THURSDAY, OCTOBER 19, 1882

THE BURMAN

The Burman: his Life and Notions. By Shway Yoe, Subject of the Great Queen. (London: Macmillan and Co., 1882.)

THE author of these two lively little volumes tells us that Shway Yoe is the name he is known by in Burma (Shway means "Golden," and is a common Burmese epithet). He himself writes in the character of a Burman, but Englishmen who have lived in the country say that there is no native capable of having written a page of such a book. Accordingly, while respecting the writer's incognito, we must consider him to be an Englishman who does not care to publish his name; but whoever he is, it is plain he knows the land and its language and ways intimately. To Europeans going there, his work will be a guide of practical value, the more so because their difficulties so often arise from misunderstandings which knowledge of native habits would prevent. For example, an Englishman, eager to push forward on his journey on a Saturday, is furious because his servants cannot be got to buy bullocks for the cart till next day. He declares it is dilatoriness or the desire to stay and see some feast, whereas the real reason is that the day is unlucky—"it is a matter of conscience, and was taught to the Burman in a rhyme when he was a little boy at school." On the other hand, the Englishman himself gets into trouble when out shooting by going on regardless of a finger-post which gives notice that a monastery lies near, and that animals must not be killed there. While the lay Burmese are generally rather slack in condemning violations by hunters and fishers of the Buddhist law not to take life, and indeed are not averse to enjoying the results in the shape of curry and strong-smelling fish-paste, yet it would be too much to expect such profanation to be allowed under the very eyes of the holy ascetics. Another way here mentioned in which our English officials both take and give offence, really arises out of an idea belonging to the early philosophy of religion having survived with great tenacity in this corner of the globe. The Burmese have not yet come to our advanced opinion that dreams are mere subjective impressions of the sleeper's mind. The animistic view still prevails that dreaming is the actual experience of the person's life or soul, which they conceive to go forth from his body in butterfly-shape, and flutter about; this leip-bya, as it is called, only going to places its owner has visited before, which accounts for dreams being of known localities. The working-out of this theory as to the causes of disease and death (vol. ii., chap. xi.) is a good specimen of the author's style. It is because of the absence of the butterfly that the Burmese (like other peoples in the same intellectual stage) are unwilling to wake a sleeping man, for his spirit might be wandering far away and not have time to get back, so that its owner would fall ill. Foreigners do not always understand this primitive biology.

"An English assistant commissioner rides unexpectedly into a small townlet in his sub-division and calls for the headman. That worthy is having his afternoon siesta, and the good wife announces this with a composure which almost surprises the young sub-janta walla into swearing. He says, 'Well, then, wake him, and tell him to bring his accounts along to the traveller's bungalow.' Old Mah Gyee shudders at the very thought, and flatly refuses. The Englishman gallops off in a fury at the dreadful impertinence of the people, and Mah Gyee calls together all her gossips to hear of the brutality of the young ayaybaing, who actually wanted her to imperil her good man's life. It needs something more than passing examinations and being a smart report-writer to govern the people well."

This dream-theory seems one of the many points of earlier and cruder religion which the Burmese keep up, notwithstanding their conversion to Buddhism. Thus they still propitiate with offerings and prayers the nats or spirits which they regard as swarming over land and water, in house or forest. That this is the old local religion is proved by its prevalence among indigenous tribes who have not learnt Buddhism, or have not assimilated its teachings so far as the Burmese proper. Thus no low class Talaing would think of eating a morsel without first holding up his platter in the air, and breathing a prayer to the village nat; while at the entrance to a Kachin village may be seen not only the remains of food and drink put out for the spirits, but even axes and choppers for them to fight with, and all this not for the love of these beings, but to give them whatever they want, so that they may let the villagers alone. It is not surprising that the subtle metaphysics of Buddhism should be over the heads of the uneducated in Burma as elsewhere. Thus Buddhist doctrine does not recognise a separate surviving soul after death. Physical individuality ceases at a man's death and dispersion into the elements, but a new personality arises in the being which succeeds him, conditioned by *karma* (Burmese *kan*), the result of the deeds of the whole line of predecessors. European students like Rhys Davids may well admire this speculative attempt to account by a chain of causation for each man's disposition and character, and may notice its foreshadowing of modern evolutionist ideas of inherited characters; but the tillers of the paddy-fields of the Irrawaddy must find much easier the simple physical conception of a dream-soul.

In the more learned Burmese monasteries Buddhist doctrine is studied, and scholars may be found to discuss the distinction between karma and transmigration of souls, or to show that *nirwana* (Burmese *neh'ban*) is not annihilation, as so many Europeans erroneously suppose. The author even claims "that at the present time Buddhism exists in Burma in a form much nearer to that which Shin Gautama taught than is found in any country where the Three Precious Things are held in reverence." Now Burmese Buddhism is doubtless purer than that of the gross and dull Tibetans, but it is setting the disciple above the master to put it thus into competition with the Buddhism of Ceylon, whence the Burmese received the missionaries and had translations of the Pali books. As to the moral rules which even more than philosophic beliefs are vital to Buddhism, their effect doubtless still manifests itself in a mildness and kindliness of life controlling the natural character, which is described as hot-blooded and combative. But the observance of the moral precepts has fallen so much away from the original standard, that we have here an instructive example of religious decay in the sophistry by which they are kept in form while violated in reality. Buddhists who lead the ascetic life are bound to support themselves by carrying round the almsbowl from house to house, not asking for anything, nor going to the doors of the rich rather than the poor, but taking what is given, and eating with loathing so much as is necessary to prevent death. The alms-bowl is still the sign of the holy man, and he carries it round, but it is only in the severest monasteries that he really eats the indiscriminate bits of fish and flesh and handfuls of rice and mango. The mess generally goes to the little boy-scholars, and after them to the crows and pariah dogs, while the monks set to on a comfortable hot breakfast in the monastery. With like ingenuity the ascetic will sit with his back to the sun, so that he does not know when it is afternoon, and can take another meal without breaking the law; while some, mindful of the law not to touch money, will wrap their hands in a cloth and then take it. Among the casuistic points which the student of morals finds most curious in theoretical and practical Buddhism is that alluded to already, how in a religion where the taking of life is one of the five great sins, even the monks receive fish and meat in their almsbowls, and every village is pervaded by the smell of nga-pee, which seems to go far beyond that of anchovy sauce, its nearest English correlative. The answer is, that if necessity drives a man to the wicked life of killing animals, he will pay the penalty in ages of misery in future states, but he who eats the meat is no way responsible. Even the fisherman finds his way out of the loose-meshed moral net:—

"Fishermen are promised terrible punishments in a future life for the number of lives they take, but popular sympathy finds a loophole of escape for them. They do not actually kill the fish. These are merely put out on the bank to dry after their long soaking in the river, and if they are foolish and ill-judged enough to die while undergoing the process, it is their own fault."

The passage of which this is part (vol. i. p. 341) may be recognised as coming from Prof. Adolf Bastian's "Reisen in Birma," which forms the second volume of his "Voelker des Oestlichen Asien." Of this important book, which has not been translated into English, the present author has in several places made use.

It is not only through Buddhism that Hindu influence has acted on Burma; indeed in one way or another, three-fourths of its civilisation seems to have been borrowed from India. This accounts for various popular superstitions, familiar in Europe as belonging to the Aryan nations, re-appearing among this Mongoloid race of South-Eastern Asia. Thus as the ordeal by water has in India the authority of the Code of Manu, it is not surprising that ducking witches is a mode of trial familiar to the Burmese; our officials now prohibit it in British territory, possibly not telling the natives how lately we did it ourselves. Another superstition here noticed, is that a Burmese prizes a child's caul as much as an English sailor does. The one may expect by its means to gain the favour of some great man, while the other carries it to save him from drowning; but these are only particular ways in which the mysterious envelope exerts its general power of giving protection or luck. It would be interesting to learn whether the Burmese have the idea of its being the abode of the child's soul or guardian spirit, which may be the source of the whole group of beliefs. The system of magic, mostly astrology, which stultifies so much of the life of the Burmese, seems almost entirely Hindu, in fact the court astrologers are a caste of Brahmans. One of their chief proceedings is to connect the days of the week in all sorts of ways with men's lives The Hindus learnt the week and its seven planet-named days through the Greek-Roman astrologers, perhaps not much earlier than our ancestors did, but while among us its astrological significance only survives in such folklore rhymes as "Monday's child is fair of face," &c., in Burma it regulates even the children's names. The letters of the alphabet are grouped in connection with the planets and their days, so that for instance a child born on Sunday must have a name beginning with a vowel, as Moung *Ohn* (Mr. Cocoanut), Ma *Eh* (Miss Cold), or Oo *Oh* (Old Pot). Thus people's names not only give the magician information as to their planets, characters, and fates, but they even determine what couples may not marry, for instance, a Friday's daughter must not marry a Monday's son, for their life would be short. Thus, too, their names will direct the doctor how to diet them when sick, as for example the Sunday-born persons whose names are given above would have to avoid food beginning with a vowel, as eggs (*oo*) or cocoa-nuts (*ohn*).

It is not our province to discuss the chapters relating to practical politics, such as the rice-trade, the annexation-question, or even the great shoe-question which weighs so heavily on the local diplomatic mind. But two more subjects may be mentioned as interesting from the anthropological point of view. One is the recognition of dancing as a direct expression of emotion (vol. ii. chap. i.).

"If a great man wants dancing he hires people to do it for him. If indeed he becomes greatly excited at a boat race, a buffalo fight, or a religious procession on its way through the town to the pagoda, he may tuck up his pasoh tightly round his thighs and caper away till his bare legs tire, but he does so ordinarily with a ludicrously solemn aspect, as if the performance were a part of his official duties, and to be got through with as much stately dignity as the dispensing of justice from the magisterial bench. It is a concession to the excitability of his nature, and he would be very much offended if next day, when he had calmed down to his ordinary composed demeanour, an Englishman were to compliment him on the agility he displayed, or the complexity of his evolutions on the previous day."

The other subject to be referred to is tattooing, which is a fine art in Burma as elsewhere in this part of Asia. A lad does not consider himself a man till he has been tattooed from waist to knees with what looks like a pair of drawers embroidered blue with elephants, apes, and tigers. The operation is so painful that opium is usually taken to deaden the pain. The instrument is a steel point, split to hold the lampblack, this pricker being fitted in a weighted holder two feet long. Besides these figures done for decoration, charm-figures and magic squares are pricked in for love-charms, or to preserve from snake-bite or drowning. It is the more interesting to read these details, as there has for some time been an extraordinary specimen of Burmese tattooing to be seen in England, namely, the "Tattooed Man," who was some while since exhibited at the Westminster Aquarium, and who is an Albanian Suliot named Georgios Konstantinos. Setting aside his mostly fictitious story of having been tattooed as a punishment in Central Asia, the fact is that his decoration with some 400 figures all over his body except the soles of his feet, was evidently done by Burmese tattooers, and is a masterpiece of their unpleasant craft. There is an account of him by Mr. Franks in the *Journal of the Anthropological Institute* for 1872.

E. B. TYLOR

PROF. STRASBURGER'S RECENT RESEARCHES

Ueber den Bau und das Wachsthum der Zellhäute. Von Dr. Ed. Strasburger, Professor an der Universität Bonn. (Jena, 1882.)

THE work before us is another evidence of Prof. Strasburger's untiring industry and minute research. Interesting as all his books have been, this one may be said to surpass its predecessors in this respect, inasmuch as the questions with which it deals are of such fundamental importance in botanical science. The main object of the researches here published is to throw light upon two difficult and much-discussed points, namely, the intimate structure of organised bodies, and the mode of growth of cell-walls and starch-grains. With regard to the researches themselves it need only be said that they appear to have been carried out with Prof. Strasburger's accustomed thoroughness and accuracy, and that they are abundantly illustrated by beautiful drawings. The conclusions deduced from them are so remarkable that a brief *résumé* will not be out of place.

With regard to the intimate structure of organised bodies, Prof. Strasburger entirely dissents from that view which is known to all botanists as Naegeli's micellar hypothesis.[1] This hypothesis was based upon the phenomena of "swelling-up" which are so characteristic of organised bodies, and upon the optical properties which certain of these bodies possess. Prof. Strasburger points out that swelling-up may be as well ascribed to the taking-up of water between the molecules of the body as to its being taken up between Naegeli's micellæ. He shows also in a striking manner that the double refraction of organised bodies, such as cell-walls and starch-grains, depends upon their organisation as a whole, for when once their organisation is destroyed their double refraction is lost, a result which cannot be explained on the micellar theory since the particles of the disintegrated micellæ would, like particles of broken crystals, still retain their double refraction. According to Prof. Strasburger the molecules of an organised body are not aggregated into micellæ which are held together by attraction, but they are linked together, probably by means of multivalent atoms, by chemical affinity in a reticulate manner. Swelling-up is then the expression of the taking-up of water into the meshes of the molecular reticulum, where it is retained by intermolecular capillarity. The more extensible the reticulum, that is, the more mobile the groups of molecules within their position of equilibrium, the greater the amount of swelling-up. The limit is reached when the chemical affinity of the molecules and the force of the intermolecular capillarity are equal; if the latter exceed the former at any moment the result is the destruction of the molecular reticulum, or, in other words, of the organisation. Protoplasm differs from other organised bodies in that the grouping of its molecules is undergoing perpetual change, the result of this molecular activity being the phenomena which we term vital.

The growth in thickness of cell-walls and of starch-grains takes place, according to Prof. Strasburger, by the deposition of successive layers. Here again he is at issue with Naegeli, who believed that the mode of growth was intussusceptive with subsequent differentiation of layers. It is impossible to go into detail with regard to the observations from which his conclusion has been formed; it need only be said that they are very numerous and elaborate, and that they confirm those of Dippel and of Schimper. Prof. Strasburger goes indeed so far as to say that even the surface-growth of cell-walls is not intussusceptive, but is merely due to stretching. It must be admitted that, assuming that all cellulose is derived from proteid, it is difficult to understand how proteid particles can be intercalated into the cell-wall to become subsequently converted into cellulose, but it is equally difficult to imagine that the wall of large cells, such for instance as an internodal cell of *Nitella* or a laticiferous cell of *Euphorbia*, is simply the much-stretched wall of the small cell from which these originated. Surely the amount of solid substance in the wall of such cells as these increases with its increased surface! Here further investigation is doubtless needed.

There is, however, one point of detail which is of such general interest that it deserves some consideration; it is with reference to the mode of formation of the cell-wall and of the thickening-layers. Schmitz some years ago expressed the opinion that the cell-wall is formed by the actual conversion of a layer of the protoplasm, that is, chemically speaking, by the production of a layer of cellulose from a layer of proteid. With this opinion Professor Strasburger entirely agrees, and he supports it by a number of remarkable observations. When a mass of protoplasm is about to clothe itself with a membrane, the peripheral layer becomes densely filled with minute proteid bodies, the microsomata, and this layer then becomes converted into cellulose. The wall of a young wood-cell of *Pinus*, for instance, is clothed internally with a layer of protoplasm filled with microsomata, which are arranged in spiral rows; the microsomata then gradually disappear, and the layer of protoplasm is found to be replaced by a layer of cellulose, which presents spiral striation corresponding to the previously existing rows of microsomata, and which constitutes a thickening layer of the cell-wall. In cells the walls of which become much thickened, the whole of the protoplasm may be gradually used up in this way. Again, the wall of pollen-grains and of spores is formed from a peripheral layer of the protoplasm which contains abundant microsomata. Its subsequent growth, and especially the development of the asperities which it commonly presents, is effected by the surrounding protoplasm which is derived from the disorganised tapetal cells; this is especially well shown in the development of the epispore (perinium) of *Equisetum* and of *Marsilia*. When an intine or endospore is present, it is produced like the outer coat, from a peripheral layer of the protoplasm of the pollen-grain or spore. Further, the septum which is formed in the division of a cell is

[1] See NATURE, vol. xxiii. p. 78.

produced in the same way. The cell-plate, like the peripheral layer of the protoplasm of a young pollen-grain, contains microsomata which disappear, and it is then converted into a plate of cellulose. Finally, the successive layers of a starch-grain are produced by the alteration into starch of layers of proteid-substance derived from the starch-forming corpuscle (amyloplast).

Besides dealing thoroughly with these main points, Prof. Strasburger touches upon others which are also of great importance. He points out that the starch which makes its appearance in the chlorophyll-corpuscles under the influence of light, is derived from the proteid of the corpuscles by dissociation. The formation of this starch is therefore not the immediate product of the synthetic processes going on in the chlorophyll-corpuscles, but only a mediate product. The processes in question produce proteid. Prof. Strasburger is inclined to accept Erlenmeyer's hypothesis, that methyl aldehyd is formed in the chlorophyll-corpuscles from carbonic dioxide and water, and to believe that by polymerisation a substance is produced which can combine with the nitrogenous residues of previous dissociations of proteid to reconstitute proteid. He does not agree with the suggestion of Loew and Bokorny that the methyl aldehyd may combine with ammonia and sulphur to form proteid *de novo*.

Lastly, Prof. Strasburger makes an interesting suggestion as to the probable physiological significance of the nucleus. He points out that the nucleus cannot be regarded as regulating cell-division, for instances are known of cell-division taking place without previous nuclear division, and, conversely, of nuclear division taking place without cell-division. He is of opinion that the nucleus plays an important part in the formation of proteid in the cell. This view is founded upon the facts that one or more nuclei have been found to be present in the vast majority of plant-cells, that the nucleus is, as a general rule, the most persistent protoplasmic structure, and that it gives the various proteid reactions in a very marked manner. SYDNEY H. VINES

LETTERS TO THE EDITOR

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

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

The Behaviour of Sulphate of Lead in a Secondary Battery

SINCE the meeting of the British Association at Southampton I have made several experiments on the action of sulphate of lead at the negative pole of a decomposition cell, with a view to ascertain, not whether the sulphate was reduced in bulk by the action of the nascent hydrogen, a matter concerning which I had satisfied myself before in the negative, but the less practically important matter whether any *trace* of metallic lead could be obtained upon the negative plate by this action.

