THURSDAY, JUNE 1, 1882

CHARLES DARWIN[1]

III.

THE influence which our great naturalist has exerted upon zoology is unquestionably greater than that which has been exerted by any other individual; and as it depends on his generalisations much more than upon his particular researches, we may best do justice to it by taking a broad view of the effects of Darwinism on zoology, rather than by detailing those numberless facts which have been added to the science by the ever vigilant observations of Darwin. Nevertheless, we may begin our survey by enumerating the more important results of his purely zoological work, not so much because these have been rarely equalled by the work of any other zoologist, as because we may thus give due prominence to the remarkable association of qualities which was presented by Mr. Darwin's mind. This association of qualities was such that he was able fully to appreciate and successfully to cultivate every department and ramification of biological research—whether morphological, physiological, systematic, descriptive, or statistical—and at the same time to rise above the *minutiæ* of these various branches, to take those commanding views of the whole range of nature and of natural knowledge which have produced so enormous a change upon our means of inquiry and our modes of thought. No labourer in the field of science has ever plodded more patiently through masses of small detail; no master-mind on the highest elevation of philosophy has ever grasped more world-transforming truth.

Taking the purely Zoological work in historical order, we have first to consider the observations made during the voyage of the *Beagle*. These, however, are much too numerous and minute to admit of being here detailed. Among the most curious are those relating to the scissor-beak bird, niata cattle, aëronaut spiders, upland geese, sense of sight and smell in vultures; and among the most important are those relating to the geographical distribution of species. The results obtained on the latter head are of peculiar interest, inasmuch as it was owing to them that Mr. Darwin was first led to entertain the idea of evolution. As displaying the dawn of this idea in his mind we may quote a passage or two from his "Voyage of a Naturalist," where these observations relating to distribution are given:—

"These mountains (the Andes) have existed as a great barrier since the present races of animals have appeared, and therefore, unless we suppose the same species to have been created in two different places, we ought not to expect any closer similarity between the organic beings on the opposite sides of the Andes, than on the opposite shores of the ocean."

"The natural history of these islands (of the Galapagos Archipelago) is eminently curious, and well deserves attention. Most of the organic productions are Aboriginal creations, found nowhere else; there is even a difference between the inhabitants of the different islands; yet all show a marked relationship with those of America, though separated from that continent by an open space of ocean, between 500 and 600 miles in width. The archipelago is a little world within itself, or rather a satellite attached to America, whence it has derived a few stray colonists, and has received the general character of its indigenous productions. Considering the small size of the islands, we feel astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period, geologically recent, the unbroken ocean was here spread out. Hence, both in space and time, we seem to be brought somewhat near to that fact—that mystery of mysteries—the first appearance of new beings on this earth."

Next in order of time we have to notice the Monograph of the Cirripedia. This immensely elaborate work was published by the Ray Society in two volumes, comprising together over 1000 large octavo pages, and 40 plates. These massive books (which were respectively published in 1851 and 1854) convey the results of several years of devoted inquiry, and are particularly interesting, not only on account of the intrinsic value of the work, but also because they show that Mr. Darwin's powers of research were not less remarkable in the direction of purely anatomical investigation than they were in that of physiological experiment and philosophical generalisation. No one can ever glance through this memoir without perceiving that if it had stood alone it would have placed its author in the very first rank as a morphological investigator. The prodigious number and minute accuracy of his dissections, the exhaustive detail with which he worked out every branch of his subject—sparing no pains in procuring every species that it was possible to procure, in collecting all the known facts relating to the geographical and geological distribution of the group, in tracing all the complicated history of the metamorphoses presented by the individuals of the sundry species, in disentangling the problem of the homologies of these perplexing animals, &c.—all combine to show that had Mr. Darwin chosen to devote himself to a life of purely morphological work, his name would probably have been second to none in that department of biology. We have to thank his native sagacity that such was not his choice. Valuable as without any question are the results of the great anatomical research which we are considering, we cannot peruse these thousand pages of closely written detail without feeling that for a man of Mr. Darwin's exceptional powers even such results are too dearly bought by the expenditure of time required for obtaining them. We cannot, indeed, be sorry that he engaged upon and completed this solid piece of morphological work, because it now stands as a monument to his great ability in this direction of inquiry; but at the same time we feel sincerely glad that the conspicuous success which attended the exercise of such ability in this instance did not betray him into other undertakings of the same kind. Such undertakings may suitably be left to establish the fame of great though lesser men; it would have been a calamity in the history of our race if Charles Darwin had been tempted by his own ability to become a comparative anatomist.

But as we have said—and we repeat it lest there should be any possibility of misstating what we mean—the results which attended this laborious inquiry were of the highest importance to comparative anatomy, and of the highest interest to comparative anatomists. The limits of

[1] Continued from p. 75.

this article do not admit of our giving a summary of these results, so we shall only allude to the one which is most important. This is the discovery of the "Complemental Males." The manner in which this discovery was made in its entirety is of interest, as showing the importance of remembering apparently insignificant observations which may happen to be incidentally made during the progress of a research. For Mr. Darwin writes:—

"When first dissecting *Scalpellum vulgare*, I was surprised at the almost constant presence of one or more very minute parasites, on the margins of both scuta, close to the umbones. I carelessly dissected one or two specimens, and concluded that they belonged to some new class or order amongst the articulata, but did not at the time even conjecture that they were cirripeds. Many months afterwards, when I had seen in Ibla that an hermaphrodite could have a complemental male, I remembered that I had been surprised at the small size of the vesiculæ seminales in the hermaphrodite *S. vulgare*, so that I resolved to look with care at these parasites; on doing so I now discovered that they were Cirripedes, for I found that they adhered by cement, and were furnished with prehensile antennæ, which latter, I observed with astonishment, agreed in every minute character, and in size, with those of *S. vulgare*. I also found that these parasites were destitute of a mouth and stomach; that consequently they were short-lived, but that they reached maturity; and that all were males. Subsequently five other species of the genus Scalpellum were found to present more or less closely analogous phenomena. These facts, together with those given under Ibla (and had it not been for this latter genus, I never probably should have struck on the right line in my investigation), appear sufficient to justify me in provisionally considering the truly wonderful parasites of the several species of Scalpellum, as Males and Complemental Males" (vol. i. pp. 292-3).

