akademiens Förhandlingar, Trettionde Argangen, 1873, Nos. 2, 3, 4 (Stockholm).—Bulletins de la Société d'Anthropologie de Paris, Fasc. i, Jan. et Feb., 1873.

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