I used, therefore, platinum electrodes, immersing them in a paste of sulphate of lead in dilute sulphuric acid. And at the suggestion of Prof. McLeod, in order to obtain sulphate pure and in a fine state of subdivision, I precipitated a quantity from dissolved carbonate.

The paste soon settled down, leaving about a quarter of an inch of clear liquid above it, which was decanted off. Small thick platinum plates stood in the paste about 2 inches apart, and were connected with either three or two Lechlanché cells. When three cells were used, the evolution of gas from both plates speedily scooped out a hole round each filled with only turbid liquid, which was kept agitated by the bubbles.

Under these circumstances a distinct darkening of both plates occurred, and after a day or two they showed a distinct though extremely thin coating of peroxide and of metallic lead respectively. Prof. McLeod had tried the same kind of experiment, and noticed that the darkening occurred more readily on portions of the plate in contact only with free liquid than on those imbedded in paste.

I therefore re-embedded my plates, and employed only two cells to charge them, so that the bubbles might not have power enough to remove the paste from contact with the plates at all parts; under these circumstances the growth of peroxide of lead at the + plate was abundant, so much so that when the plate was ultimately pulled out, it left a black mass behind it, which had penetrated into the white paste; but the growth of the metallic lead on the – plate was even less perceptible than before, and it was evident that the metallic lead was better deposited from the solution than from the paste. It seemed probable, therefore, that though the sulphate is extremely insoluble in dilute acid, yet that a sufficient trace was dissolved to be acted on by the hydrogen, and that as fast as this was decomposed more was dissolved from the large quantity of solid present, provided the liquid was free to circulate and become replenished.

To test this further, I first made a saturated solution of sulphate of lead in the acid, by shaking and stirring it up with the finely divided precipitate for many hours—though ordinary dilute sulphuric acid is probably perfectly saturated without any such treatment—and then electrolysed the clear solution. No effect is ordinarily perceived under these circumstances, and I could perceive none. Hence the quantity dissolved at one time must be something infinitesimal; and it is able to give no appreciable deposit, unless fresh solid is present to replenish it.

Next I took a vessel full of the sulphate paste, but with a third of an inch clear liquid standing above it; and into this clear liquid I dipped the platinum plates, barely letting them touch the pasty mass below. In this position they remained several days connected to two Leclanchés, and the result was a distinct blackening of the – plate with a deposit of metallic lead from the solution; but the + plate scarcely seemed to receive any deposit of peroxide except along its bottom edge, which probably just touched the paste, and which showed a narrow line of deep puce colour. The observation that the – plate received its deposit more easily from the free solution than from the paste, had been previously made by Prof. McLeod. But to get the deposit most quickly, it is best to immerse the plates in the paste, and to cause sufficient gas to be evolved to keep them free from actual contact with it; while at the same time the solution surrounding them is so near a large surface of paste, that it can be very rapidly replenished.

On neutralising the acid with ammonia, so that ammoniacal salts and common salt might be present, in which sulphate of lead is known to be somewhat soluble, the deposit of metallic lead went on with far greater rapidity.

I have subsequently repeated the experiments with a paste of ordinary sulphate of lead, and the results appear to be quite the same. A week's deposit could be dissolved off the negative platinum plate with a single drop of nitric acid, and could only be made to show a faint precipitate when sulphuric acid was added to this solution in a watch-glass.

Moreover, unless the plate were rinsed on extracting it from the paste, the small amount of sulphuric acid clinging to it was sufficient to so whiten the deposit in the course of a night as to make it seem almost as if it had disappeared.

The matter is rather a small one to write so much about, but the behaviour of sulphate of lead in secondary batteries is really of considerable importance, and is at the bottom of a great many of the difficulties which one meets with in practical operations with secondary lead cells.

Moreover, it is only due to Dr. Gladstone that I should say how far I have been able to obtain his results; and he will perceive that if all he asserts is that platinum electrodes do show a nearly infinitesimal tarnish of metallic lead (as I understood him to say at Southampton), then my experience agrees with his. But I think that this is merely due to the partial solubility of the sulphate; and I never find that the reduction is able to spread through the paste in the slightest degree, in such a way as to have any practical bearing on the behaviour of a secondary battery. OLIVER J. LODGE

University College, Liverpool.

On the Conservation of Solar Radiation

IT appears to me a difficulty arises with regard to Dr. Siemens' theory when we consider the original condition of the earth and of the other planets. What, in fact, has become of the great amount of energy which was present in the form of heat in those bodies?

Just as in the case of the sun, the rotation of the earth would produce a continuous cycle current, the decrease of rotatory energy being perhaps counterbalanced by shrinkage, the radiant heat would become transformed into the potential energy of dissociation, and this energy again would be given back to the earth in the form of heat in another part of the circuit where the elements recombine. Now it is quite impossible that the whole of the heat radiated should be used in this way, for after a lapse of years we should find a considerable diminution of potential, or (perhaps) rotatory energy, and we therefore should be forced to the conclusion that the earth became continually hotter. Hence some of the radiant heat escaped must have escaped into space, never to return.

Is it then a feasible solution that more heat is radiating from the sun than is necessary for the dissociation of the elements? If so, then at least we should have a satisfactory explanation of its slowly-diminishing activity. G. B. S.

THE writer of this letter is right in concluding that in accordance with my hypothesis the earth also must throw out a stream of matter equatorially into space; and if your correspondent will refer to my article in the *Nineteenth Century* of April last, he will find that at p. 522 I speak of such a terrestrial outflow, with which I connect the phenomena of Aurora Borealis. If at any period of the world's history the rotatory velocity of the earth has been much greater than it is now, and its surface-temperature sufficiently high to cause ignition of combustible gases, it may be reasonably supposed that it had the power of recuperating its heat of radiation. The amount of heat so recuperated would, under all circumstances, be less than that received back by combustion, and the result of gradual diminution of temperature would be that on a certain day the temperature must have fallen below the point of ignition, from which day forward no further recuperation of heat could be expected. The process of cooling would then proceed at a very rapid ratio, until the surface-temperature had reached another point of comparative constancy, at which the radiation into space was balanced by the heat received by solar radiation, and which is our present condition. C. W. SIEMENS

12, Queen Anne's Gate, S.W., October 16

The Great Comet and Schmidt's Comet

THERE can be no doubt of the elongation of the nucleus of the Great Comet in the direction of the axis of the tail, in which direction it is three times as long as in a direction at right angles thereto.

The place of the comet this morning, at 6h. 0m. G.M.T., was

$$R.A. = 10h.\ 18m.\ 53 \pm 5\ secs.$$
$$P.D. = 103^\circ\ 31'\ 35'' \pm 10''.$$

A neighbouring object was carefully observed, through haze, as a star of reference; its place was

$$R.A = 10h.\ 18m.\ 53s.$$
$$P.D. = 102^\circ\ 30'\ 0''$$

On consulting the Catalogue, it appears there is no star in this place. The object observed was probably Schmidt's Comet, discovered on the 8th of this month, but not since heard of here.

Unfortunately the above are absolute, not differential measures, but they have been corrected by measures of λ Draconis, also observed as a star of reference; its place is

$$R.A. = 10h.\ 4m.\ 46s.$$
$$P.D. = 101^\circ\ 46'\ 27''.$$

WENTWORTH ERCK

Sherrington House, Bray, October 16

[The nearest bright star to Mr. Erck's place is L. 20158, 6·7 mag. in Gould; R.A. for 1882, 10h. 17m. 32s., N.P.D. 102° 47'. λ Draconis is evidently a slip of the pen for λ Hydræ.—ED.]

The B.A. Unit

I WISH to call the attention of readers of NATURE who are interested in the experiments which have recently been made for the determination of the B.A. unit of resistance, to a paper by F. Kohlrausch, read before the Academy of Sciences at Göttingen, September 6, 1882, "On the Measurement by Electrical means of the mean Area of the windings of a Coil." Prof. Kohlrausch has applied his method to redetermine the mean area of the coils of the earth inductor used by him in his experiments on the value of the B.A. unit in 1874. He finds the area of this coil to be 387,200 sq. cm.; the value used in 1874, calculated from the geometrical measurements of Weber in 1853, was 392,800 sq. cm. In consequence the value of the B.A. unit as determined from his experiments requires alteration, and, making the necessary corrections, Prof. Kohlrausch obtains $1\ B.A.\ unit = \cdot 990 \times 10^9 \frac{cm.}{sec.}$, agreeing much more nearly with the values found by Rowland, Rayleigh and Schuster, and myself. R. T. GLAZEBROOK

Trinity College, Cambridge, October 13

The African Rivers and Meteorology

THINKING that the following extract from a letter written from the Niger Delta may be of interest to your readers, I beg leave to offer it for insertion.

"As yet there has been little water in the Niger, the rise up to the present (August 29) has not been over 3 feet in the lower river, and they say no rise has taken place in the upper river as yet. The upper river commences at Locayo, or where the Benue or Chadda joins the Niger, and continues thence on to Timbuctoo. So far as I can foresee, there will be a famine in the Niger Valley this year, as there has been a complete failure of the first crop from drought, and there has been no chance of putting in the second crop for the same reason."

The regimen of the waters of such great rivers as the Nile, the Niger, and the Congo, both as to quantity and periods of rise and fall, must be closely related to the meteorological conditions of the highlands of Africa, so little known to us, so extensive, and as yet so inaccessible for observation. May it not, therefore, be assumed that the comparative and continuous study and observation of those rivers as regards their volumes and periods of rise and fall, would be likely to furnish most valuable data for the prediction or forecast of weather in Europe. Thinking so, I have suggested to my correspondent the advisability of keeping a systematic record of the rise of the river Niger, and, if possible, of the temperature and other conditions of the water, with a view to their utilisation for meteorological purposes, and from this point of view I have thought that the above communication may present some interest. J. P. O'REILLY

Royal College of Science for Ireland, Dublin, October 13

A "Natural" Experiment in Complementary Colours

YESTERDAY evening I was reading Goethe's account of his visit to the falls of Schaffhausen ("Journey to Switzerland in 1797"). After mentioning that the morning was a misty one, and describing the general effect of the cataract, he adds: "Wenn die strömenden Stellen grün aussehen, so erscheint der nächste Gischt leise purpur gefärbt." I had certainly never heard of this phenomenon before, but it naturally occurred to me that it was probably an effect of complementary colours. Less than two hours afterwards I opened NATURE for the week, and found precisely the same phenomenon, with the same explanation as given by Mr. C. T. Whitmell. The point is interesting, as giving testimony to Goethe's close and accurate observation of colour phenomena; while the coincidence involved seems also to be worth recording. WALTER R. BROWNE

October 13

Ventilation of Small Houses

I HAVE been much interested in the reports of the Sanitary Institute. May I call attention to the fact that the majority of the smaller houses in our large towns have no means of ventilation except through the rooms. There are no ventilators or staircase windows, and the back house door opens into the kitchen. In a three-storied house the staircase is lit by the fanlight over the front door and a skylight in the roof, neither of which opens; this arrangement gives little enough light and no air. Can it be healthy? Ought it to be? It is at least most disagreeable. A. H.

October 15

ON THE PROPOSED FORTH BRIDGE

AN interesting account of the plan of the railway bridge for crossing the Forth at Queensferry, as designed by our distinguished engineer, Mr. Fowler, with the association of Mr. Baker, was given by Mr. Baker to the British Association at their late meeting at Southampton. Supported as it was, to the advantage of those present, by the exhibition of the model of the proposed bridge, it must have given extensive information on the character of the structure. Yet it seems to me that, amidst many valuable particulars, on the strength of materials, their mode of application in this instance, and similar important subjects—it would hardly impress sufficiently, upon the minds of hearers or readers, the vastness of the scheme, the novelty of its arrangements, and the dangers (yet untried) to which, conjecturally, it may be subject. I have thought therefore that I might, without impropriety, offer to the editor of NATURE some remarks on points which after careful consideration have suggested themselves to me. For some particulars I am indebted to the courtesy of Mr. Fowler himself, and I greatly value this kindness.

It is known that at Queensferry the separation of the river-banks, or rather that of the piers next to the banks, at the elevation required for the railway, approaches to a mile. This space is divided by three piers (for which there are excellent foundations on rock and hard clay) into four parts, but only the two middle parts concern us now. They are exactly similar, and are treated in exactly the same way; and subsequent allusions, referring ostensibly to one, are to be considered as applicable to both. Each of the three piers is an iron frame, 350 feet high, the central pier 270 feet wide (in the direction of length of the bridge), and each of the others 150 feet. These lofty frames are braced, each upper angle on one side to lower angle on the other side, with no other diagonal bracing, but with a simple tie at mid-height. The lengths of the diagonal bracing are respectively about 430 and 360 feet. The water-spaces between two piers are each about 1700 feet; and the engineering question now is, how this space of 1700 feet (roughly one-third of a mile) is to be bridged for the passage of a railway.

The plan proposed is, to attach to each side of each frame (that is, to each side which will face a traveller entering upon the bridge) a framed cantilever or bracket about 675 feet long (that is, exceeding in length an English furlong by 15 feet), attached at top and bottom to the iron frame above mentioned, but having no other support in its entire length of 675 feet. To give the reader a practical idea of the length of this bracket, I remark that the length of St. Paul's Cathedral, outside to outside, is exactly 500 feet; and thus this bracket, which is to project over the water without any support whatever, is longer than the Cathedral by 175 feet. This in itself is enough to excite some fear, supposing the bracket to support merely its own weight. But further, the bracket bears also the very considerable weight of the roadway and rails. It is also heavily loaded on its point. The two opposing brackets from the two iron frames cover 1350 feet, but the whole space to be covered is 1700 feet, leaving 350 feet yet to be supplied for the support of the railway. To furnish this, a lattice-girder carrying a railway is provided, rather more than 350 feet long, whose extremities rest upon the tips of the two brackets.

This statement is enough, I think, to justify great alarm. No specimen, I believe, exists of any cantilever protruding to a length comparable, even in a low degree, to the enormous brackets proposed here. The only structures of this class, in ordinary mechanics, known to me, are the swing-bridges for crossing dock-entrances, and the like, and these are absolutely petty in the present comparison.

I now advert to the weights of the principal portions of the bridge, and the strains which they will create. I understand that the weight of the two parallel braced sides of one bracket is about 3360 tons, to which is to be added the weight of roadway and rails for 675 feet, on which I have no information. I proceed to inquire what strains, in the nature of horizontal pull at the top of the pier and horizontal push at the bottom of the pier, will be caused by this weight. If the weight were evenly dispersed over the triangular bracket, its centre of gravity would be distant from the pier by one-third of the distance of the point from the pier. But as no vertical bar near the pier is included in the weights above, I must take a larger factor, say $\frac{2}{5}$. The vertical weight being 3360 tons, acting at a distance from the pier of $\frac{2}{5} \times 675$ feet, and the separation of the points of connection with the pier being 350 feet, it is easily seen that the horizontal pull at the top and push at the bottom are each about 2600 tons. The inclined tension along the great upper bar of the cantilever and the inclined thrust along the great lower bar of the cantilever are therefore each about 2670 tons. The extremities of the great upper bar and the great lower bar being connected at the point of the bracket, and (for a moment) no other weight being supposed to act, there is no tension or thrust at that point, and therefore the tension and the thrust increase gradually, according to the attachment of their loads, from nothing at the point of the bracket to 2670 tons at connection with the pier.

But the point of the bracket is permanently loaded with half the weight of the intermediate 350-feet railway, or 363 tons, and occasionally loaded with the whole weight of a railway train, say for a passenger train 150 tons (a mineral train would be heavier). The vertical weight of 513 tons thus introduced would be met by a tension of 1004 tons through the whole length of the great upper bar, and a thrust of 1004 tons through the whole length of the great lower bar. Thus we have—

For the great upper bar, a tension increasing from 1004 tons near its point, to 3674 tons near the pier.

For the great lower bar, a thrust increasing from 1004 tons near its point, to 3674 tons near the pier.

The second of these statements particularly requires attention.

Mechanical students and professional engineers are accustomed to estimate by numerical measure the magnitude of a horizontal or nearly horizontal thrust, but persons in ordinary life scarcely attach a clear meaning to such a phrase. I am therefore compelled to make a somewhat violent explanatory supposition, with the hope that it may convey a practical impression as to the meaning of the statements just given.

The great lower bar is in fact a nearly flat frame, braced from side to side, about 120 feet wide at the bottom, and about 40 feet wide at the top, and 690 feet long. Suppose this structure to be planted vertically, say in St. Paul's Churchyard, without any bars, chains, or any thing else, below its vertex, to prevent motion edgewise, but with bracing (which, under ordinary circumstances, would suffice, but which will be the subject of further remark) to prevent its moving flatwise. Its top would be 310 feet higher than the top of the cross of St. Paul's Cathedral. Suppose a weight of 1000 tons to be placed on its very top, and additional weights (if necessary) to be placed at its sides, till the whole weight pressing the ground is 3600 tons. In this state its condition is exactly that of the great lower bar, as regards the crushing and distorting tendency of the weights (although the upper weight itself ought to be considered as partially protected from lateral movement by the great upper bar). With this enormous load at this stupendous height, would the citizens of London in the Churchyard below feel themselves in perfect security? I think not; and I claim the same privilege of entertaining the sense of insecurity for the proposed Forth Bridge.