The remarkable phenomena of sexuality in these animals is summed up thus:—

"The simple fact of the diversity in the sexual relations, displayed within the limits of the genera Ibla and Scalpellum, appears to me eminently curious. We have (1) a female, with a male (or rarely two) permanently attached to her, protected by her, and nourished by any minute animals which may enter her sac; (2) a female, with successive pairs of short-lived males, destitute of mouth and stomach, inhabiting the pouches formed on the under sides of her two valves; (3) an hermaphrodite, with from one or two, up to five or six similar short-lived males without mouth or stomach, attached to one particular spot on each side of the orifice of the capitulum; and (4) hermaphrodites, with occasionally one, two, or three males, capable of seizing and devouring their prey in the ordinary Cirripedal method, attached to two parts of the capitulum, in both cases being protected by the closing of the scuta."

With reference to these Complemental Males (so called "to show that they do not pair with a female, but with a bisexual individual") Mr. Darwin further observes: "Nothing strictly analogous is known in the animal kingdom; but amongst plants, in the Linnean class, Polygamia, closely similar instances abound;" and also that "in the series of facts now given we have one curious illustration more to the many already known, how gradually nature changes from one condition to the other, in this case from bisexuality to unisexuality" (ii. 29).

Lastly, to give only one other quotation from this work, he writes:—

"As I am summing up the singularity of the phenomena here presented, I will allude to the marvellous assemblage of beings seen by me within the sac of an *Ibla quadrivalvis*, namely, an old and young male, both minute, worm-like, destitute of a capitulum, with a great mouth and rudimentary thorax and limbs, attached to each other and to the hermaphrodite, which latter is utterly different in appearance and structure; secondly, the four or five free, boat-shaped larvæ, with their curious prehensile antennæ, two great compound eyes, no mouth, and six natatory legs; and lastly, several hundreds of the larvæ, in their first stage of development, globular, with horn-shaped projections on their carapaces, minute single eyes, filiform antennæ, probosciform mouths, and only three pairs of natatory legs. What diverse beings, with scarcely anything in common, and yet all belonging to the same species!" (i. 293).

Scattered through the "Origin of Species," the "Variation of Plants and Animals under Domestication," and the "Descent of Man," we meet with many purely zoological observations of much interest and importance as such, or apart from their bearing on the general principles and arguments for the illustration or fortification of which they are introduced. In this connection we may particularly allude to the chapters on Variability, Hybridism, and Geographical Distribution—chapters which contain such a large number of new facts, as well as new groupings of old ones, that we cannot undertake to epitomise them in a *résumé* of Mr. Darwin's work so brief as the present. Nor should we forget to mention in the present connection his experimental proof of the manner in which bees make their hexagonal cells, and of the important part played in the economy of nature by earthworms. Moreover, the hypothesis of sexual selection necessitated the collection of a large body of facts relating to the ornamentation of all classes of animals, from insects and crustacea upwards; and whatever we may think about the stability of the hypothesis, there can be no question, from a zoological point of view, concerning the value of this collection as such.

But without waiting to consider further the purely zoological results presented by the work before us, we must turn to consider the effects of this work upon zoological science itself. And here we approach the true magnitude of Darwin as a zoologist. Of very few men in the history of our race can it be said that they not only enlarged science, but changed it—not only added facts to the growing structure of natural knowledge, but profoundly modified the basal conceptions upon which the whole structure rested; and of no one can this be said with more truth than it can be said of Darwin. For although it is the case that the idea of evolution had occurred to other minds—in two or three instances with all the force of full conviction—it is no less certainly the case that the idea proved barren. Why did it prove so? Because it had never before been fertilised by the idea of natural selection. To demonstrate, or to render sufficiently probable by inference the *fact* of evolution (for direct observation of the process is from the nature of the case impossible) required some reasonable suggestion as to the *cause* of evolution, such as is supplied by the theory of natural selection; and when once this suggestion was forthcoming, it mattered little whether it was considered as propounding the only, the chief, or but a subordinate cause; all that was needed to recommend the evidence of evolution to the judgment of science was the discovery of *some* cause which could be reasonably regarded as not incommensurate with *some* of the effects ascribed to it. And, unlike the desperate though most laudable gropings of Lamarck, the simple solution furnished by Darwin was precisely what was required to give a *locus standi* to the evidence of descent.