The danger arising from the endwise action of so large a force on so long a bar or frame, is produced by the curvature technically called "buckling," and there appears to be fear of its occurrence in various parts of the bracket, and in some parts sequentially, that is to say, that a buckling of a minor order might lead to a buckling of a more important order. Thus, proceeding from the pier, the first support of the great lower bar is by a suspension-rod from the great upper bar; to which, as regards merely the suspension-rod, there can be no objection. But the upper attachment of this suspension-rod is supported by a thrust-rod about 340 feet long. Can this rod be considered safe against buckling? In the total absence of experiment or explanation, I may be permitted to express a doubt of safety. And if that rod fail, the corresponding part of the great lower bar will sink, it will buckle under its enormous end-thrust, and the bridge will be ruined. The second support of the great lower bar depends, in like manner, on a thrust-rod whose length is 240 feet; considerations of the same kind apply to it, though probably in a minor degree.

Experienced engineers must have known instances in which buildings have failed from want of consideration of buckling. The following occurred within my knowledge. When the Brunswick Theatre was built, the construction of its trussed iron roof was greatly extolled, and Mr. Whewell and myself, then residing at Cambridge, and proposing to visit London about the same time, had arranged to inspect the truss. But before we reached London it was ruined. There was no adequate bracing of the principal rafters in the plane of the roof; the suspension of a very slight weight on the great tie caused the rafters to buckle sideways, and the roof fell, destroying the building.

I am not aware whether a theory of buckling finds place in any of the books which treat of engineering in a somewhat mathematical form. But there ought to be such. It can be formed with no difficulty and little trouble, giving such a form of result, that all that will be required in any case, to determine the end-pressure which can safely be applied to the end of a bar, will be expressed in terms of the length of the bar, and the curvature caused by a tranversal strain (determined by simple experiment). This theorem ought to be applied in every instance.

I need scarcely to remark that every construction is liable to chance-errors of unforeseen character, and I think that the proposed construction, which depends for its safety entirely on the maintenance of the thrust-principle in perfection, is more liable than any other to danger from these causes. A rivet-head may slip, or a screw may strip, and all may be imperilled. Robert Stephenson, when building the Menai Bridge, used every caution that an active mind could invent: in particular he provided that the masonry for final support of the tubes should be raised as quickly as possible to take the bearing of the tubes at every moment. Yet an accident, though a small one, did happen. The ends of the tubes were raised by the power of hydraulic presses; the cylinder of one of these presses burst, and the end of the tube fell three or four inches. This minute fall, in the judgment of the attendant engineers, gave a strain to the tube such as it never sustained before or since. (This accident came first to my knowledge in a singular way. With the assistance of my friends, Capt. Tupman, R.M.A., and James Carpenter, Esq., and before having heard of the accident, I made experiments on the state of permanent magnetism of the great iron tubes. One of these showed an anomaly, somewhat similar to that of iron heavily struck. On my mentioning this to Mr. Edwin Clark and others, the phenomenon was at once referred to the accidental shock which I have described.)

Much has been said on the action of the wind, and on the difference of that action upon a suspended bridge, and upon a girder bridge. In regard (first) to the amount of pressure, I refer to a former letter of mine, correctly cited in the evidence before the Committee on the fall of the Tay Bridge, in which I state that the maximum pressure may be more than 40 lbs. on the square foot (I should say more than 50 lbs. for Scotland), but that this action is so limited, both in time and in local extent [and is, I add, so continually varying in direction], that the average of direct pressure probably would not exceed 10 lbs. on the square foot. In regard (secondly) to the difference of wind-action in the two systems of construction;—the immediate effect of the wind appears to me to be a shock, of limited extent, which is much less likely to be injurious on a comparatively flexible frame suspended from above, than on a jointed frame where every joint must be tight, and where ruin will follow disturbance. In the proposed Forth Bridge, however, there is risk of danger of the most serious kind, which may perhaps surpass all the other dangers. It arises from the horizontal action of the wind on the great projecting brackets, and its tendency to wrench them laterally from their attachments. The ruinous force depends, not simply on the magnitude of the wind's pressure, but also on its leverage; as measured by the proportion of the height of the Tay Bridge or the length of the bracket of the Forth Bridge, to the separation (in each case) of their horizontal attachments to the solid piers. This leverage is considerably greater in the instance of the proposed Forth Bridge than it was in that of the unfortunate Tay Bridge; and we may reasonably expect the destruction of the Forth Bridge in a lighter gale than that which destroyed the Tay Bridge.

I may now collect the heads of my remarks on the proposed Forth Bridge:—

I. The proposed construction is, as applied to railway bridges, entirely novel.

II. The magnitude of its parts is enormous.

III. These has been no succession of instances of the construction, with rising degrees of magnitude, which might furnish experimental knowledge of some of the risks of construction.

IV. The safety of the bridge depends entirely on a system of end-thrusts upon very long rods; a system which appears generally objectionable, but particularly so when the length of the rods is very great.

V. No reference is made to theory applied to the buckling of rods under end-thrusts.

VI. The liability to ruinous disturbance by the lateral power of the wind acting with the leverage of the long brackets appears to be alarmingly great.

My own impression is, that the proposed construction is not a safe one, and I should be happy to hear that it is withdrawn.

I refer unhesitatingly to "the Suspension Bridge" as the construction which I should recommend. On this system generally I remark: (1) that I am incredulous as to the oscillation of 8 feet in extent, or any sensible part of it; (2) that if the railway is slightly arched upwards to the degree corresponding to depression caused by an average train, such a train will run on a horizontal plane; (3) that a stiffening lattice may be used with very good effect against vertical oscillations from all causes.

The considerable height of the piers, and the great length of the suspension-chains, are matters to be viewed carefully.

To reduce them as far as possible, I would suggest for examination the following proposals:—

1. Suppose the stone or iron piers to be much lower than in the plans hitherto proposed, and suppose that the top of a pier carries a bracket on each side, so that the great suspending chain passes over the points of the brackets, and its suspending action begins at those points. The bracket frame may be horizontal where it passes the top of the pier; or it may be raised in a horn on each side, and thus adapted to a smaller height of pier. By this construction, with brackets 150 feet long (a trifle compared with those of the proposed cantilevers), the piers may without difficulty be shortened 200 feet, and the acting-length of suspending chain may be reduced 150 feet at each end, or 300 feet over each water-channel. This would leave much liberty in regard to the curvature of the chain.

2. It is very desirable, if possible, to reduce the specific weight of the chains per yard, corresponding to a specified suspension strain. This has been attempted on the Continent by the use of wire, and it has been highly praised for its combination of lightness and strength. The longest carriage-bridge that I have passed (that of Freyburg, 890 feet span) is a wire bridge. I have also crossed the Rhone at Montelimart by wire arches of considerable span. I know not whether this construction has been tried in England. G. B. AIRY

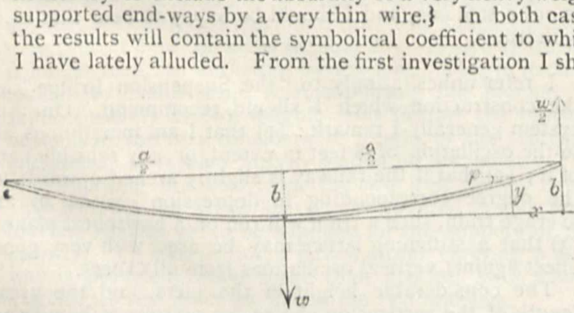
The White House, Greenwich, September 26, 1882

APPENDIX

Having adverted above to the measurement of the endwise or "buckling" force upon a bar, I will here give a theory, by application of which the admissible amount of end-pressure in any case may be ascertained.

The curvature of any point of a bar depends upon the action of two causes. The first cause is the external force, whose angular momentum or effect to bend the bar at any point under consideration is proportional to the product of the force (expressed in multiples of a definite unit—as the pound avoirdupois, or the ton, &c.) by the distance of its line of action from the point under consideration (expressed in multiples of the inch, or the foot, &c.). The second cause is the internal elastic force of the bar produced by curvature, whose tendency is to oppose the bending action of the external force; I shall assume the magnitude of this force to be proportional to the curvature, or inversely proportional to the radius of curvature, at the point under consideration, its coefficient being for the present expressed only as a symbol. The effects of these two causes balance in a quiescent position of the bar, and they must therefore be made algebraically equal.

The course of investigation will now be as follows:—First, I shall give the equation between force and curvature when a bar is bent by a transversal force, acting at the middle of its length. Second, I shall give the similar equation when a bar, at least slightly bent, is exposed to an end-wise force. {The condition "slightly bent" is necessary to exclude the absurdity of a very heavy weight supported end-ways by a very thin wire.} In both cases the results will contain the symbolical coefficient to which I have lately alluded. From the first investigation I shall



deduce the value of that co-efficient. I shall substitute it in the result of the second investigation; and finally, shall obtain a most convenient expression for the largest admissible force acting endwise on the bar.

(First). Theory of a bar supported at its ends and bent horizontally by a force applied to the middle of its length. The symbols are sufficiently explained in the diagram. It is indifferent, practically, whether the support of either end of the bar against the force w be a pin (as on the left side), or a force $\frac{w}{2}$ (as on the right side); the latter is the more intelligible. We shall limit our attention to the right-hand half, as the algebraic expressions can be continuous only for the space between two points of application of forces.

Then the angular momentum round the point p produced by the force $\frac{w}{2}$ is $\frac{w}{2} \times x$, tending to throw the point of the bar upwards.

The angular momentum in the opposite direction, produced by the elasticity at p, is proportional to $\frac{1}{\text{radius of curvature at } p}$, or (if the flexure is not very large) to $\frac{d^2y}{dx^2}$; and may be called $C.\frac{d^2y}{dx^2}$, C being the coefficient to which allusion is made above.

Therefore $C.\frac{d^2y}{dx^2}$ must $= \frac{w}{2} \times x$, or $\frac{d^2y}{dx^2} = \frac{w}{2C} \times x$.

Integrating, $\frac{dy}{dx} = \frac{w}{4C} \times x^2 +$ constant. To determine the constant, we remark that, when $x = \frac{a}{2}$ the curve is parallel to the line a, or $\frac{dy}{dx}$ is 0; and therefore $\frac{w}{4C} \times \frac{a^2}{4}$ + constant = 0, or constant $= -\frac{w}{4C} \times \frac{a^2}{4}$; and the complete value of $\frac{dy}{dx} = \frac{w}{4C} \times \left(x^2 - \frac{a^2}{4}\right)$. Integrating again, $y = \frac{w}{4C} \times \left(\frac{x^3}{3} - \frac{a^2x}{4}\right) +$ new constant. When $x = \frac{a}{2}$, y must $= 0$; this gives new constant $= +\frac{a^3}{12}$; and the complete value of $y = \frac{w}{4C} \times \left(\frac{x^3}{3} - \frac{a^2x}{4} + \frac{a^3}{12}\right)$. This is to equal b when $x = 0$, or $\frac{w}{4C} \times \frac{a^3}{12} = b$; from which we obtain $C = \frac{a^3 . w}{48 . b}$.

(Second). Theory of the same bar, at least slightly curved, in a vertical position; its lower end supported on the ground, &c., and its upper end loaded with a weight W.

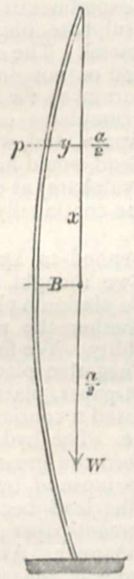
It will be convenient here to take the centre of length of the vertical line for origin of x. As no force or fixation occurs between the two ends of the bar, the same theory will apply throughout.

Here the angular momentum of the weight W on the point p, tending to bend the top to the right, is $W \times y$. The angular momentum produced by the curvature at p, tending to throw the top to the left, is $-C\frac{d^2y}{dx^2}$. {It may be convenient to remember that $\frac{d^2y}{dx^2}$ is here a negative quantity}. To make these balance we have

$$Wy = -C.\frac{d^2y}{dx^2}, \text{ or } \frac{d^2y}{dx^2} + \frac{W}{C}y = 0.$$

The solution of this equation is $y = E . \sin\left(x\sqrt{\frac{W}{C}}\right) + F . \cos\left(x\sqrt{\frac{W}{C}}\right)$: where E and F must be determined to suit the peculiarities of the case. Now, neglecting the weight of the bar (which may usually be done), the curve will be symmetrical above and below; and therefore the value of y will be the same for $x = +e$ and for $x = -e$; e being any number between $-\frac{a}{2}$ and $+\frac{a}{2}$. This cannot hold for $\sin\left(x\sqrt{\frac{W}{C}}\right)$, and therefore we must consider $E = 0$. The solution therefore is restricted to $F.\cos\left(x\sqrt{\frac{W}{C}}\right)$. At the centre of the bar, where $x = 0$, this must $= B$. Therefore the solution is $y = B.\cos\left(x\sqrt{\frac{W}{C}}\right)$.

Now here we have a very remarkable circumstance. It will be remembered that in the first investigation we arrived at a relation between w, the weight, and b, the greatest ordinate of the curve. But here we find no relation whatever; and we come to this conclusion, that for the state of equilibrium fundamentally assumed, the degree of bulge of the bar is immaterial. And this agrees with plain reasoning: by varying the bulge of the bar, we vary in equal proportions, (1) the elasticity which depends on that bulge and on the general curvature, and (2) the distance of the line of action of W from each point p, and its consequent angular momentum; and therefore, if they are equal for one degree of bulge, they



will be equal for every degree of bulge. The value of B, therefore is absolutely indeterminate.

But we do obtain one most important conclusion. When $x = \pm\frac{a}{2}$, y must $= 0$. And since, in the product $B.\cos\left(\frac{a}{2}\sqrt{\frac{W}{C}}\right)$, we are not permitted to make B necessarily $= 0$, we must make $\cos\left(\frac{a}{2}\sqrt{\frac{W}{C}}\right) = 0$. The simplest form of effecting this is by making $\frac{a}{2}\sqrt{\frac{W}{C}} = \frac{\pi}{2}$, or $W = C.\frac{\pi^2}{a^2}$. Substituting for C the value $\frac{a^3.w}{48.b}$, which was found from the first investigation.

$$W = \frac{\pi^2}{48}.\frac{a}{b}.w = 0{\cdot}206.\frac{a}{b}.w;$$

and this defines the limiting value of the weight under which the curved bar can rest. If the weight be diminished, the curved bar will expand and lift it; if the weight be increased, that increased weight will crush down the curve.

It is important to observe that the first and second investigations apply to the same bar. And thus, in order to ascertain the limiting buckling force, we need only to ascertain by experiment on the same bar the amount of bend produced by any convenient transversal force.

In some cases, instead of making the first measure by application of the weight w to act horizontally on the middle of the bar, it may be more convenient to make a measure of the vertical flexure of the bar (supported at its two ends in a free horizontal position), produced by its own weight. The following will be the corresponding theory.

(Third). Use the diagram of the first investigation, but substitute c for b, and put Z for the whole weight of the bar: and estimate the angular momentum round the point p. The reaction upwards of the force $\frac{Z}{2}$ at the pin produces $\frac{Z}{2} \times x$. The action downwards of the weight of bar included between the pin and the point p, which is $\frac{Zx}{a}$, will produce $\frac{Zx}{a} \times \frac{x}{2}$ or $\frac{Zx^2}{2a}$. The combination of these produces the angular momentum $Z\left(\frac{x}{2} - \frac{x^2}{2a}\right)$ upwards. The elastic force produces $C \times \frac{d^2y}{dx^2}$ downwards, where C has the same value as in the first and second investigations. Making these equal, $C.\frac{d^2y}{dx^2} = \frac{Z}{2a}(ax - x^2)$. The first integration gives $C.\frac{dy}{dx} = \frac{Z}{a}\left(\frac{ax^2}{4} - \frac{x^3}{6}\right) +$ constant. At the middle of the bar, where $x = \frac{a}{2}$, $\frac{dy}{dx}$ must $= 0$; the constant therefore equals $-\frac{Z}{a}\left(\frac{a^3}{16} - \frac{a^3}{48}\right)$; and $C.\frac{dy}{dx} = \frac{Z}{a}\left(\frac{ax^2}{4} - \frac{x^3}{6} - \frac{a^3}{24}\right)$.

Integrating again, $Cy = \frac{Z}{a}\left(\frac{ax^3}{12} - \frac{x^4}{24} - \frac{a^3x}{24}\right) +$ new constant. This is to be 0 when $x = \frac{a}{2}$; the constant is found to be $+\frac{Z}{a}.a^4.\frac{5}{384}$. For the value when $x = 0$, and consequently $y = c$, we have $C.c = \frac{5a^3.Z}{384}$, or $C = \frac{5a^3.Z}{384.c}$. Inserting this value of C in the expression found in the second investigation,

$$W = \frac{\pi^2}{a^2}.\frac{5a^3.Z}{384.c} = \frac{5\pi^2}{384}.\frac{a}{c}.Z = 0{\cdot}128\frac{a}{c}Z,$$

where (as before) W is the limit of weight acting endwise on the bar, which the bar can bear without buckling.

If we wish roughly to introduce the consideration of the bar's weight, it will be sufficient to remark that at the lower part of the bar the whole weight of the bar is acting in conjunction with the weight W; and therefore, when we have computed the force (as above) we ought to deduct from that result the weight of the bar, and the residual will be the force which is permissible for action on the top of the bar.