But we should form a very inadequate estimate of the services rendered to science by Mr. Darwin if we were to stop here. The few general facts out of which the theory of evolution by natural selection is formed—viz. struggle for existence, survival of the fittest, and heredity —were all previously well-known facts; and we may not unreasonably feel astonished that so apparently obvious a combination of them as that which occurred to Mr. Darwin should have occurred to no one else, with the single exception of Mr. Wallace. The fact that it did not do so is most fortunate in two respects—first, because it gave Mr. Darwin the opportunity of pondering upon the subject *ab initio*, and next because it gave the world an opportunity of witnessing the disinterested unselfishness which has been so signally and so consistently displayed by both these English naturalists. But the greatness of Mr. Darwin as the reformer of biology is not to be estimated by the fact that he conceived the idea of natural selection; his claim to everlasting memory rests upon the many years of devoted labour whereby he tested this idea in all conceivable ways—amassing facts from every department of science, balancing evidence with the soundest judgment, shirking no difficulty, and at last astonishing the world as with a revelation by publishing the completed proof of evolution. Indeed, so colossal is Mr. Darwin's greatness in this respect, that we doubt whether there ever was a man so well fitted to undertake the work which he has so successfully accomplished. For this work required not merely vast and varied knowledge of many provinces of science, and the very exceptional powers of judgment which Mr. Darwin possessed, but also the patience to labour for many years at a great generalisation, the honest candour which rendered the author his own best critic, and last, though perhaps not least, the magnanimous simplicity of character which, in rising above all petty and personal feelings, delivered a thought-reversing doctrine to mankind, with as little disturbance as possible of the deeply-rooted sentiments of the age. In the chapter of accidents, therefore, it is a singularly fortunate coincidence that Mr. Darwin was the man to whom the idea of natural selection occurred; for although in a generation or two the truth of evolution might have become more and more forced upon the belief of science, and with it the acceptance of natural selection as an operating cause, in our own generation this could only have been accomplished in the way that it was accomplished; we required one such exceptional mind as that of Darwin to focus the facts, and to show the method.

It seems almost needless to turn from this aspect of our subject to enlarge upon the influence which a general acceptance of the theory of descent has had upon biology. We do not state the case too strongly when we say that this has been the influence which has created organisation out of confusion, brought the dry bones to life, and made all the previously dissociated facts of science stand up as an exceeding great army. Let any one turn to the eloquent prophecy with which the pages of the "Origin of Species" terminate—a prophecy which sets forth in order the transforming effect that the doctrine of evolution would in the future exert upon every department of biology—and he may rejoice to think that Mr. Darwin himself lived to see every word of that prophecy fulfilled. For where is now the "systematist . . . incessantly haunted by the shadowy doubt whether this or that form be a true species"? And has it not proved true that "the other and more general departments of natural history will rise greatly in interest—that the terms used by naturalists, of affinity, relationship, community of type, paternity, morphology, adaptive characters, rudimentary and aborted organs, &c., will cease to be metaphorical, and will have a plain signification?" Do we not indeed begin to feel that "we no longer look at an organic being as a savage looks at a ship, as something wholly beyond his comprehension; and when we regard every production of nature as one which has had a long history, when we contemplate every complete structure and instinct as the summing up of many contrivances, each useful to the possessor, in the same way as any great mechanical invention is the summing up of the labour, the experience, the reason, and even the blunders of numerous workmen, when we thus view each organic being," may we not now all say with Darwin, "How far more interesting—I speak from experience—does the study of natural history become?" And may we not now all see that "a grand and almost untrodden field of inquiry on the laws of variation, on correlation, on the effects of use and disuse, on the direct action of external conditions" *has* been opened up; that our classifications, *have* become "as far as they can be made so, genealogies, and truly give what may be called a place of creation;" that rules of classifying *do* "become simpler when we have a definite object in view;" and that "aberrant species, which may fancifully be called living fossils," actually *are* of service in supplying "a picture of ancient forms of life?" And again, must we not agree that "when we can feel assured that all the individuals of the same species and all the closely-allied species of most genera, have, within a not very remote period, descended from one parent, and have migrated from some one birth-place; and when we better know the many means of migration, then, by the light which geology now throws, and will continue to throw, on former changes of climate and of the level of the land, we shall surely be able to trace in an admirable manner the former migrations of the inhabitants of the whole world?" And who is now able to question that "by comparing the differences between the inhabitants of the sea on the opposite sides of a continent, and of the various inhabitants on that continent in relation to their apparent means of migration, some light can be thrown on ancient geography?" Or, if we turn to "the noble science of geology," do we not see that we are beginning "to gauge with some security the duration of intervals by a comparison of the preceding and succeeding forms of life?" And last, though not least, have we not found this one short sentence so charged with meaning that a new and extensive science, second in importance to none, may be almost said to have grown out of what it states:—"Embryology will often reveal to us the structure, in some degree obscured, of the prototypes?'"

If the progress of science during the last two-and-twenty years has in so astonishing a measure verified the prophecy of the "Origin of Species," surely, in conclusion, we are more than ever constrained to agree with the sentiments expressed by its closing words :—"When I view all beings, not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Cambrian system was deposited, they seem to me to become ennobled. . . . There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one ; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."

(*To be continued.*)

ECLIPSE NOTES[1]

III.

THE eclipse of 1882 is now over, and it is not too much to say that the observations have been most successful. Much more work has apparently been done in former eclipses, but it has been of a far more general nature, and, as the old saw has it, *dolus latet in generalibus.* This year the work has put on very much more of a quantitative look, and each observation therefore more or less means a real step in advance. And indeed the time had come when this should be so, for day by day the quantity of laboratory work done which can be more or less compared with eclipse observations is increasing, and in the case of general observations either in one case or the other comparisons are impossible. I have taken many prior occasions of insisting upon this point; but perhaps the reason why this principle has been so generally acted upon on the present occasion has been a capital example set to future eclipse parties. Some days before the eclipse there was a regular Congress of the leaders of the different expeditions and the chief observers, held under the presidency of Mahmoud Pacha, the astronomer at Cairo, and not only was the general plan of observations agreed upon but the necessity of a limited field of inquiry was generally acknowledged ; hence at the moment of the eclipse each worker had only a limited part of the spectrum to study, and the instrument to be employed whatever its form, and there were many forms employed, was carefully prepared for this part, and this part only, before totality.