G. B. A.

THE LATE DR. VAN MONCKHOVEN

IN Dr. Désiré Charles Van Monckhoven the scientific world has lost an able coadjutor, and his death is to be the more regretted in that he was taken from his many friends when almost in the prime of life. Van Monckhoven was born on September 25, 1834, and on September 25 of this year he died, having thus only traversed forty-eight years of the threescore-and-ten years to which there seemed every human probability he might reach. At an early age he turned his attention to scientific pursuits, and commenced his career as a chemist, the training for which so eminently fitted him for the active part he took for the last twenty-five years in matters relating to photography. When scarcely of age he wrote his "Traité Générale de Photographie," a new edition of which was called for almost year by year, its popularity being nearly unprecedented. Usually sound in his ideas, we may take it that much of the teaching of photo-chemistry has been propagated through the instrumentality of that work. Not only was Van Monckhoven an ardent experimentalist in the domain of chemical physics, but he also entered into all optical questions bearing on photography with a zeal which those alone who had the pleasure of his acquaintance can estimate. The Monckhoven solar enlarging apparatus is a standing record of his great ability in this department of science. At a very early period of his career he applied the spectroscope to record the effects of light on different inorganic and organic bodies, and his photographic researches on the spectra of gases occupied no inconsiderable portion of his time; his very latest published work, presented recently to the Académie des Sciences, being on the effect of temperature and pressure on hydrogen. Whilst Science, for herself, had charms for Van Monckhoven, yet he was able to put to commercial use much of the knowledge which he had acquired. For instance, he entered with enthusiasm into the mysteries of carbon printing, and established a factory for the production of the necessary tissue. Indeed the Monckhoven's tissue is the only one which enters into any sort of competition with that manufactured by the Autotype Company. Again to perfect the preparation of the latest photographic novelty—gelatine plates—he rushed into researches with all the ardour of an experimentalist, and having more or less mastered its intricacy, he established a manufactory for their commercial issue, and probably the Monckhoven plates are better known on the Continent than any other. Van Monckhoven, besides being the author of the treatise on photography, contributed many memoirs to various periodicals, amongst which we may name *La Lumière*, *Le Bulletin Belge*, and *La Revue des deux Mondes*. His style was vigorous, and everything he had to say was written with a terseness which many a busy scientific man may envy. In reviewing Van Monckhoven's life we cannot point to any great discovery or to any startling inventions he made, but he was one of those men who are so useful to science, giving, as it were, the decorations to the more solid building. We are sure that though there may be greater names, there is scarcely one which is more universally known than his, and whose loss will be more universally felt. There are not many who can claim to be distinguished as an astronomer, a chemist, an optician, and photo-chemist, Van Monckhoven could make good his claim to such distinction, and withal to be a busy man in the world of commerce.

Within a short time of his death he was engaged in an important research on the influence of pressure and temperature on the spectra of gases, in which he had introduced quite a new method of attack, and one which promised to be of great value.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS

PART IV.—*The Function of Sulphate of Lead*

IN our previous communications on the chemistry of the lead and peroxide batteries we have frequently remarked on the formation of lead sulphate and its importance in the history of a cell.

In Part I. (NATURE, vol. xxv. p. 221) we showed that the local action that takes place at first energetically between the metallic lead and the peroxide is gradually diminished by the formation of sulphate of lead.

In Part II. (vol. xxv. p. 461) we stated that in the original formation of a Faure cell sulphate of lead is oxidated on the one plate and reduced on the other. We also described an experiment in which two platinum plates were covered with lead-sulphate, immersed in dilute sulphuric acid, and placed in the circuit of a galvanic current; the result being that "the white sulphate was decomposed to a large extent on each plate, the positive being covered with deep chocolate-coloured peroxide, the negative with grey spongy lead."

In Part III. (vol. xxvi. p 251) we showed that on the discharge of a cell, lead sulphate is the ultimate product on both plates.

It might naturally be inferred from our previous statements that in the re-charging of a cell this lead sulphate would be oxidated on the one plate and reduced on the other as in the original formation. This matter, however, has given rise to some controversy. All subsequent experimenters admit the *oxidation* of the lead-sulphate, but Dr. Oliver Lodge could not obtain any reduction of it, when pure sulphate was employed. Sir William Thomson also, when experimenting, with two platinum plates and layers of sulphate, obtained only a doubtful indication of reduced metal. The question as to whether the sulphate is reduced or not on re-charging a Faure cell is one of vital importance; for if the sulphate formed at each discharge accumulates on the positive plate it would clog up the space, and, what is perhaps worse, a fresh surface of the lead would have to be oxidated (or rather, converted into sulphate) at each discharge. Thus the positive plate will be continually corroded, and its life will be limited.

We have already replied to Dr. Lodge in NATURE (vol. xxvi. p. 342), but we thought it desirable to repeat the experiment with the platinum plates, especially with a view to determine whether the reduction was effected slowly or with any rapidity. We fastened 20 grms. of the white sulphate upon a negative plate by binding it round tightly with parchment-paper, placed it vertically in the sulphuric acid, and passed a continuous current of somewhat under an Ampère. The hydrogen was at no time wholly absorbed—indeed the greater part of it certainly escaped—but after the lapse of twenty-four hours, small patches of grey metallic lead became distinctly visible through the wet parchment-paper; and these gradually spread in an irregular manner. At the end of ten days it was found that the whole of the sulphate, except a few small patches on the surface, was reduced to a grey spongy mass. Although there could be no reasonable doubt that this was metallic lead, a portion of it was tested chemically, and proved to be such.

It thus appears that the *reduction* of the pure sulphate of lead is an absolute fact, although it does not take place so easily as the oxidation.

In an actual cell the sulphate of lead is of course mixed with other bodies. Thus, in the formation of a Faure battery, the minium is converted by the sulphuric acid more or less completely into peroxide of lead and sulphate. We have already described an experiment in which 4489 c.c. of hydrogen were absorbed on a plate, the materials of which were capable of absorbing only 4574 c.c., if the whole sulphate as well as the peroxide was reduced In our note-book we have the particulars of four other experiments made in each case with the same, or nearly the same, amount of material, in which 4199, 4575, 4216, and 4387 c.c. respectively were absorbed, although perhaps in not one of these cases was the experiment continued until the action was absolutely complete. As, however, it may be objected that the amount of sulphate produced upon these plates was an unknown quantity, we have in a recent experiment treated the minium in the first instance with a considerable amount of sulphuric acid. This gave us a mixture which, on analysis, was found to contain 18·5 per cent. of sulphate of lead. This mixture, when submitted to the reducing action of a current yielded a mass of spongy lead that contained only a mere trace of sulphate.

As it seemed desirable fully to establish the fact that the sulphate of lead formed on the discharge of a cell is reduced in the subsequent charging, we took the quondam lead plate of a fully discharged cell, determined the proportion of sulphate to unaltered spongy lead, and submitted it to the reducing action of a current. The amount of sulphate on the plate before passing the current was found to be 51 per cent., but, after the passage of a current, of about an ampère for 60 hours, not a trace of it remained.

Hence it may be concluded that, during the alternate discharging and re-charging of a Planté or Faure cell, sulphate of lead is alternately formed and reduced on the lead plate, and that the plate itself is not seriously corroded. It would, however, appear desirable not to allow the whole of the spongy lead to be reduced to sulphate during the discharge, for two reasons, viz.: (1) because the supporting plate stands a chance of being itself acted on if there is not a sufficient excess of spongy metal; and (2) because the presence of this excess tends to facilitate the reduction of the sulphate.

We have already shown that sulphate of lead is produced by the local action that takes place between the peroxide and its supporting lead plate during repose. The same local action also takes place during the charging of the plate, as was pointed out in our second communication, and this sulphate is, in its turn, attacked by the electrolytic oxygen. In this way the absorption of oxygen in forming the negative plate ought never to come to an end. In order to see whether this was the case, we allowed an experiment to continue for 115 hours, although the main action was over in about forty hours. For the last two days of the experiment, the amount of oxygen absorbed was pretty constant, being about 9 c.c. per hour, which is equivalent to 0·24 grms. of sulphate of lead formed and oxidated. The whole charge on the plate was forty grms. of peroxide. This local action also takes place during the discharge, as is evidenced by the sulphate of lead formed on the negative plate always exceeding in amount that formed on the positive plate.

Through this local action taking place during the formation of the cell, during repose, and during the discharge, the lead plate which supports the peroxide must be continually corroded more and more; and it is probably due to the insolubility of the sulphate formed that the destruction of this kind of secondary battery is so materially retarded in practice.

J. H. GLADSTONE
ALFRED TRIBE

REFLECTIONS ON READING "DEGENERATION": AN ESSAY, BY E. R. L., F.R.S.

THE Ascidian came down like a wolf on the fold
In the ages ere Earth had grown wrinkled and old,
He peered through the waves with his cerebral eye,
Frisked his tail, and dashed after the innocent fry.

Like the leaves of the forest when Summer is green
That gay host of youthful Ascidians was seen,
Like the leaves of the forest when Autumn has blown
Their helpless descendants lie glued to a stone.

For the Angel of Darwin came, gentle and bland,
And lapped them in comfort and fed them by hand,
And their eye myelonic waxed useless and blind,
And their caudal appendage was cut off behind.

And there lies the sea-squirt with gill-slits all wide
And through them there eddies the nutritive tide,
Half mollusc, half vertebrate, solve him who can,
A riddle, a lesson for curious Man.

J. H. P.

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

IX.

23. THE PIGMY HOG (*Porcula salvania*).—Few additions to the Zoological Society's living collection of late years have attracted more attention than the Pigmy Hogs of Nepaul, of which the first specimens ever imported into Europe reached the Gardens in May last.

For our first knowledge of the existence of this diminutive form of the pig-family in the sub-Himalayan forests we are indebted to the researches of Mr. Bryan H. Hodgson, formerly Resident at the Court of Nepaul, who described the Pigmy Hog so long ago as 1847, in an article published in the Journal of the Asiatic Society of Bengal. He named it *Porcula salvania*, from the forest of Saul trees (*Shorea robusta*), in which it is chiefly found. While the Wild Boar, or a species closely resembling it abounds all over India, the Pigmy Hog is exclusively confined, as Mr. Hodgson tells us, to the deep recesses of the primeval forests of the Terai of Nepaul and Bhotan, where it roams about in herds. It is very rarely seen even by the natives. A well-known hunter informed Mr. Hodgson that during fifty years' abode in the Saul forests he had obtained but three or four of these animals to eat, partly owing to their scarcity, and partly to the speed with which the females and young disperse, and to the extraordinary vigour and activity with which the males defend themselves while their families are retreating. Dr. Jerdon in his volume on the Mammals of India, tells us that the full-grown males live constantly with the herd, which consists from five to twenty individuals, and are its habitual and resolute defenders against harm. These animals feed principally upon roots and bulbs, but also devour birds' nests, eggs, insects, and reptiles. The female has a litter of from three to four young ones. Dr. Jerdon adds, that whilst at Darjeeling, he in vain endeavoured to procure a specimen of it from the Sikkim Terai, and Sir Joseph Fayrer, who hunted many years in the Terai, was also unsuccessful in meeting with the Pigmy Hog.

Under these circumstances, it will be readily understood that the authorities of the Society have been much pleased at the recent acquisition of a small herd of these animals, consisting of a male and three females, of one of which we give an illustration (Fig. 23). They were obtained in the Western Dooars of Bhootan after vast trouble and expense, and were brought to England by Mr. B. H. Carew, who has parted with them to the Society. They were caught by Mr. Carew's hunters in snares which were set for them in hundreds, over a range of country twenty miles in extent. Though on their first arrival they were very wild, they are already becoming tame and confidential, and are, it is hoped, likely to breed.

In its general appearance the Pigmy Hog is not unlike a small variety of the common boar, but measures only about 1 foot 2 inches in length, and has but a very small tail. The colour is a nearly uniform brown, slightly shaded with dirty amber. The coat of hair is thin, except upon the back. The Pigmy Hogs will be found by visitors to the Zoological Society's Gardens in what is usually called the Ostrich House, just beyond the Zebra House, where a compartment has been specially fitted up for their accommodation.

[1] Continued from p. 134.

24. THE KOALA (*Thascolarctos cinereus*). For many years was deemed impossible to keep the Koala, or Native Sloth of Australia, alive in captivity. Great and persistent efforts, it was said, had been made by many persons in

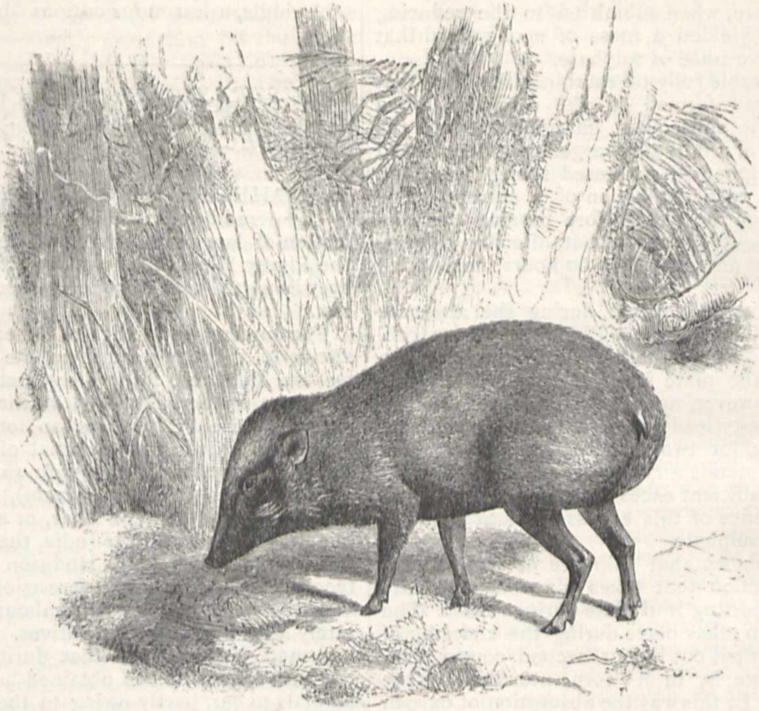


FIG. 23.—The Pigmy Hog.

various parts of the Australian Colonies to induce this curious little animal to submit to confinement. But as they never survived long, even under the most favourable conditions in Australia, it was hopeless to expect that we should ever see this animal living in London.

These prophecies, however, like other forebodings on

FIG. 24.—The Koala.

more serious subjects, have turned out to be fallacious. In April, 1880, the Society acquired a living example of this animal in excellent health. It had been brought home from Australia along with a large barrel of the dried leaves of one of the gum-trees (*Eucalyptus*), upon which scanty diet, however, it appeared to have thriven well during the voyage. On being placed in a compartment of a room fitted up specially for it with branches to climb about upon, and supplied with fresh gum-tree leaves and a little bread and milk, it continued to prosper admirably, until it lost its life by an untoward accident.

The specimen had not been replaced until May last, when a second example, from which our Fig. (24) has been taken, was acquired of a London dealer, and seems, like its predecessor, likely to do well in this country under similar treatment.

The Koala is nocturnal or semi-nocturnal in its habits. In the daytime it is usually seen coiled up asleep on the topmost branch of its cage. In the evening it descends to munch the leaves of the *Eucalypts* provided for its food, but it never seems to be very active in its movements, and does not appear to have much intelligence.

In its native land, as we are told by Gould, in the first volume of his "Mammals of Australia," the Koala inhabits the dense and luxuriant bushes stretching along the south-eastern coast of the continent from Port Phillip to Moreton Bay, and the cedar-bushes of the mountain ranges of the interior. It is apparently confined to the south-east of Australia. It is recluse in its habits, hiding in the day time in the dense foliage of the eucalypti or native gum trees, so that without the aid of the natives it is not easily detected. By these, however, it is readily discovered, and captured by the aid of their waddies or throwing-sticks. It is exceedingly tenacious of life, clinging to the branches after being shot until perfectly dead.

The Koala, when full grown, is about 2 feet in length, and about 18 inches in girth. The limbs are strong and muscular, and the long clawed feet are well adapted to its arboreal habits. On the fore-feet the two innermost toes are so arranged that they form, as it were, a double thumb, and act against the three outer, thus giving to the foot the grasping power of a hand; whilst on the hinder foot the inner toe is very large, nailless, and thumb-like, and acts against the four long-clawed outer toes in a manner resembling that of the thumb. The head is rounded and the muzzle short, the ears are not of large size, their prominent appearance being given to them by the very long hairs with which they are covered. These in the adult are fully two inches in length, and on the outer side of the ears are of the same grey hue as the rest of the body. The fur covering the body is long, soft, and rather woolly; the general colour may be described as ashy-grey, with an under-tint of brown.

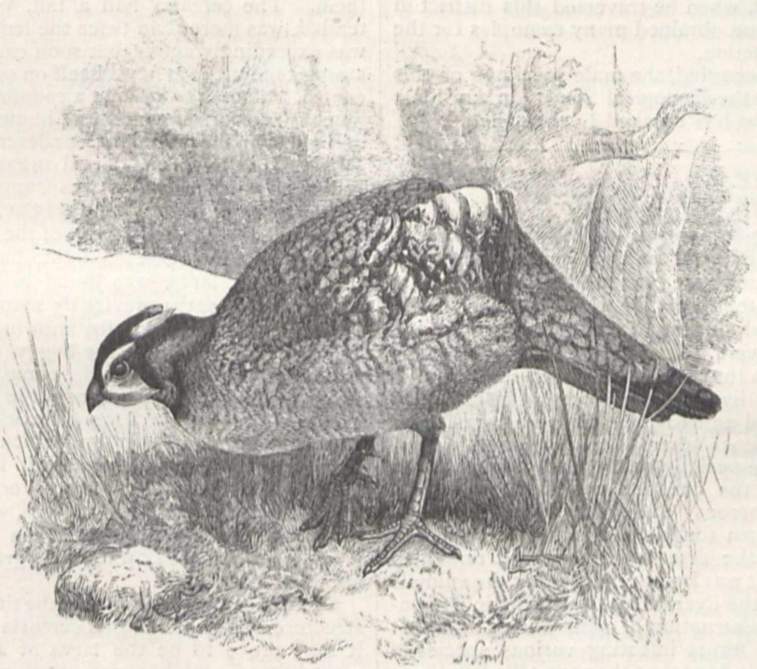


FIG. 25.—The Cabot's Tragopan.

The natives of Australia are said to be very fond of the flesh of the Kaola, and readily join in the pursuit of it; they examine with wonderful rapidity and minuteness the branches of the loftiest gum tree, and upon discovering a Koala, they climb the treee with as much ease and expedition as a European would mount a tolerably high ladder. Having reached the branches, which are sometimes forty or fifty feet from the ground, they follow the animal to the extremity of a bough, and either kill it with a tomahawk, or take it alive.

Thus persecuted by the natives, and driven into the interior by the progress of civilisation, the Koala is now getting rare in many districts near the coast, where it was formerly abundant, and even for Australians the Gardens of the Zoological Society of London will shortly become perhaps the most convenient place to inspect this strange animal.

25. THE CABOT'S TRAGOPAN (*Ceriornis caboti*).—The Tragopans, or Horned Pheasants, constituting the genus *Ceriornis* of naturalists, must be ranked amongst the finest and most brilliantly coloured representatives of the splendid group of Indian game birds. Two of them—the Crimson Tragopan of the Central and Eastern Himalayas, and the Black-headed Tragopan of the Western Himalayas and Cashmere, are well known to Indian Sportsmen, and are familiar objects of pursuit, though we believe, by no means easily procured. The Crimson Tragopan was introduced into Europe by the Zoological Society in 1859, and has frequently bred in their Gardens, as has likewise the Temminck's Tragopan (*Ceriornis temmincki*), first received by the Society in 1864. Of the Black-headed Tragopans a pair was acquired in the spring of the present year, but this species, so far as we know, has not yet reproduced in Europe.

Between the furthest known eastern range of the Crimson Tragopan and the frontiers of China a fourth species of *Ceriornis* has its home. This is Blyth's Tragopan (*C. blythi*), first discovered in the Mishmi Hills by the late Dr. Jordin during his excursion to Assam in 1869, and subsequently met with by Major Godwin-Austen in the Naga Hills, south of the Brahmaputra. Blyth's Tragopan has likewise been once exhibited alive in the Zoological Society's Gardens, an adult male of this fine bird having been presented to the collection by Major Montagu in 1870. Little, however, is yet known of it.

The fifth and last species of Tragopan, which we now figure (Fig. 25), from an example lately acquired by the Zoological Society, is still more rare and little known than the four above-mentioned members of the genus. Cabot's Tragopan, as it is called, was described in 1857 by the late Mr. Gould, and subsequently figured in his great illustrated work on the Birds of Asia. Its habitat is South-Eastern China, but little is yet known of its exact range. The only naturalist who has met with it in its native wilds is the celebrated Chinese explorer, M. le Père David. M. David, in his "Oiseaux de la Chine," tells us that he found this fine Gallinaceous bird rather common in the wooded mountainous range which separates the provinces of Fokien and Kiangsi, when he traversed this district in the autumn of 1873, and obtained many examples for the French National Collection.

So far as has been recorded, the male specimen of this Tragopan, received by the Zoological Society in April last is the only example that has reached Europe alive.

THE ROT IN SHEEP, OR THE LIFE-HISTORY OF THE LIVER-FLUKE

THE winter of 1879-80 was marked by a widely-spread outbreak of the liver-rot amongst our sheep. The losses during that winter were estimated at three million sheep, or about one-tenth of the total number in the United Kingdom, and during the following winter the losses were equally severe. It had long been known that the disease was due to the presence in large numbers of a parasite called the liver-fluke (*Fasciola hepatica*) in the liver of the affected animals, and that the parasite invaded sheep or sometimes other animals allowed to feed on wet pastures, and especially on flooded ground. But notwithstanding that the question had been repeatedly investigated by numerous zoologists, including Prof. Leuckart, so well known for his researches on parasites, the manner in which the disease was incurred remained a complete mystery. It was known indeed that the animals most nearly allied to the liver-fluke, the digenetic Trematodes, presented an alternation of generations, and that they possessed larval forms infesting various species of molluscs. These nurse-forms, as they are called, produce internally larvæ, usually tailed, known as cercariæ, which leave the nurse and encyst themselves in some other mollusc or in aquatic insect larvæ, &c., and remain there quiescent, only reaching maturity if swallowed together with the animal harbouring them by some suitable vertebrate host. Such is a typical instance of the development of a trematode with alternation of generations, but there is a good deal of variety in the life-histories of the different species. It was supposed that the liver-fluke had a somewhat similar life-history, but all attempts to discover what mollusc served as intermediate host had been fruitless.

The Royal Agricultural Society of England was induced by the heavy losses of sheep in 1879-80 to offer a grant for the investigation of the natural history of this most destructive parasite. I undertook the research, and the results of my work during the summer and autumn of 1880 were published in the Journal of the Society for April 1881. Certain slugs had been suggested as probable bearers of the larval form of the liver-fluke, and I was able to show that these conjectures had little evidence to support them, and suggested that *Limnæus truncatulus* was really the intermediate host, or at least one of the intermediate hosts of the liver-fluke. For on the Earl of Abingdon's estate at Wytham, I examined thoroughly a clearly circumscribed area of infection situated on the side of a hill far above the reach of floods, and found that almost the only species of water-snail occurring on the ground was *Limnæus truncatulus*, found in a boggy spot. This contained an interesting form of cercaria, produced in a cylindrical redia, or nurse-form provided with digestive tract.

The free cercaria had a body of oval form, about 0·3 mm. ($\frac{1}{80}$ in.) in length, but was of very changeable shape. The two suckers characteristic of the adult forms of the family of the *Distomidæ* were of nearly equal size, the oral sucker about terminal, and the ventral sucker near the middle of the ventral surface. The anterior part of the body was covered, at least in the most mature examples, with exceedingly minute spines. But the most striking character of the cercaria was due to lobed lateral masses extending the whole length of the body on each side of the middle line. These lobed masses were an opaque white from the multitude of granules composing them. The cercaria had a tail, which, when fully extended, was more than twice the length of the body. It was exceedingly active, but soon came to rest, showing a strong tendency to encyst itself on surrounding objects. It contracted so as to assume a rounded form, and exuded a mucous substance, containing numerous opaque granules derived from the lateral masses described, which were thus shown to be a special larval organ, producing the substance of which the cyst was composed. The tail continued to wag violently, and was at length pinched off as it were by the hardening wall of the cyst. The cysts were snowy white by reflected light, but on rupturing them the included larvæ was found to be quite transparent. I had a few months previously seen a sheep which I had the best possible reason for knowing to be infected with flukes, wandering over the boggy spot from which the snail containing the cercaria came, and the presence of so highly developed an organ for the production of the substance of the cyst in a cercaria which encysted on any plants at hand, seemed to indicate that here was the cercaria of the liver-fluke, and it has since been proved that such was the case. Moreover, I had collected evidence from independent sources, which rendered it probable that the parasite was taken up by the sheep while grazing from the damp roots of grass, most likely in the encysted condition.

Of this cercaria I wrote at the time as follows:—"The structure and habits of this cercaria render it possible that it may prove to be the larva of *Fasciola hepatica*, but want of material has prevented my testing the question by giving the cyst to rabbits. I intend, however, to pursue this case further."

Accordingly, during the summer of 1881, I endeavoured to procure *L. truncatulus* in order to put my strong suspicion to the test of experiment. But I was unfortunately unable to find any, even in the localities where I had found it during the previous year. In my search I had on many occasions the skilled assistance of my friend and colleague Mr. W. Hatchett Jackson, but we never found any other trace of this species than the empty shells. The localities for the snail mentioned by Whiteave in his paper on the mollusca inhabiting the neighbourhood of Oxford, were searched, but without success. My friends at a distance were appealed to, but were unable to assist me. There can be little doubt that the freedom of sheep near Oxford from the liver-rot during last winter was directly connected with the real scarcity of this snail. This year, however, there were floods on the Isis in July, and *L. truncatulus* was brought down by the water in vast quantities, probably from marshy ground far up the river. So numerous were they that I repeatedly obtained as many as 500 specimens at a single sweep of a small hand-net. The low-lying meadows near the river were covered with the flood waters, and when these subsided the snails were left scattered broadcast over the fields. The snail is almost the smallest species of Limnæus; the variety which I found so abundantly was only a quarter of an inch long when fully grown. Although it is a water-snail it lives much out of water. My observations have convinced me that the individuals left by floods on the fields continue to live out of water so long as the ground is moist. Their numbers are recruited by others which crawl out of neighbouring ditches or streams. If a drought occurs they become dormant, but unless too long continued they revive with the first shower of rain.

On discovering these snails I immediately started infection experiments with them, and was at once successful. The adult fluke in the liver of the sheep or other mammalian host produces vast quantities of eggs. So prolific is it that I have estimated the number produced by each fluke to be at least several hundred thousand. The eggs pass with the bile into the intestines and are distributed over the fields with the manure. If the eggs fall on to wet ground, or are washed into a ditch, development continues, and after a time, the length of which depends upon the temperature, embryos are hatched out of the eggs. For the purpose of my infection experiments I obtained eggs from the livers of affected sheep, and kept them in water until the embryos were hatched, and then transferred them to vessels containing the snails to be experimented upon.

The embryo of the liver-fluke has the shape of an elongated cone with rounded apex; its average length is ·125 mm., or about 1/200 of an inch; its breadth at the anterior end about one-fifth of this. The broader end or base of the cone is always directed forwards, and in the centre of this a short retractile head-papilla. The whole of the surface, with the exception of the head-papilla, is covered with very long cilia, by means of which it swims, with head-papilla drawn in, swiftly and restlessly through the water. It is exceedingly active; sometimes it goes rapidly forwards, and then rotates on its longitudinal axis, just turning a little from side to side as if searching for something. At other times, by curving its body, it sweeps round in circles, or, curving itself still more strongly, spins round and round without moving from the spot. The cilia are carried by an outer layer of flattened ectoderm cells arranged in five or six transverse rings around the body, and are of the same length over the whole of the surface. The first ring is composed of four cells arranged around the papilla, and these are thicker than the other outer cells, often forming projections at the side of the embryo and resembling epaulets. Beneath these ciliated cells is the body wall proper, and within this are a number of delicate vesicular cells—the germinal cells. Behind the head-papilla is a rudimentary digestive tract. The body-wall contains, near the anterior end, a double eye-spot, composed of crescentic masses of dark pigment, placed with their convex sides turned towards each other.

When the embryo, in moving through the water, comes in contact with any object, it pauses for a moment, and feels about as if trying to discover its nature, and if not satisfied darts off hastily again. But if the object be a *Limnæus truncatulus* it at once begins to bore. Under ordinary conditions the head-papilla of the embryo is short and blunt, but as soon as the animal begins to bore it becomes longer, conical, and pointed. The embryo spins round on its axis, the cilia working vigourously and pressing the embryo against the surface of the snail. This pressure is increased by the body of the embryo being alternately drawn up and then suddenly extended. As the papilla sinks further into the tissues of the snail it becomes longer and longer until it reaches five times its original length, and the tissues of the snail are forced apart as if by a wedge, leaving a gap through which the embryo squeezes its way into the snail.

The embryo will not bore into all snails alike; the only other species which I have found it bore into from without is *Limnæus pereger*, and even here the specimens have always been such as were still very small. I have found embryos enter certain other snails, such as *Planorbis*, but only from eggs which had been swallowed by the snail and had been hatched in the digestive tract. This difference seems to be due to an instinctive choice on the part of the embryo, rather than to a greater softness of the tissues in *Limnæus truncatulus*. The tissues of *Physa fontinalis*, for instance, appear to be equally soft, but I have found that if these two species are placed in a small bulk of water with a very large number of embryos, the *Limnaei* will be found on dissection to contain fifty or more embryos, whilst the *Physæ* will be entirely free from them.

But although the instinct of the embryo seemingly prompts it to enter the right snail, it does not teach it to discriminate between the different parts of the snail's body, for I have found as many as a dozen embryos within the substance of the foot of a single *Limnæus truncatulus*. Such a position of course is not favourable to further development of the embryos, which, thus gone astray, soon perish.

The natural place for the further development of the embryo appears to be the pulmonary chamber, but they may also be found in the body cavity. Once safely lodged in the suitable locality, the embryo undergoes a metamorphosis. It loses the external layer of ciliated cells and changes from the conical to an elliptical shape. The eye-spots usually become detached, but they, as well as the head-papilla persist, showing the identity of the young sporocyst—for so it must now be called—with the embryo of the liver-fluke. The active embryo has degenerated into a mere brood-sac, in which the next generation is produced. The sporocyst increases rapidly in size, the round, clear cells contained within it increase in number, partly perhaps owing to the division of the germinal cells of the embryo, but also owing to a multiplication and subsequent detachment of the cells lining the inside of the body wall. As growth proceeds the contents of the sporocyst arrange themselves into round balls of cells, the germs of the second generation These germs increase in size, and assume first an oval and then an oblong shape, whilst a delicate cuticle is formed upon the surface. At one end a number of cells are arranged to form a spherical pharynx, which leads into a blind digestive sac. A little behind the pharynx the surface of the body is raised into a ridge, forming a ring surrounding the anterior end, whilst near the opposite end two short processes grow out. The germ has now become a redia, as the brood-sac or nurse-form provided with pharynx and intestine is called. The adult sporocyst is sac-shaped and reaches the length of ·6 mm.: it usually contains one or two rediæ nearly ready to leave, together with two or three larger and several smaller germs. There is another method of increase during the sporocyst stage, namely, by the division of a sporocyst into two others by a constriction separating the original one into two smaller ones. This method of multiplication, however, does not appear to be frequent in this species.

When the redia is ready to come forth, it breaks through the wall of the sporocyst, and the wound caused by its forcible exit immediately closes up, and the remaining germs continue to develop. The injury done by the parasites to the snails causes a serious mortality amongst them, especially at the time the rediæ begin to leave the sporocysts, for the former are much more active than the almost inert sporocysts, and migrate from the pulmonary chamber into the other organs of the snail, and particularly into the liver, upon which they feed. The rediæ can be observed with the microscope, through the trans parent shell, moving in the snail's liver. So great is the injury done, that in the laboratory, at any rate, very few snails survive three weeks from infection.

The redia increases in size, and may ultimately reach the length of 1·3 mm. or about one-twentieth of an inch. It resembles in every respect the rediæ I formerly described as found in the same snail at Wytham. Its contents of spherical cells arranged themselves into round germs as in the sporocyst, though I was able in this case to observe the formation of a gastrula. The germs at first were spherical, they then become oval, and afterwards they elongate still more, whilst one end becomes narrower than the other. The narrower end is partially constricted from the remainder, and, becoming long and slender, forms the tail of the cercaria, whilst the rest of the germ becomes the body. A sucker appears at the anterior end, and another of nearly equal size at the middle of the ventral surface of the flattened body, whilst within a digestive tract appears. This digestive tract is simply forked, and presents no trace of the lateral branches so characteristic of the adult.

The adult redia contains about a score of germs, but these are in very different stages of development. There are generally two or three nearly mature, the others in various stages down to small spheres of cells. Close to the raised ring surrounding the body of the cercaria there is a small opening as in all rediæ, by means of which the cercariae are destined to be liberated one by one as they come to maturity.

But not all the rediae produce cercariae, for they sometimes produce other rediae, and these daughter-rediae then give rise to cercariae. These latter, therefore, sometimes only appear as the fourth generation in the snail, and in one set of experiments I had reason to believe that no cercariae appeared earlier. It will thus be seen that a single embryo may give rise to more than a thousand cercariae.

In April of the present year Leuckart published a paper in the "Archiv für Naturgeschichte," where he described certain experiments on the development of the liver-fluke. He believed that *Limnaeus pereger* was the intermediate host, and had succeeded in infecting this species, though he had failed to rear the redia beyond the stage in which the contents were forming into spores. He had, however, obtained a number of *L. truncatulus* from a friend, and had found in them three different sorts of rediae. One of these contained tail-less distome larvae, and notwithstanding that the characters of the redia were very different from those reared from the embryo of the liver-fluke, he believed the conjecture that this was really the larva of the liver-fluke to be entirely justified until further results were obtained. The second form he considered might possibly be related to the liver-fluke, but the probability was far less than in the case of the tailless form. In his description of the third form I at once recognised the cercaria I had already found and suggested as the larva of the liver-fluke. Leuckart, however, did not consider that there could be any connection, because he failed to detect any spines on the surface of the body such as we should expect, and on account of the lobed lateral organs, which he thought might be the vitellaria of the adult.

I wrote a report of my own results as described above, giving them, however, in greater detail, for the October number of the Journal of the Royal Agricultural Society. This report was sent to the printer on the 1st of September, and a fortnight later received a revision which was merely verbal.

On October 9th a paper by Leuckart appeared in the *Zoologischer Anzeiger*, a periodical which gives rapid publication to important papers. In this Leuckart extends his former results, and states that he too has reared the cercaria of the liver-fluke in *L. truncatulus*, and finds that it is the form with the lobed lateral organs which he had already seen, and supposed to have no connection with the liver-fluke. It will be seen, therefore, that the cercaria of the liver-fluke is really the form found by me in *Limnaeus truncatulus* at Wytham, and described in the Royal Agricultural Society's Journal for 1881. It is interesting to see this result confirmed, not only by my own experiments, but also by Leuckart's independent investigations.