In the way of dispersion, MM. Thollon and Trépied outdistanced all their *confrères,* as each had the most powerful form of Thollon spectroscope yet constructed. The dispersion in this instrument is about the same as that given by a Rutherfurd grating (of 17,000 lines to the inch) in the third order, with this important difference, that the quantity of light is much greater, so that a spectrum can be much better observed. With these spectroscopes, object-glasses of 9 inches aperture, and siderostats of a simple altazimuth focus were employed. All the other spectroscopic arrangements, whether for eye or photography, were mounted on equatorial stands. The instruments employed for exposing the rapid plates, which recent progress in photographic science has placed in the hands of the astronomers, were perhaps the most complicated Thus we had a camera with large lens some 5 feet focus ; on this a slitless spectroscope of the Fraunhofer form, similar to that employed in Siam in 1875, but with a prism of greater angle in front of the object-glass then a tele-spectroscopic camera of small dispersion with small image of the sun in the slit, and last of all an ordinary camera of small focus.

[1] Continued from p. 52.

Perhaps before I go further it will be convenient to give a collective note agreed upon in a second congress held two hours after the eclipse. This will show the *general* opinion as to the general results.

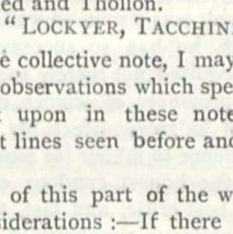
"Unprecedented facilities afforded by Egyptian Government for observation of the eclipse. The plan carried out was agreed upon by the members of the English, French, and Italian expeditions. The accord among the results is very satisfactory. Photographs of the corona and of its complete spectrum were obtained by Schuster on Abney's plates, H and K being the most intense lines. A study of the red end of the spectrum of the corona and prominences was made by Tacchini. A comet which was very near the sun, and a very striking object, was photographed and observed with the naked eye. Bright lines were observed before and after totality of different heights by Lockyer, and with intensities differing from the Fraunhofer lines by Lockyer and Trépied. An absolute determination of the place of the coronal line at 1474, of Kirchhoff's scale, was made by Thollon and Trépied. The absence of dark lines in the corona spectrum was noted by Tacchini and Thollon with very different dispersions. Many bright lines in the violet were observed in the spectrum of corona by Thollon, and were photographed by Schuster. Hydrogen and coronal lines studied in grating spectroscope by Puiseux, and in direct-vision prism by Thollon. Rings observed with grating by Lockyer, first, second and third orders. Continuous spectrum relatively fainter than in 1878, and stronger than in 1871. Intensification of absorption observed in group A at the edge of the moon by Trépied and Thollon.

"LOCKYER, TACCHINI, THOLLON."

Having given the collective note, I may be permitted to refer first to those observations which specially bear upon the matter dwelt upon in these notes—observations touching the bright lines seen before and at the moment of totality.

The importance of this part of the work arises from the following considerations :—If there be a layer of a certain height, by the absorption of which the lines of Fraunhofer are reversed, the lines visible under the stated conditions during eclipses will all be of the same height, and their intensities will all be those of the Fraunhofer lines; if, on the contrary, the reversing layer is a myth, as I believe it to be from a consideration of all the prominence and spot work done up to the present time, the lines will not be all of the same height, and the intensities will widely differ from those of the general spectrum of the sun, for the following reasons :—

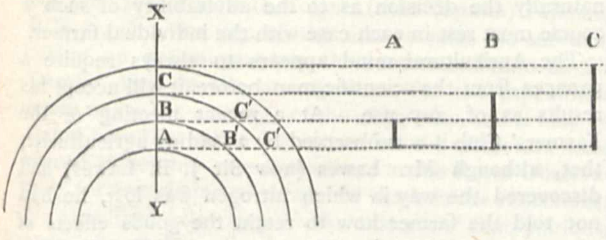
As explained in my first batch of notes, it is most probable that the solar spectrum is built up of the absorption of different layers, and not of one, thus—



A, B, C, layers.

A, layer nearest the sun, and therefore hottest, and therefore probably best represented in prominence-spectrum. B and C, layers further from the sun, and therefore cooler, and therefore probably best represented in spot-spectrum.

If this be so, when we can see the lines of these layers we shall see something like this—



The lines of A—the hottest layer—will be brightest and shortest.

The lines of B—the next cooler layer—will be less bright and longer, and will also go down to the sun, on account of the part of the layer at B, although it is unrepresented at A, along the section X—Y.

And so on with C.

In an eclipse we have a condition in which the atmospheric light is gradually withdrawn. The lines should appear, therefore, in the order of their lengths; that is, the line which turns out to be longest should be the last to appear, and this is a magnificent proof that the substance which produces the line does not extend down to the sun, for if it did it should be brightest at bottom, and should at first appear as a short line.

Now what were the facts? Dealing with the region between F and *b*, and not all of that, and especially with the three iron lines I have so often mentioned, this was the order of appearance—

May 17, 8.18 a.m., saw F and T_1 very short.

(T_1 meaning the single iron line of the three *w l* 49233 so constantly seen by Tacchini in prominences).

8.19 ... F + T_1 + 4933 short.
8.20 ... F + T_1 + 4933 + *b* long.
8.23 ... F + T_1 + 4933 + *b* + T_2 short.