Leuckart has not been able to find any trace in the cercaria of the spines which cover the surface of the adult fluke. He has, however, found in the cells of the cercaria small rod shaped bodies closely resembling bacteria in shape and size, and thinks they may eventually be arranged in bundles and form the spines of the adult. But I have already stated that the anterior part of the body of the cercaria is covered with exceedingly fine spines, which can, however, only be seen in the most mature examples. The reason why Prof. Leuckart could not observe these spines was possibly because his examples were scarcely so mature. The rod-like bodies he mentions have certainly no connection with the spines of the adult. He states that they have never yet been found in other cercariae. I may perhaps be allowed to say that they have been described by three different observers, first by Wagener, then by Filippi in the cercaria of *Amphistoma subclavatum*, and by myself in the cercaria of the liver-fluke (described in April, 1881.

For further details of the structure and natural history of the liver-fluke, as well as the discussion of preventive measures, I may refer to my reports in the Journal of the Royal Agricultural Society.

A. P. THOMAS

University Museum, Oxford, October 13

A NEW CASE OF COMMENSALISM

CASES of Commensalism amongst the higher animals are rare. Those of the Prairie dog and Rattlesnake, in North America, and of the Burrowing Owl and Vizcacha in the Pampas of Buenos Ayres, are, however, familiar instances of it. The newly issued volume of the "Transactions and Proceedings of the New Zealand Institute" contains a communication from Prof. von Haast on a new and interesting case of two very different animals owning a common habitation.

One of these creatures being exceedingly scarce and little known, a few details upon this curious subject will be the more acceptable.

In December 1880, Mr. Reischek (a correspondent of Prof. v. Haast) paid a visit to a cluster of islands, called the "Chickens" situated East of Wangarei Bay on the East coast of the North Island of New Zealand. These Islands are now uninhabited by man but contain numerous remains of Maori Pahs and Kitchen-Middens showing that they were formerly much resorted to by the Natives.

The present inhabitants consist of certain species of birds, of which Mr. Reischek furnishes a list, and of multitudes of the celebrated Tuatara Lizard (*Sphenodon punctatus*)—one of the most anomalous forms of the Lacertian order, if, indeed, we are permitted by Dr. Günther to call it a Lizard at all.

Of these birds certain Petrels (namely *Procellaria gouldi*, *P. Cooki*, and *Puffinus gavius*) live in holes dug out by the Tuataras and keep apparantly on the best terms with them. The Tuatara, we are told, excavates its hole mostly on the western slopes of the Islands. The entrance to its chamber is generally four or five inches in diameter, and the passage leading to it often two or three feet long, first descending and then ascending again. The chamber itself is about one foot and a half long, by one foot wide and six inches high and is lined with grass and leaves. The Petrels and Tuataras have their nests separately, one on each side of the entrance, so that they in no way interfere with one another.

Generally the Tuatara lives on the right side and the Petrel on the left. Mr. Reischek says he sometimes found two Petrels inhabiting their side of the chamber but never two Tuataras together.

He is certain that the Tuataras in most cases excavate the holes as he watched them doing it, and moreover found them in holes only half finished without any birds with them. But there is no doubt that in some instances the Tuataras also inhabit holes dug out by the Petrels. Mr. Reischek likewise gives us some interesting facts about the Tuataras' habits.

During the daytime these lizards are seldom met with outside their holes, and never far from the entrances. But as soon as the sun has set, the Tuatara leaves its hole to seek its food, which consists of worms, beetles, etc. It also feeds on the remnants of fishes and crustaceans brought by the Petrel into the chamber. During the night, a peculiar croaking sound is heard emanating from these lizards, not unlike the grunting of a pig when it is tormented. This is the best time to catch the Tuataras. Mr. Reischek believes that the female *Sphenodon* lays its eggs in February, as in January he found in one of them eight fully developed eggs, and about the same time obtained a young one only eight inches long including the tail.

So little has been hitherto recorded concerning the habits of the Tuatara in a state of Nature that these facts ascertained by Mr. Reischek and communicated by Professor von Haast to the New Zealand Institute must be allowed to be of great interest. Although the Tuatara has not unfrequently been brought alive to this country, and there are at the present time two examples of it living in the Zoological Society's Collection, this reptile is already quite extinct upon the main-land of New Zealand and exists only in some of the more remote islets which border its northern shores.

THE COMET

I SEND a few sketches and a brief account of the comet Cruls. I found the comet at 11h. a.m. September 22, by sweeping the sky near the sun with the 10-inch refractor of the Observatory of Palermo. It was not an easy object to find; it seems but a point with a surrounding nebulosity, and a trace of tail directed to the south-west.

On the following morning the comet had the form (observed by Prof. Zona and myself) of Fig. 1, and preserved it until September 27; the tail was very splendid, inclined 50° to the horizon (that is to say, nearly parallel to the equator), a little convex to the south; the visible

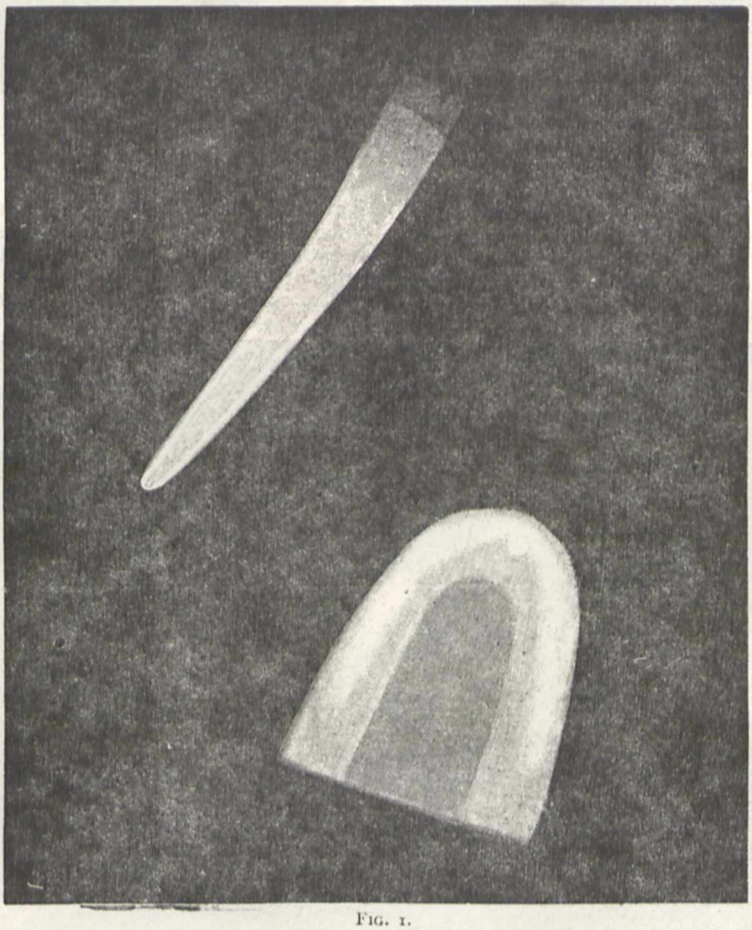


FIG. 1.

length in the glare of dawn and moo . was 6°, and then 10°; the breadth at the top was 40′, and then 1° 18′. The nucleus was round and very brilliant, with a yellowish light.

The spectrum was formed of the linear continuous spectrum of the nucleus, traversed by a large and strong line, that of sodium (D); by enlarging the slit of the spectroscope, I saw a globular, monochromatic image of the nucleus and coma. Besides the line of sodium, many others were present, but my spectroscope not having a

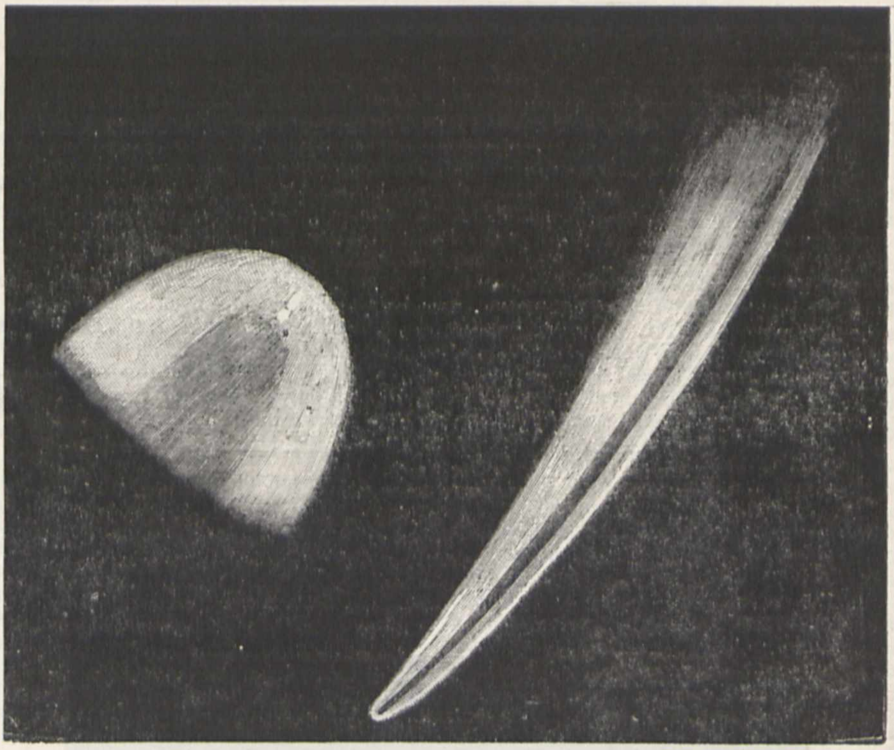


FIG. 2.

micrometer, I did not determine them ; I observed a band in the red, a line in the yellow near and after D, two others in the green, and an enlargement of the continuous spectrum of the nucleus in green and blue.

From the form of Fig. 1, the comet passed to that of Fig. 2 till October 1. The tail was more curved and diverging, inclined to the horizon a little more than 45°; the length was near 15°, the breadth at the top 1° 48′; the south edge was very much stronger and brighter than the north edge; an obscure streak seems to divide the comet through the whole length. The nucleus was less luminous; it appeared double, and lengthened to 25″, having a very brilliant jet directed to the sun.

The comet was not now as yellow as before, and corre-

FIG. 3.

spondingly in the spectrum the sodium line was very reduced and little luminous; but the usual three bands of the hydrocarbons—yellow, green, and blue—were very conspicuous.

From October 1 to the present time the comet approached the form of Fig. 3, which I observed this morning; around the nucleus and very excentrically to the north, it is a faint envelope; at the top of the south edge a sort of horn issued; the north extremity is 1° distant from *a* Hydræ. The length of the tail is 17°, the breadth 2° 48′.

The nucleus is much diminished and little luminous, and the colour of the comet almost white.

Besides the linear spectrum of the nucleus, the three bands of hydrocarbons extend 5′ round the nucleus.

The spectrum of the tail is continuous, and visible to the end.

It is remarkable that the changes of the spectrum (according to Dr. Hasselber's experiments) enabled me to predict that the comet had passed the perihelion before the orbit was calculated.

The beautiful sky of Palermo permitted me to observe the comet Cruls every day except October 5.

Observatory, Palermo, October 11 A. RICCO

NOTES

WE regret that Sir E. J. Reed is confined to bed with severe gout, but are glad to learn, from inquiry last night, that his illness is not dangerous.

THE family of the late Prof. Balfour have presented his scientific library to the University of Cambridge, for the use of the morphological laboratory. It consists of rather more than 500 volumes, and 1100 pamphlets bound in 77 volumes. These include many most important original papers on morphology and embryology, which had been very carefully collected, and arranged according to subjects.

PROF. TACCHINI has recently visited London. We understand that he has been entrusted by the Italian Government with the arrangements for the Italian members of the expedition which will visit the Marquesas to observe the solar eclipse of May 6, 1883. Prof. Trépied, the director of the Observatory of Algiers, who also proposes to observe the eclipse, is now in this country.

WE understand that a new Lecture and Model Room has been appropriated in the Science School at South Kensington to the Metallurgical Department. But notwithstanding the great increase of the accommodation as compared with that formerly provided in Jermyn Street, the class is overflowing, several students having been unable to obtain admission.

ADMIRAL MOUCHEZ has decided to send MM. Henry, the well known astronomers, to the Pic-du-Midi Observatory, in order to report upon the practicability of establishing at this station (altitude 3200 metres) a permanent astronomical observatory. The investigation will extend over six weeks, and the two astronomers may possibly be detained by snow for a longer period.

THE installation of the set of magnetic instruments invented by M. Mascart has been completed, at Parc St. Maur Observatory, twelve miles from Paris. M. Theophile Moreau, one of the physicists of the Bureau Central, has been appointed to superintend the self-registering observations.

THE Conference on Electrical Measurement began its sittings on Monday at the French Foreign Office, under the provisional chairmanship of M. Duclerc, the Prime Minister, who delivered an address of welcome to the delegates and retired, when M. Cochery was nominated President of the Commission. The delegates for arranging for the security of cables afterwards opened their sittings; the two Commissions will meet on alternate days. It is believed the Commission for Electrical Measurements will appoint a sectional committee to conduct the scientific investigation, and that the work of the Cables Committee will be of short duration. A letter was read from Sir William Thomson, excusing the delay in his arrival. He will be in Paris to-day, ready to act in either Congress.

A LETTER received from Mr. Henry O. Forbes, dated July 12 last, announces that he was expecting to be landed next day at Larat, the mainland of Timorlaut on the east side. From all accounts Mr. Forbes was inclined to believe that the natives would be well disposed, and that he would have no difficulty in making collections in this *terra incognita*, towards the exploration of which 50*l*. was granted by the British Association at the Southampton meeting.

IN the neighbourhood of the Thuringian town of Kösen there are some disused saltworks with considerable water power. The latter is now to be utilised for the electric lighting of the town, and Kösen will thus be the first German town to introduce the electric light for illuminating the whole town.

THE foundation stone for a monument in memory of Columbus was laid at Barcelona on September 26.

LAST year an Anthropological Society was founded in Lyons, and the first number of its *Bulletin* lies before us. The Society works on much the same lines as the similar society of Paris. The *Bulletin* contains several good papers. Dr. Arloing writes on the influence of education in the development of the cranium of the dog; Dr. Lacassagne on the progress of criminality in France, and also on the history of sepulture among different peoples; M. Paulet on sepulture among ancient and modern peoples; and M. Lacassagne on tattooing. The Paris publisher of the *Bulletin* is G. Masson.

A SHOCK of earthquake was felt at Panama at midnight, October 12–13. A rather smart shock preceded by thunder occurred on Thursday last on the south side of the Lake of Geneva, between Thonon and Douvaine, and a slighter yet very perceptible shock was felt at Geneva on Friday night. A very distinct shock of earthquake is reported to have been felt at the village of Comrie, Perthshire, on Saturday morning, about three o'clock, and was followed by another and more severe shock about half-past seven. The disturbance was accompanied by a sound resembling the distant booming of a cannon, and appeared to pass from the south-west to the north-east.

THE 6th part of Prof. Dodel Port's "Atlas der anatomischen und physiologischen Botanik" has recently appeared, and the work is thus approaching completion. The new part contains the usual six large coloured plates. They illustrate *Phaseolus coccineus*, L.; *Elodea canadensis*, Gaspary; *Erythrotis Beddomei*, Hooker f.; *Cuscuta glomerata*, Choisy; *Peziza*; and *Endocarpon pusillum*. Parts 6 and 7 of the same author's "Illustrirtes Pflanzenleben" has also just appeared. This work will be completed with Part 10.

HARTLEBEN'S "Chemisch-technische Bibliothek," of which some 100 volumes have now appeared, is no doubt known to many of our readers. This enterprising firm has now entered upon a similar undertaking, viz. an "Elektro-technische Bibliothek," of which the first volume, entitled "Die magnetelektrischen und dynamoelektrischen Maschinen," by Gustav Glaser-de Cew, has just appeared. The "Electro-technische Bibliothek" will, for the present, be completed in ten volumes. The following will be their contents:—Vol. II. The transfer of electric force; Vol. III. Lighting and heating by electricity; Vol. IV. Galvanic batteries; Vol. V. Telegraphy; Vol. VI. The tele phone, microphone, and radiophone; Vol. VII. Galvanoplastics, electrolysis, and the preparation of pure metals; Vol. VIII. The electrical measure and precision-instruments; Vol. IX. The principles of electricity; Vol. X. Electrical formula.

THE encouraging results that were obtained in the way of optical communication between the frontiers of Morocco and the Spanish coast, a distance of about 300 km., have induced the idea of similarly connecting the islands of Mauritius and Réunion, and Mr. Adams (we learn from *Comptes Rendus*) is making preparations in Paris with that object. The principal station in Mauritius will be on the Plateau du Pouce, at an altitude of 750 m.; in Réunion, a spot has been selected near the lip of the crater of Nèfles, at 1130 m. The distance between the two stations is nearly 215 km. (say 134 miles). Mr. Adams is taking out two of Col. Mangin's large telescopic apparatus, with mirrors 0·60 m. in diameter. He means to use a so-called *automatic eclipser*, of the following arrangement:—A rule, with a number of equidistant holes in its upper surface, is moved along horizontally and regularly by a rack and pinion below. Pegs are inserted in certain of the holes, so as to produce long and short eclipses forming the letters of the Morse alphabet, by raising in turn a lever arm connected with a screen, which affects the telescopic apparatus. It is proposed to receive the luminous impression on a band prepared with gelatino-bromide of silver, passed uniformly at the focus of the receiving telescope. From Col. Mangin's experiments it appears certain that a petroleum lamp with flat wick, viewed edgewise, will be sufficient for the signals in question. With this method of signalling, if successful, it will often be possible to telegraph to Réunion the approach of a cyclone, twenty-four to thirty-six hours before it has reached Mauritius.