(T_2 meaning a high temperature iron line at *w l* 50176, constantly seen by Tacchini with 49233).

At this time the darkness sensibly decreased, and then for the first time several long thin lines suddenly burst out.

8.23.30: Single iron line at 49565, and double at 4918 and 49195 and line at 49325, the last three being the longest. Other long lines made their appearance, but their positions were not absolutely determined.

Totality was announced at 8h. 25m. 42s., and it was arranged that I should then change my instrument. I fancy the signal was given a little too soon, for when I went to my 3¾ telescope to study the structure of the corona the cross wires were still some distance from the point at which the sun disappeared; but be this as it may, I missed the flash, but this was unimportant, the real work was done. Still this is a point so crucial that we ought not to be satisfied till all these changes, even including the flash, have been photographed on a moving photographic plate, an idea which struck me too late for utilisation during the present eclipse.

Next, as to the structure of the corona. Again the predictions were fulfilled; we were in presence of a repetition of the eclipse of 1871; everything special to that of 1878 had disappeared. There was absolutely no structure near either pole. I was using the same telescope as in 1878, when this feature was so marked, so there can be no mistake on this point. The filamentous character of the streamers, a marked feature in 1871, was however not so decided.

As with the structure so with the ring spectrum. The rings so bright in 1871, so conspicuously absent in 1878, were again visible, but with a Rutherfurd grating they were not so obvious as I at all events expected to find them. As seen at mid-eclipse, 1474 was the faintest ring, and C the brightest.

With regard to the spectrum of the corona as seen with an ordinary tele-spectroscope, arranged to give as much light as possible, I have not so much to say as I had hoped, for the reason that the totality lasted longer than we counted upon. The result of all the preliminary *pourparlers* had been to fix upon sixty-five seconds as the most probable duration of totality, or rather as the duration to be provided for especially from the photographic point of view, since a photograph exposed during totality would be ruined if the sun reappeared before the cap of the camera had been replaced. Sixty-five seconds having elapsed from the announced commencement of totality, I went to the corona spectroscope which I should have gone to ten seconds earlier (but the comet had taken five seconds, and the grating observation had been more uncertain than I had expected). At the moment I made the observation the eclipse was over, but still I noted F, and 1474, and C, bright, and extending right across the field, and a *banded spectrum*, that is to say, not a continuous spectrum certainly, but into maxima and minima, though the minima gave no signs of dark lines. The observation, however, was almost instantaneous, and too much importance must not be attached to it.

Here my notes must close for the present; 104° in the shade is not conducive to writing, even if camels were not growling, and flies teasing, as they can tease in Egypt. J. NORMAN LOCKYER

Siout, May 21

(*To be continued.*)

BIOLOGY AND AGRICULTURE

RECENT advances in our knowledge of the lowest forms of life have tended to bring into prominence not only their relation to disease but to the ever-increasing importance of the part which they play in our arts and industries. Probably in none of the industrial arts, save those concerned with fermentation, commonly so called, has the progress of this branch of biology shown such remarkable development as in its bearing on the art of agriculture.

It has even been suggested that a *bacterium* is at the bottom of the present state of agricultural depression, and there is a considerable amount of force in this suggestion. The loss of nitrogen from the soil in the form of nitrate is one of the most serious difficulties with which the farmer has to contend; and, as this loss takes place by the washing out of nitrates in the drainage and its diffusion into the subsoil below the reach of the roots of plants, it is necessarily greater in wet seasons such as have been the rule for the last few years.

We believe that Pasteur was the first to suggest, twenty years ago, that the process of nitrification going on in soils and waters might be due to the agency of an organism; but it was not until the last five years that the researches of Schlösing and Müntz and of Warington conclusively showed that this is the case and that the organism is a *bacterium*. This *bacterium* is present in all fertile service soils and under the proper conditions of temperature, moisture, supply of oxygen, and presence of salifiable base is continually converting ammonia and nitrogenous organic matter, which has passed the putrefactive stage, into nitrates. That nitrates are the chief form from which most crops and especially the cereals assimilate their nitrogen is now admitted generally, even by the few physiologists who still cling to the belief that plants can assimilate free atmospheric nitrogen; the very great use of this nitrifying organism is thus apparent. It may be remarked in passing that this Schizomycete is able to effect a change in a mineral substance, ammonia, causing its oxidation into nitric acid, all other known organised ferments being concerned in the transformation of organic bodies, and this is an operation hitherto unsuspected in the life of any Bacteria.

Nitrification takes place in soils most rapidly in the hot months of the year, and as a cereal crop assimilates little or no nitrogen after June, but merely transfers that already taken up and present in the roots, stems and leaves to other organs, it follows that, on a cornfield, in the late summer and the autumn months, nitrates will be formed and, will, in the event of wet weather, be readily washed out of the soil.

Observations made during many years at Rothamsted, and recently published by Messrs. Lawes, Gilbert, and Warington,[1] show the extent to which this loss of nitrates may occur. They find that on land uncropped and unmanured, that is, a bare fallow, during 4 years 1878-1881, nearly forty-two pounds of nitrogen per acre per annum, equal to nearly two and a half hundredweight of ordinary nitrate of soda, was lost by drainage. They also estimate that on land under continuous wheat cropping from ten to twelve pounds of nitrogen per acre per annum was lost by drainage from plots which received no nitrogenous manure. When nitrogen is applied in the manure, considerably larger quantities are lost in the drainage, and this is exclusive of that diffused into the lower layers of soil below the reach of plant roots, and of that which may under certain conditions be lost by deduction to elementary nitrogen.