THE Cambridge University Press will shortly publish an illustrated volume on "The Fossils and Palæontological Affinities of the Neocomian Deposits of Upware and Brickhill," being the Sedgwick Prize Essay for the year 1879, by Walter Keeping, M.A., F.G.S. The "Lectures on Education" delivered before the University by Mr. J. G. Fitch, have now reached a fourth edition, which has lately been brought out at a reduced price for the use of teachers.

ON Sunday, the 8th inst., a large number of botanists in connection with the various natural history societies in the neighbourhood of Huddersfield, assembled at the Sun Inn, Highgate Lane, Lepton, and held a meeting specially for the display of the fungi of the district. The result of the day's hunt was arranged on tables in the large room, and the meeting being open to the general public, a large number of people assembled. Mr. Richard Jessop, president of the Lepton Botanical Society, was in the chair, and this gentleman gave a brief opening address. Messrs. A. Clarke and John Carter, of the Huddersfield Botanical Society, then named and described the fungi exhibited; these included the most known edible and poisonous species, and one plant of considerable botanical interest, viz. *Agaricus brevipes*, Bull. Several large dishes of fungi were then cooked by the landlady of the inn, and tested by the company: the flavour of each species being discussed and compared.

FOUR London Field Clubs, viz. the Hackney, Essex, Highbury, and Walthamstow Societies, visit Epping Forest in the neighbourhood of Chingford, on Saturday next, October 21, under the guidance of Dr. M. C. Cooke, Mr. Worthington G. Smith, Dr. H. L. Wharton, and Mr. J. English.

WE have received the first volume of the Spanish Cyclopædia, which is being brought out at Madrid by Mr. F. Gillman. It contains four extended treatises on Agriculture, Architecture, Anatomy, and Astronomy. The compilation appears to us to be done with care and conscientiousness, and the illustrations are good and profuse. The printing is well done, and the whole undertaking is creditable to Mr. Gillman.

THE chemistry of saké-brewing is described in a long and interesting paper by Prof. R. W. Atkinson, published by the University of Tôkiô as No. 6 of the Memoirs of their Science Department. The consumption of saké in Japan amounts to about six gallons per head per annum. The preparation of this liquid may be regarded as taking place in three stages. (1) Preparation of *koji*: rice is cleaned and the outer skin removed, it is then beaten or trodden with water, and lastly steamed; the embryo is thus killed and germination rendered impossible. The steamed rice is mixed with a little *tane*, a yellowish powder, consisting of the spores of a fungus (*Eurotium oryzæ*), and the mixture exposed on trays for several days, during which time the temperature of the surrounding air and also of the mixed rice and fungus spores rises very considerably. These operations are conducted in underground chambers cut off from the influences of the outer air. *Koji* contains dextrose and dextrin, unaltered starch, mineral matter, and a diastase-like substance or substances; it converts cane-sugar partially into inverted sugar, and gelatinised starch into maltose, dextrose, and dextrin. (2) Preparation of *Moto*: steamed rice, *koji*, and water are mixed and maintained at a low temperature (0°–10°) for some time; the starch of the rice is thus for the most part changed into dextrose and dextrin. (3) Fermentation: the *moto* is heated by placing closed tubs of boiling water in the liquid; temperature rises, fermentation begins, and is continued for twelve or thirteen days by the introduction of fresh heaters; from time to time the mash is divided into portions, each of which is mixed with more *moto*, steamed rice, and *koji*, and then fermented. The fermented liquid is filtered, cleared by standing, and heated in order to prevent it from souring. Saké does not keep for any length of time in warm weather, and must be repeatedly heated by the brewer. The sudden occurrence of fermentation when *moto*, rice, and *koji* are heated is peculiar, as no ferment has been purposely added. Prof. Atkinson is inclined to regard the preparation of *moto* as being analogous to that of yeast in beer brewing; the ferment germs are being derived, he thinks, either from the air or from the grains of *koji* employed in the first part of the process.

MESSRS. SAMPSON LOW, MARSTON, AND CO. are about to publish a cheap edition of the illustrated re-issue of Gilpin's "Forest Scenery," edited, with notes bringing it up to date, by Mr. F. G. Heath, author of "Autumnal Leaves."

IN an interesting article on printing in China, the *North China Herald* says that the first great promoter of the art of printing was Feng Ying Wang, who in 932 A.D. advised the Emperor to have the Confucian classics printed with wooden blocks engraved for the purpose. The first books were printed in a regular manner, and in pursuance of a decree in 953. The mariner's compass and rockets were invented about the same time, showing that at this period men's minds were much stirred towards invention. Twenty years after the edict the blocks of the classics were pronounced ready, and were put on sale. Large-sized editions, which were the only ones printed at first, were soon succeeded by pocket editions. The works printed under the Lung emperors at Hangchow were celebrated for their beauty; those of Western China came next, and those of Fokhien last. Movable types of copper and lead were tried about the same time; but it was thought that mistakes were more numerous with them, and therefore the fixed blocks were prepared. Paper made from cotton was tried, but it was found so expensive that the bamboo-made paper held its ground. In the Sung dynasty the method was also tried of engraving on soft clay and afterwards hardening it by baking. The separate characters were not thicker than ordinary copper coins. Each of them was, in fact, a seal. An iron plate was prepared with a facing of turpentine, wax, and the ashes of burnt paper. Over this was placed an iron frame, in which the clay types were set up until it was full. The whole was then sufficiently heated to melt the wax facing. An iron plate was placed above the types, making them perfectly level, the wax being just soft enough to allow the types to sink into it to the proper depth. This being done it would be possible to print several hundred or thousand copies with great rapidity. Two forms prepared in this way were ready for the pressman's use, so that when he had done with one he would proceed with another without delay. Here is undoubtedly the principle of the printing press of Europe, although western printers can dispense with a soft wax bed for types and can obtain a level surface without this device. Perhaps the need of capital to lay in a stock of types, the want of a good type-metal easily cut and sufficiently hard, and the superior beauty of the Chinese characters when carved in wood have prevented the wide employment of the movable types which are so convenient for all alphabetic writing. The inventor of this mode of printing in movable types five centuries before they were invented in Europe was named Pi Sheng.

THE manner in which the Chinese Government render the popular deities subservient to political ends has been noticed by Sir Alfred Lyall in a paper in the *Fortnightly Review* in the beginning of the present year. In a recent *Peking Gazette* we find an instance of how a deity is raised in rank for presumed public services. The military governor of Urumtsi prays the Emperor to confer a tablet on the deities of a mountain in his district, in recognition of various acts of supernatural interposition. In this mountain there is a large lake of unfathomable depth, upon the waters of which the inhabitants of the whole surrounding country rely for the irrigation of their lands. Of recent years, however, it appears the springs had shown signs of exhaustion, and much anxiety has been felt on this account. Last year a temple, dedicated to the divinities of the mountain, was erected, and scarcely had it been completed when the water in the lake rose more than a hundred feet, and has ever since afforded an unfailing supply of water. The assistance of these deities has been invoked with unvarying success on many occasions when locusts threatened to devastate the country, or when snow was urgently needed for the protection of the crops. The memorialist thinks that important services such as these should not go unrequited, and he begs therefore, in accordance with the expressed wish of the inhabitants, to address the Emperor on the subject. His Majesty replies graciously conferring the suggested tablet on mountain divinities.

THE Vienna municipal authorities have established a number of regulations for persons wishing to manœuvre a balloon. They are obliged to prove that they have gone through a course of instruction with a competent aëronaut, and have executed by themselves a number of successful ascents. Persons desirous to be passengers in a balloon are obliged to procure an authorisation from their wife and children, if any.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus* ♀ ♀) from India, presented by Mr. A. Cornet; a Common Paradoxure (*Paradoxurus typus*) from India, presented by Sir Louis S. Jackson, F.Z.S.; a Golden Eagle (*Aquila chrysaëtos*) from Hudson's Bay, presented by Capt. Hawes; five Delaland's Geckos (*Tarentola delalandii*), four Millipedes (*Joulus*, sp. inc.) from Teneriffe, two Sharp-headed Lizards (*Lacerta oxycephala*) from Madeira, presented by Mr. A. D. Bartlett; a Galeated Pentonyx (*Pelomedusa galeata*) from South Africa, presented by Mr. W. A. Watkins; two Black Wallabys (*Halmaturus ualabatus*) from New South Wales, a Dormouse Phalanger (*Dromicia nana*) from Tasmania, a Grand Eclectus (*Eclectus grandis*) from Moluccas, a Red-sided Eclectus (*Eclectus polychlorus*) from New Guinea, purchased; a Rufous Rat Kangaroo (*Hypsiprymnus rufescens* ♂), a Squirrel-like Phalanger (*Belideus sciureus* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY AT CHICAGO.—We have received from Professor G. W. Hough his annual report as director of the Dearborn Observatory at Chicago, for the year 1882. It is mainly devoted to the reduction and discussion of the numerous series of observations on the spots upon the disc of the planet Jupiter, made with the 18½-inch refractor, including measures for position of the great red spot, of equatorial white spots and other markings, and angles of position of the equatorial belt. The observations extend over the period from September, 1879, to March, 1882. Those made in 1879 and 1880 showed that the red spot was retrograding with accelerated velocity, and this drifting has continued with such uniformity, that Prof. Hough considers "the position of the spot at any future period can be very accurately computed." It was found that all the observations could be fairly represented by a period of rotation, varying directly with the time, and the discussion leads to the following formula:—

$$1879,\ \text{September}\ 25 + t \times 0{\cdot}00209\text{s.},$$

which gives 9h. 55m. 35·9s. for the mean period between September 25, 1879, and March 29, 1882, comprising 916 days, or 2214 rotations of the planet.

Hence it is inferred that the apparent rotation-period has increased about four seconds since the opposition of 1879, showing a total drift of the red spot in longitude of 40,000 miles; and Prof. Hough regards his observations as evidence that the great red spot is not the solid portion of the planet. "An immense floating island," nearly 30,000 miles in length, and more than 8000 in breadth, has "maintained its shape and size, without material change, during more than three years." He has failed to recognise any fading of the colour of the spot, which on February 2 in the present year he judged to be a light pink, as formerly. Although the dimensions of the spot may not be said to have materially changed, the micrometrical measures do indicate a diminution in length to the extent of 0″·95 between the oppositions of 1879 and 1881, at which latter epoch it was 11″·30 (reduced to Jupiter's mean distance).

The direction of the south edge of the equatorial belt was nearly parallel with the planet's equator, as given in Marth's ephemeris; the north edge of this belt was found to be slightly concave.

The elliptical white spots were more numerous in 1882 than previously; but with the exception of two situate south of the red spot, they were seen with difficulty, and were only measurable under best vision. The two spots named were observed systematically during the three months from November 21, 1881, to February 23, 1882. The following of the two appeared to be at rest relatively to the red spot from November 22 to December 6, and subsequently to drift in the direction of rotation to the extent of about 41°; the average drift during the last two months was at the rate of fifteen miles per hour. The preceding spot also did not retain the same relative position in longitude with respect to the great red spot. Prof. Hough adds: "The observations of the small white spots during 1880 and 1881 prove that the whole surface of the planet outside the margin of the equatorial belt rotates with nearly the same rate." The approximate rotation-period for the principal white spot between the edges of the great equatorial belt was 9h. 50m. 9·8s. from observations over more than eight months, which is the same as for the second spot observed during 1880. Hence these equatorial white spots drift in the direction of the planet's rotation, at about 260 miles per hour, or through a complete revolution in about 45 days.

Twelve tinted drawings of the appearance of the disc of Jupiter accompany the report. The first of two made on July 3, 1880, shows the second satellite just entering on the great red spot at 15h. 43·5m., and the other, made nine minutes later, shows it nearly over its centre. A notch was formed so soon as the satellite touched the end of the red spot, and when completely entered, it appeared as white as when outside the planet's disc.

Mr. S. W. Burnham, who was at the Washburne Observatory during the summer of 1881, has returned to Chicago, and has recommenced his valuable measures of double stars with the large refractor. The present report has an engraving of this instrument, and of the tower of the Dearborn Observatory, in which it is mounted.

COMET 1882 *b* (FINLAY, SEPTEMBER 8).—The following positions of this comet are deduced from the elements published in NATURE last week :—

At 18h. Greenwich M.T.

	R.A. h. m. s.	Decl. ° ′	Log. distance from Earth.	Log. distance from Sun.
Oct. 19	10 13 22	−15 7·3	0·1592	0·0466
21	10 10 39	15 54·2	0·1613	0·0640
23	10 7 53	16 40·4	0·1633	0·0804
25	10 5 3	17 26·0	0·1651	0·0959
27	10 2 8	18 11·0	0·1666	0·1106
29	9 59 7	18 55·5	0·1679	0·1247
31	9 55 59	−19 39·6	0·1690	0·1382

CHEMICAL NOTES

MM. HAUTEFEUILLE AND CHAPPUIS have obtained what appears to be pure liquid ozone, by compressing a mixture of oxygen and ozone at 125 atmospheres, and cooling the end of the capillary tube by a jet of liquid ethylene : on suddenly releasing the pressure, a drop of a very deep indigo-blue liquid remained in the end of the tube. The gas above this liquid was colourless, but as the last traces of liquid evaporated, the gas was seen to have a blue colour (*Compt. rend.* xciv. 1249).

IT is well known that sulphuretted hydrogen produces little or no precipitate in an aqueous solution of arsenious oxide : according to the experiments of Messrs. H. Schulze (*Journal für pract. Chemie*, 2, xxv. 431), such a liquid contains a colloidal form of arsenious sulphide. This colloid may be completely separated from dissolved arsenious oxide by prolonged dialysis ; the solution, if dilute, is scarcely changed by long-continued boiling ; the presence of free acids or of such soluble salts as chloride of potassium, iron, or chromium induces a change of the colloidal into an insoluble form of arsenious sulphide.

BY strongly compressing phosphoretted hydrogen in presence of water, and then suddenly decreasing the pressure, M. Cailletet has obtained a crystalline hydrate of this compound, the existence of which is conditioned by the temperature and pressure ; the critical point, *i.e.* the temperature above which the substance cannot exist, whatever be the pressure, is 28°. Hydrates of sulphuretted hydrogen and of ammonia have also been obtained by this method (*Compt. rend.*, xcv. 58).

BY a somewhat similar process, M. Wroblewski has obtained a solid crystalline hydrate of carbon dioxide, $CO_2 . 8H_2O$: the experimental results of this author seem to show that at the pressure required to cause the absorption of carbon dioxide by water in the proportion indicated by the formula $CO_2 . H_2O$, the water would be entirely frozen, and therefore that this hydrate cannot be obtained by this method (*Compt rend.*, xciv, 1355).

"WHEN solution of two salts, capable of mutual action, are mixed, the solution contains four salts" : it has hitherto been difficult to give a direct experimental proof of this generalisation made half a century ago by Berthelot. In the last number of the *Berichte* of the German Chemical Society (15, 1840) Herr Brügelmann describes the following experiments designed to prove the justness of Berthelot's statement :—Equal volumes of cold saturated solutions of cobalt chloride and nickel sulphate are mixed and allowed to deposit crystals by evaporation at ordinary temperatures ; the crystals contain cobalt and nickel, but combined with sulphuric acid only. A mixture of solution of cobalt chloride and copper sulphate, prepared similarly to the preceding, deposits sulphate of the two metals almost free from chlorides. Copper sulphate and potassium dichromate solutions when mixed deposit crystals consisting almost entirely of sulphates of copper and potassium, the second crop of crystals contain a little chromate of the two metals, and the final crop is nearly free from sulphates.

THE "Compagnie Generale des Cyanures et Produits Chimiques" of Paris have issued a small pamphlet explanatory of the various technical applications of the salts known as sulphocyanates, which can be now readily manufactured in a state of purity. Sulphocyanate of aluminium is used as a mordant in alizarine dyeing ; sulphocyanate of copper in the preparation of aniline black, and also, along with potassium chlorate and antimony sulphide, in the preparation of matches ; sulphocyanate of potassium may be employed as a refrigerating material, as during the solution of 130 parts of this salt in 100 parts of water, temperature is lowered through 34° ; sulpho-cyanate of ammonium is more effectual, weight for weight, as an antichlor, than hyposulphite of soda.

INVESTIGATIONS conducted at the Baden Aniline and Soda Works show that the change of orthonitrophenyl-propiolic acid into indigo, which (as already explained in this journal) has been for the most part effected by grapes or with sugar, can also be produced by the agency of sulphides, sulphydrates, polysulphides, thiocarbonates, and especially the alkaline xanthates (*Chemisches Centralblatt*, 1882, 366).