In an ordinary rotation the loss of nitrogen will be considerably less than in these experiments, for crops will often be growing for months after the cereal crop is removed, and thus conserve the available nitrogen and store it up for future use. It is however obvious, that, with a bare fallow favouring the production of nitrates, followed by a wet season, a very considerable loss of available nitrogen will occur through loss of nitrates, and it becomes a matter for the farmer to consider whether it is to his advantage, for the sake of cleaning his land, to take the risk of this loss and supply the nitrogen at a cost, in ammonia, salts, or Chili saltpetre, of nearly a shilling per pound, or on the other hand, adopt some system of cultivation and cropping by which much of the loss may be obviated. On some soils the growth of an autumn green crop would save most of the nitrates and leave the land in fair condition for a succeeding crop; naturally the decision as to the advisability of such a course must rest in each case with the individual farmer.

[1] *Journal of the Royal Agricultural Society* [2] xvii. and xviii.; and *Journal of Society of Arts*, April 7th, 1882.

The Agricultural mind appears to always require a panacea from the scientific man before it will accept his results as of any use. At a recent meeting of the Farmers' Club it was observed by a leading agriculturist, that, although Mr. Lawes (now Sir J. B. Lawes) had discovered the way in which nitrogen was lost, he had not told the farmer how to retain the goods effects of nitrogenous manures in adverse seasons. The discovery of the manner in which the loss occurs is, however, an immense step in the right direction, and moreover Lawes and his colleagues have clearly shown that with a growing crop on the land the loss is very greatly lessened.

This *bacterium* of nitrification is but one of a great number of the lower forms of life now engaging the attention of scientific men, which are, or ought to be, of immense interest to the scientific pursuit of agriculture. The researches of Pasteur on the life history of *Bacillus* of Anthrax, Aitken and Hamilton's investigations now being conducted into the causes producing braxy and louping ill; and the study of the organisms concerned in the changes which occur during the souring of milk and the ripening of cheese are kindred studies bearing in a direct manner on the daily practice of the farmer. Of no less interest too is the biological work done by Kühn and Liebscher, which has traced the *beet sickness* to the presence of a Nematode, while the investigations into the life history of *Hemileia vastatrix*, the too well-known coffee leaf disease, the *Plasmidiophora*, which is the proximate cause of *anbury* in turnips, and the fungus of potatoe disease, all point to the growing relation between the kindred sciences of biology and agriculture. Illustrations might be multiplied almost indefinitely but these are of sufficient importance to show that the work of the microscopist and biologist has a wide and deep influence, first of all on the practice of agriculture, and through it on the comforts and the pockets of the consumers at large.

THE TRANSIT OF VENUS, 1874

Account of Observations of the Transit of Venus, 1874, December 8, made under the Authority of the British Government. Edited by Sir George Biddell Airy, K.C.B., Astronomer-Royal.

THIS volume, recently published under the authority of the Treasury, contains the official account of observations of the last transit of Venus, by the five expeditions organised at the public expense and the reduction of the observations.

In an Introduction Sir George Airy briefly recapitulates the various steps taken by himself with the view to the efficient observation of this phenomenon, from his first communication to the Royal Astronomical Society in April, 1857, "On the means which will be available for correcting the measure of the sun's distance in the next twenty-five years." His official correspondence with the Admiralty commenced in October, 1868; the early proceedings were reported to the House of Commons in July, 1869, and after much public discussion a statement on the general plan was made to the House in March, 1873. The collection of an efficient body of observers was then proceeded with, Colonel (then Captain) Tupman, R.M.A., who was one of the first to offer his services, taking an active part, on the recommendation of Sir George Airy, in the arrangements for the expeditions made under the authority of the Admiralty, and it may be stated here that since his return all the observers were placed under his superintendence at the Royal Observatory, for completing their special share in the reductions. He examined every step in the observers' computations, especially all that related to the adjustments of the instruments. "Never perhaps," says Sir George, "was such an enormous mass of calculations so severely criticised, and where necessary, repeated." In the latter part of 1880, the calculations with portions of introduction for each station, were handed over to Sir George Airy, by Captain Tupman, who was about to leave the country, and the remainder of the work was performed under the immediate guidance of the Astronomer-Royal, who states that it had occupied all the hours, not engaged on routine business, on which he could usually have reckoned for other matters of science.

The volume is divided into five parts, referring to as many expeditions for the observation of the transit, with an appendix. Part I. treats of the expedition to the Sandwich Islands, and the observations at Honolulu, Kailua, and Waimea; II. the expedition to Egypt (Mokattam Hills, near Cairo and Suez); III. that to Rodriguez, and the observations at Point Venus, Point Coton, and Hermitage Islet; IV. that to Kerguelen Island, and observations at Observatory Bay, Supply Bay, and Thumb Peak; and Part V. details operations in New Zealand. The observations and reductions in the expedition to the Sandwich Islands are printed at much length, but particulars relating to the other expeditions were presented on the scale which Sir George Airy had proposed in an address to the Royal Astronomical Society in March, 1875. It is hardly necessary to say that the actual observations of the transit are given *in extenso*, with full descriptions of the determinations of longitude, whether by telegraph, runs with chronometers, or lunar observations with the transit or alt-azimuth, to which last method Sir George Airy had called early attention, as one which it might be essential to apply in certain cases. The reduction of the observations is carried to the formation of the equations of condition, from which the parallax, &c., have to be determined. Sir G. Airy says he has "endeavoured to give the equations in the shape that will admit of combination in the easiest way for the computer's further operations—(whether he may desire to use the Calculus of Probabilities for the whole, or to make any special selection of combinations)—when he shall have decided on the recorded phase of contact of limbs which he thinks best to adopt."

The Appendix contains some tabular details and an account of photographic observations of the transit. The photographs are preserved at the Royal Observatory, and Sir G. Airy considers it possible that some astronomer may deem them worthy of rediscussion, though he does not anticipate that any great improvement can be made in measuring them.

This important volume, which extends to over 500 pages, is printed for Her Majesty's Stationery Office.

OUR BOOK SHELF

Worked Examination Questions in Plane Geometrical Drawing. By F. E. Hulme, F.L.S., F.S.A. (London: Longmans.)

THE Art Master at Marlborough College has gathered together in this book 300 problems, chiefly from papers set at the examinations for entrance to the military colleges. He gives fully worked out solutions to two-thirds of the questions, leaving the student to exercise himself unaided with the remainder. The figures embodying the solutions seem to have been very carefully prepared, and are clearly printed, and each plate is furnished with a blank fly-leaf, making reference easy.

A fair knowledge of geometry is assumed, but to certain of the questions notes are appended on special points as they arise, such as might not have been dealt with in the text-book or course that the student has worked through. These notes are very good, and not too long; the author's experience enabling him to anticipate difficulties and to give warning against pitfalls. Especially is the attention of the student drawn to constructions which, though they do not involve much head knowledge, yet require great care to ensure accuracy, and are thus severe tests of neatness and power in the use of instruments. In view of the growing importance of graphical methods of obtaining numerical results, the acquisition of this sort of hand-skill is becoming every day more desirable.

This book will be a welcome addition to the appliances of all teachers of the subject, for it will help to fill a wide gap; still the author might have made it more generally useful by a more judicious arrangement of his materials. The current text-books resemble treatises on arithmetic with very few examples: this volume furnishes an admirable collection of miscellaneous examples, but they are neither graduated nor classified; and they are too numerous for use by ordinary students *after* going through a systematic course of instruction in the subject. Teachers will know how to use the materials here provided whilst developing the subject, but their labour would be lightened, and the book made more serviceable for private students, by a classified table of contents or index to the problems. A. R. W.

Contributions to the History of the Development of the Human Race. By Lazarus Geiger. Translated from the second German edition by Daniel Asher, Ph.D. (Trübner and Co.)

THE firm of Trübner and Co. has done well in admitting this translation as a member of its *Philosophical Series*. The work is a thoughtful contribution by an able linguist to the science of anthropology as elucidated by the study of language. It is full of interesting facts and suggestive ideas concerning each of the following subjects, which form the headings of the six chapters of which the work consists:—The importance of language in the development of the race, the earliest history of the race as elucidated by language, the colour-sense of primitive times, the origin of writing, the discovery of fire, and the primitive home of the Indo-Europeans.

The Brain and its Functions. By J. Luys. International Scientific Series, vol. xxxvii. (London: Kegan Paul and Co., 1881.)

WE consider this a disappointing book, whether we regard it from a physiological or a psychological point of view.

It adds nothing, either to our previous knowledge of facts, or to our previous conceptions with regard to them, and so is of no use to scientific readers; while the manner in which it treats its subject is so dreary that we fear it is no less ill adapted to the requirements of popular readers. We regret this failure the more because the author, as is well known, is so hard a worker, both in cerebral morphology and morbid psychology, that in writing this book he deserved a success which he has failed to achieve. Having said this much it seems needless to enter on any detailed criticism. We have forced ourselves to read the work from end to end, but cannot advise any one else to follow our example.

Ideality in the Physical Science. By Benjamin Peirce. (Boston: Little, Brown and Co., 1881.)

THIS work is a series of six lectures published posthumously by the author's son. The lectures are of a purely popular character, and their object throughout is to maintain that science is, so to speak, an intellectual handmaiden to Christianity. The arguments, or rather illustrations, are all drawn from the domain of physics and astronomy, of which the writer was himself so distinguished a cultivator, and every page glows with the fervour of a deeply religious mind. Indeed, we may question whether there is not rather too much of this, even in view of the emotional effects which it seems to be the main object of the speaker to produce. The intellectual or argumentative object throughout is to show that the "ideality in the physical sciences" points to ideation in the source of the physical universe, or, to quote the concluding paragraph: "Judge the tree by its fruit. Is this magnificent display of ideality a human delusion, or is it a divine record? The heavens and the earth have spoken to declare the glory of God. It is not a tale told by an idiot, signifying nothing. It is the power of an infinite imagination, signifying IMMORTALITY."

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.*]

Mr. Charles Darwin's Letters

WILL you allow me to mention that I am collecting my father's letters with a view to a biography. I shall be much obliged to any of my father's friends and correspondents who may have letters from him, if they will kindly allow me to see and make copies of them. I need hardly add that no letter shall be published without the full consent of its owner.