GEOGRAPHICAL NOTES

NEWS has been received from the expedition of Dr. Emil Riebeck, dated July 7 last. It will be remembered that Dr. Riebeck, together with Dr. Schweinfurth made a thorough investigation of the island of Socotra, which was of high scientific importance. After this task was accomplished, the travellers separated, and Dr. Riebeck crossed to Bombay, travelled through large tracts of the Himalaya Mountains, remained for some time in Cashmere, then passed through the Ganges land, investigated Ceylon, and eventually undertook a special and detailed examination of the coast district of Aracan. He ascended the Karnasuli River from Tschittagong as far as the Hill tribes, to which Prof. Bastian has drawn special attention. He made many measurements, took numerous photographs and plaster casts of this highly interesting tribe, which is still living in a most primitive natural state. The climate, however, and particularly the frequent fording of rivers, soon told upon Dr. Riebeck's health. He contracted a fever, and had to be taken to Singapore. His valuable collections of zoological, anthropological, and ethnological specimens duly attracted the attention of geographers, and were frequently referred to at the recent "Geographentag." Since then Dr. Riebeck has continued his journey. Starting from Singapore, he is to follow the eastern coast of the Asiatic continent, then to cross over to Australia and New Zealand, and finally to return to Europe next summer by way of San Francisco and Panama.

To the Berlin Geographical Society the other evening, Major von Mechow gave some account of his explorations during the last year or two in the region of the Coango. Leaving Berlin in September, 1878, accompanied by a ship's carpenter and a gardener, Major von Mechow arrived at Dundo on the Coanza in the following January ; but, owing to various difficulties, it was the beginning of 1880 before he could start northwards into the interior at the head of 115 native carriers. Crossing and re-crossing the Cambo, and passing through various powerful and hospitable tribes, the German traveller, after a thirty-seven days' march, at last reached the Coango on July 19, 1880, and, under the guidance of the great chief Tembo Aluma, visited the magnificent Succambondu waterfall, which he named after the Emperor William. After canoeing it on the Coango for twenty-five days, Major von Mechow made a detour to pay his respects to the great Muene Putu Kassongo, by whom he was received in great state, and returning on September 19 to the river, he followed it to longitude 5 deg. 5 min., from which point the fear of his followers of the neighbouring cannibals compelled him to return. In forty-five days he again reached the abode of Kassongo, where he stayed some time, and at last arrived on February 20, 1881, at Malange, where he met his returning countryman, Dr. Buchner, as well as Herr Pogge and Lieut. Wissmann, who were both starting on a similar tour of exploration.

A GERMAN edition of Amici's "Morocco" has been published by Hartleben of Vienna. Herr von Schweiger-Lerchenfeld is the editor, and has to a considerable extent remodelled the work, adding interesting ethnographical and historical notes, and omitting passages and references which in the original work can only interest Italian readers, on account of their purely private and local character. Its scientific value is also considerably increased. Two new chapters have been added, one on Southern Morocco, the other on the war between Spain and Morocco in 1860, and these are not the least attractive ones in the book, quite apart from the geological interest attaching to the first one. Herr von Schweiger-Lerchenfeld describe Rohlfs' journeys in 1862 and 1864, the Oases of Tafilet and Boanan, the Draa district, the extreme south-western coast districts, the Wadi Sus valley, the journeys from Ktaua to the southern frontier, and from Tafilet to Igli, the Saura river, Beni Abbes and Karsas, the journey to the oasis of Tuat, In Salah, and numerous other subjects of geographical interest. His descriptions are graphic and full.

NEWS of the Danish Arctic Expedition has been received at Copenhagen, Tuesday night, up to September 22. The Expedition was then ice-bound near Mistni Island; but it was confidently hoped that the vessel would get free, and in any case there appeared then to be no danger.

AT its last sitting, the Geographical Society of Hamburg resolved to despatch a new expedition into the centre of East Africa. Its chief will be Dr. Fischer, who was one of Denhardt's companions in 1872, and remained behind at Zanzibar when his leader returned home. Dr. Fischer applied this summer to the Hamburg Geographical Society for means to enable him to cross the Snow Mountains, and then penetrate to the north of the Gallas regions, and as the enterprise seemed likely to favour the development of certain branches of the Hamburg trade, a sum of 15,200 marks was immediately subscribed for its furtherance.

THE "Thüringisch-Sächsidsche Verein für Erdkunde" held a general meeting at Kösen on October 1. Prof. Brauns (Halle) spoke on his travels in the mountain districts of Southern Japan; Dr. Nicolai (Jena) on the land and people between the Ruhr and the Wupper; Dr. Assmann (Magdeburg) on meteorological observations made on the summit of the Brocken.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Although the new Statutes have come into force, regulating the courses given by the various teachers of science, and bringing the college tutors more or less under the control of the central authority of the Science Board, as yet no steps have been taken to form any of the new Boards of Faculties, and for this term at least lecturers only consult their own convenience and the wants of their particular pupils. In the Physical Department of the Museum, Prof. Clifton gives a course on "The Electricity developed when Different Substances are in Contact with one another;" Prof. Price gives a course on Optics; Mr. Stocker a course on Elementary Mechanics; and Mr. Heaton will form a class for the study of problems in elementary mechanics and physics.

At Christ Church Mr. Baynes gives a course of lectures on Electrical Testing, to be followed by a course of practical instruction in electrical and magnetic measurements.

At Balliol Mr. Dixon gives a course of lectures on Elementary Physics.

In the Chemical Department of the Museum Prof. Odling gives a course of lectures on Cyanogen and its Compounds. Mr. Fisher lectures on Inorganic, and Dr. Watts on Organic Chemistry. Mr. F. D. Brown will form a class for practical instruction in Organic Chemistry.

At Christ Church, Mr. Vernon Harcourt lectures and forms a class for practical work in Quantitative Analysis.

In the Biological Department of the Museum, Prof. Moseley continues his course on Comparative Anatomy. Each lecture is followed by a practical course in illustration of the lecture.

Mr. S. J. Hickson will lecture on some recent improvements in histological methods, each lecture to be followed by practical instruction. Mr. Morgan gives a course on the Teeth of Vertebrata, and Mr. Barclay Thompson a course on the Vertebrate and Invertebrate Skeleton.

The Scholarship in Natural Science at Trinity College has been awarded to Mr. David H. Nagel, of St. Andrew's University; *proxime accessit*, Mr. H. T. O. Minty, of the Royal College of Science, Dublin. The following gentlemen have been named as distinguishing themselves in the examination:—Mr. J. Waddell, of Dalhousie College, Nova Scotia; Mr. F. L. Overend, of Manchester Grammar School; and Mr. T. H. J. Watts, of Llandovery School.

CAMBRIDGE.—To supply the place of a Demonstrator which the late Prof. Balfour had asked for, and to carry on his work during the current year, the Council of the Cambridge Senate have recommended that 300*l*. be placed at the disposal of the Board of Biological and Geological Studies for the year. Trinity College has appointed Mr. A. Sedgwick, who was lately Mr. Balfour's Demonstrator, and had the sole charge of the classes for two terms during Mr. Balfour's illness this year, to a lectureship for the current year, on conditions similar to those under which Mr. Balfour conducted his classes before his appointment to the professorship.

The following science lectures have been announced:—Professor Cayley, on the Abelian and Theta Functions; Professor Lewis, on Mineralogy and Crystallography; Mr. Muir, Caius College, on the Metals, and General Principles of Chemistry; Mr. Lea, on Chemical Physiology; Dr. Michael Foster, on Elementary Physiology; Mr. Langley, on Physiology and Histology, with practical work; these lectures will deal with protoplasm, the cell theory, theory of contraction, blood corpuscles, muscle, ciliated cells, nerve cells, endings of nerves, and the general physiology of nerve and muscle.

Mr. A. Sedgwick will give an elementary and an advanced course on the Invertebrata, with practical work. The advanced course will be given in conjunction with Mr. W. H. Caldwell, of Caius, College, and will extend over three terms.

Prof. Newton is lecturing on the Evidence of Evolution in the Animal Kingdom.

Prof. Humphry is lecturing on Osteology, and holds advanced classes in Anatomy and Physiology.

Messrs. A. G. Greenhill and R. R. Webb are appointed Moderators for the ensuing year.

Mr. W. N. Shaw (Emmanuel College) is appointed a member of the Board of Physics and Chemistry, and Messrs. A. Sedgwick and E. Hill are added to the Board of Biology and Geology.

Mr. R. Etheridge, F.R.S., and the Rev. E. Hill, are appointed adjudicators for the Sedgwick Prize.

The Medical Examiners for the year are, 1st M.B., Messrs. P. T. Main, W. Garnett, and S. H. Vines; 2nd M.B., Drs. Watney, Shuter, and A. M. Marshall; 3rd M.B., Drs. Reginald Thompson, Galabin, and Handfield Jones. Examiners in Surgery, Messrs. Luther, Holden, and T. Brayant; Assessor to the Regius Professor of Physic, Dr. Cheadle.

Messrs. R. S. Heath, Second Wrangler 1881, and A. E. Steinthal, Third Wrangler 1881, have been elected to Fellowships at Trinity College.

SCIENTIFIC SERIALS

Zeitschrift für wissenschaftliche Zoologie. Bd. 37, Heft i., August, 1882, contains:—On the development of *Asterina gibbosa*, Forbes, by Prof. Dr. Hubert Ludwig (with woodcuts and plates 1 to 8).—On *Marginella glabella*, L., and on the Pseudo-marginellidæ, by Justus Carrière (plate 9).—On the lateral canal system in *Cottus gobio*, by Dr. E. Bodenstein (plate 10).—On the coloration of the nestlings of the genus Eclectus (Wagl.), with a list appended of seventy-one papers on this somewhat vexed question, by A. B. Meyer.

Verhandlungen der k.k. zool.-botan. Gesellschaft in Wien, Bd. xxxii. Pt. 1 (January to June, 1882), contains, in addition to the proceedings of the Society, the following memoirs:—Zoology. By Dr. R. Bergh, contribution to a knowledge of the Aeolididæ, vii. (plate i.-vi.).—Dr. F. Brauer, on *Sympycna paedisca*, a justification of this as a new species.—Dr. R. Drasche, a revision ot the types of Diesing and Molin in the Nematode collection of the Society (plates 7 to 9).—On Oxycoryina, a new genus of Synascidian (plate 13).—Helminthological notes (plate 12).—Count Keyserling, on new American spiders (plate 15).—Dr. Löw, the characteristics of the genera Aphalara and Rhinocola (plate 11). A revision of the palæarctic Psyllidæ, and on a new species of coccus (*Xylococcus filiferus*) (plate 16).—A. v. Pelzeln, on the export of birds from Borneo.—A. Wimmer, on some adriatic shells.—Botany: Dr. G. Beck. New Austrian plants (plate 14).—W. Vos, material towards a list of the fungi of Krains.—Dr. F. Arnold, in memory of F. X. Freiherr v. Wulfen, born November 5, 1728, died March 16, 1805.

Revue internationale des Sciences biologiques, August 15, 1882, contains—On modern Hylozoism, by Jules Soury.—On the structure and the movement of protoplasm in vegetable cells, by H. Frommann (in continuation).—On psychology and the labours of Broca, by M. Zaborowski.

Archives des Sciences Physiques et Naturelles, August 15.—On the rotatory polarisation of quartz (second part), by L. Soret and E. Sarasin.—Some new aromatic ketones obtained by molecular condensation, by A. Claparède.—On the quantity of hail that fell during the thunderstorms of August 21, 1881, and of July 13, 1788, and some words on the history of hail-preventers, by P. Dufour.

Gegenbaur's Morphologisches Jahrbuch, 8 Bd. Heft 1, 1882, contains:—Contributions to the morphology of the oral glands in vertebrates, by P. Reichel (plate 1)—On *Rhodope veranii*, Koll = *Sidonia elegans*, M. Schultze, by Prof. Dr. L. v. Graff (plate 2). This little animal, found on Ulva, at Trieste, belongs not to the Gastropods, as Kolliker thought, but to a section of the Rhabdoccela.—Notes on the calcareous skeleton in the Madrepores, by G. v. Koch (plate 3).—Contributions to the anatomy of the organs of vision in fish, by Dr. E. Berger (plates 4 and 5). Contains an account of researches made on one Cyclostomous nine Selachoid and nine Teleosteous fishes, and is accompanied by an account of the literature of the subject.

Niederländisches Archiv für Zoologie, Supplement Band 1, Lief. 3, 1882, contains a report on the sponges dredged up in the Arctic Sea by the *Willem Barents*, in the years 1878 and 1879, by Dr. G. C. J. Vosmaer, with four plates. Vosmaer differs from Sollas, though apparently without the same amount of material to judge from, regarding *Thenea muricata*, Bwk., as the same species as *Th. wallichi*. This very excellent memoir is written in good English, but as the sheets were not corrected for press by the author, several very perplexing mistakes occur, which are corrected in the appendix.—Report on the Echinoderms of the same expedition, by Dr. C. K. Hoffman, with one plate.—On the Nemertians of the expedition, by Dr. A. A. W. Hubrecht.—On the Gephyrea, by Dr. R. Horst, second portion, with two plates. *Stephanostoma barentsii* is described as a new species.—A catalogue of the Polyzoa, by D. W. J. Vigelius, with one plate.—On the Crustacea, by Dr. P. P. C. Hoek, with three plates.—List of the Mollusca, by Th. W. Van Lidth de Jeude; and list of the Birds, by Dr. H. Schlegel.

SOCIETIES AND ACADEMIES

London

Entomological Society, October 4.—Mr. H. T. Stainton, president, in the chair.—Two new Members were elected.—Mr. R. McLachlan exhibited nymph-skins of *Hagenius brevistylus*, Selys (a dragon-fly occurring in Texas).—Mr. C. O. Waterhouse stated that the beetle exhibited at the August meeting as destructive to beer-casks at Rangoon was not *Xyleborus Saxesenii*, Ratz., but *Bostrichus perforans*, Woll. A discussion followed as to whether wood-feeding beetles attack healthy as well as unhealthy trees.—Papers read Prof. J. O. Westwood, Further descriptions of insects infesting figs.—Mr. G. C. Lewis, A supplementary note on the specific modfications of Japanese *Carabi*, and some observations on the mechanical action of sun-rays in relation to colour during the evolution of species.

Paris

Academy of Sciences, October 9.—M. Blanchard in the chair.—M. Dumas communicated the results of the labours of the International Committee of Weights and Measures for 1882. The comparison of a new metre and kilogramme of iridised platinum with the old French standards of platinum proved very satisfactory (showing close similarity).—On a new theory of the sun, by Dr. C. W. Siemens, by M. Faye. He urges that gas rarefied to $\frac{1}{2000}$ would be, for the astronomer, a dense medium, presenting much greater resistance than is observed, to celestial movements. Moreover, the hypothesis adds 100000 times the mass of the sun, to those masses which celestial mechanics has hitherto reckoned so minutely.—On the shock of two spheres, having regard to their degree of elasticity, and to the friction developed on contact, by M. Ledieu. These chiefly apply to the prevalent notion of electromotive forces, (total or partial) and of currents.—Observations of the great comet (Cruls) at Marseilles Observatory, by M. Borrelly.—Theorems on the functions of an analytical point, by M. Appell.—On Fuchsian functions, by M. Poincaré.—On a series for developing the functions of a variable, by M. Halphen.—On the gravity-barometer, by M. Mascart. He made a rough trial of his instrument in a journey to the north of Norway. He finds that it is easily transportable, and that its precision is apparently not less than that obtained with the pendulum. One has merely to observe the mercury-level and the temperature, and the installation may be done in less than an hour in a hotel-room.—Transmission of work a great distance, on an ordinary telegraph-line, by M. Deprez. Between Miesbach and Munich (57 km.) he used two telegraph wires of galvanised iron 4·5 mm. thick. The total resistance of the circuit, including the two quite similar Gramme machines (each 470 ohms) was about 1900 ohms. In a first experiment, a work of 38 kgm. per second (or ½ a horse-power) was got directly at Munich with a velocity of 1500 turns a minute (the Miesbach machine giving 2200 turns). More than 60 per cent. of the work expended was recovered. Heavy rain fell all the time of the experiments. The receiving machine fed a cascade through a centrifugal pump. The heating after two hours was hardly appreciable.—Thermoscopic method for determination of the ohm, by M. Lippmann. This differs from Mr. Joule's calorimetric method in not requiring measurement of the quantities of heat, nor a knowledge of the mechanical equivalent of heat. After measuring the heat from passage of a current of known intensity through a wire in a calorimetric vessel, equal heat is developed by friction in the vessel, and from the work expended, and the intensity of the current, the electric resistance may be deduced.—On the rotatory polarisation of quartz, by MM. Soret and Sarasin. A new method is described, which yields results closely agreeing with those got before.—On experiments made to determine the compressibility of nitrogen gas, by M. Amagat. He notes important points of difference between M. Cailletet's method and his own (which some have affirmed to be quite similar), shows that the curves obtained are quite different, and contends for the greater accuracy of his own results.—On some combinations of bisulphide and biselenide of tin, by M. Ditte.—On the fermentation of nitrates, by MM. Gayon and Dupetit. Their experiments confirm the hypothesis that the reduction of nitrates, as well as nitrification, is a physiological phenomenon. Thus, in sewage water containing a little nitrate of potash, with some altered urine, the nitrate disappears gradually, and the liquid is filled with microscopic organisms. Chicken broth does better than sewage-water. (The presence of organic matters is necessary.) Carbolic acid and salicylic acid in antiseptic, or even higher doses, not only do not hinder the life of the reducing microbe, but themselves disappear completely with the nitrate.—Note on the transformation of amides into amines, by M. Baubigny.—On the decomposition of the tertiary acetate of amyl by heat, by M. Menschutkin.—Observation of the aurora borealis of October 2, 1882, by M. Renou. Accounts of the phenomenon were received from the Park of Saint Maur, from Nantes, Evreux, and Cherbourg.—M. Maumené said that black phosphorus appears nearly always in the first drops of phosphorus which distil in a current of hydrogen (prepared from zinc and sulphuric acid). The following drops are colourless and destroy the colour of the first by liquefying them and mixing with them. CO_2 does not give the phenomenon.

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