Down, Beckenham, May 25 FRANCIS DARWIN

Comet (*a*) 1882

THE following observations of Comet (*a*) 1882 have been made with the Transit-Circle of the Radcliffe Observatory, Oxford, when passing *sub-polo*:—

	1882.	G.M.T. h. m. s.	Observed R.A. h. m. s.	Observed N.P.D. (uncorrected for parallax). ° ′ ″	Observer.
(*a*)	May 12,	8 57 20·13	0 14 22·90	15 32 53·4	R.
(*b*)	13,	9 18 33·31	0 39 36·12	15 54 2·9	W.
(*c*)	15,	9 57 21·31	1 26 23·60	17 8 33·8	R.
(*d*)	16,	10 14 15·71	1 47 17·34	18 0 13·7	W.
(*e*)	17,	10 29 20·28	2 6 20·93	19 0 10·5	R.
(*f*)	18,	10 42 34·30	2 23 33·69	20 7 31·7	W.
(*g*)	19,	10 54 4·86	2 39 2·69	21 21 18·8	R.
(*h*)	20,	11 3 59·82	2 52 55·84	22 40 44·3	W.
(*i*)	21,	11 12 28	3 5 (22)	24 5 (18)	R.
(*k*)	22,	11 19 38·70	3 16 30·40	25 33 (54)	R.

Observers' notes:—

(*a*), (*b*) Very faint; but observations fair.
(*c*) Very faint at times; observation fair on the whole.
(*d*) Nucleus sometimes showed as a bright point, but generally not so well defined, and would scarcely stand any illumination of field. Observation, though difficult, very fair.
(*e*) Observation good.
(*f*) Observation considered very good. Nucleus very sharp at times.
(*g*) Difficult, but observation considered fairly good. Nucleus faint at times.
(*h*) Faint. Observation good.
(*i*) Observation only approximate. Sky cloudy.
(*k*) R.A. good. N.P.D. very rough, from a single bisection when extremely faint.

General Notes:—In the telescope, the light of the head on the night of May 18, the nucleus being better defined than on any other night when the observations were made by me, was certainly not brighter than an eighth magnitude star (W.).

Brightness = Eight in star-magnitude (R.).

Observers—W. = Mr. Wickham.
R. = Mr. Robinson.

E. J. STONE

Sea-shore Alluvion—Calshot and Hurst Beaches

WESTWARD of Brighton; Shoreham Harbour, Portsmouth, Southampton, and the Solent roadstead, all derive protection from shingle moles thrown up to windward of their entrances, the most remarkable of which, Calshot and Hurst Points, have each one of Henry VIII.'s stone castles at their extremities. The first incloses a large tidal estuary (Owers Lake) at the entrance to Southampton water, and forms a pier covering, the entrance to that fine natural harbour from the south-west.

The condition of this spit is not much altered since Leland's time, A.D. 1539; it terminates in a horn, which forms the lake, and the outfalls of the Beaulieu and Lymington Rivers westward have similar windward moles on a modified scale.

Hurst Point is two miles in length in a north-west and south east direction, formed of rounded siliceous pebbles on an argillaceous base, which last terminates in a nearly perpendicular submarine cliff 200 feet in height; this physical peculiarity of position has been described by Webster and other writers; it has for centuries acted as a breakwater to the Solent and the small natural harbours eastward of it on the Hampshire coast, but has also limited their capacity by promoting a rapid deposition of silt along their foreshores. In the storm of November, 1824, its position was, and remained for some time, considerably altered, as has been described by Lyell. Still, however, the maps in the Cottonian and Burleigh collections all show the peculiar horn-like termination due to the indraught into the Solent, and the general outline of the spit much as at present, which doubtless has preserved its main features for centuries, subject, however, to local disturbance and variation. Half a mile landward of the lighthouses the beach curves eastward, and forks into three or four gradations of "fulls," showing modern variations and additions to the extremity locally termed the "Point of the Deep," a quarter of a mile long, and running nearly at right angles to the main mole; two smaller spits called "Rabbit Point" and "Shooting Points" (a double formation), tail out from the main spit, within or landward of the extremity.

Parallel to the entrance to the Solent, a bank of shingle three to four miles in length, with about six feet water over it at low water of spring tides, varying in level with the weather, easterly winds banking it up, stretching from the extremity of Hurst Point, south-westward to opposite the ledge called the "Bridge," off the "Needles" rocks, leaves the small entrance channel (the "Needles" Channel) intervening.

Hurst Beach presents many characteristics peculiar to the Chesil, Calshot, and other similar formations such as a low, flat shore to leeward or eastward, and a highly-inclined beach seaward, with a tendency to curve round north-eastward, and ultimately to inclose a tidal mere or lake; the elevation and size of the pebbles increase towards the summit and termination, and in places patches of sand and shingle conglomerate of an early date crop out through the shifting modern "fulls."

The degradation of the cliffs to the westward has been very great, and they are much serrated and water-worn, with frequent slips in the upper strata of sand and gravel on a clay base, and in the neighbourhood of Hordle huge masses of fallen cliff alternate with hollow chines. At Barton also the loss is great, averaging over certain periods one yard per annum, and the whole frontage of Christchurch Bay is similarly affected.

The shingle immediately westward of Hurst becomes smaller, as is universally the case with these spits. Hurst Beach in effect, with alternating withdrawals and renewals, due to change of wind, represents by its height and the size of its pebbles the general leeward accumulating drift.

General observation leads to the conclusion that littoral shingle travels mainly along the shore, as in all cases the coarse pebbles are succeeded by fine shingle, and this ultimately, by sand, silt, or clay; but that spits of shingle grow out into deep water, creating a base for themselves the numerous nesses on our coasts amply show; but before arriving on the shore that shingle does travel at very considerable depths is shown by such cases as the above-mentioned submarine shingle bank west of the Needles passage and the "Boulders" off Selsea Bill.

Here the "Park Anchorage" eastward of the Bill is the traditional site of the bishop's see, and hydrographic authorities cited in the English Channel Pilot describe the gravel bottom as rough and thinly covering a strong clay. J. R. REDMAN

6, Queen Anne's Gate, Westminster, S.W., May 18

Difficult Cases of Mimicry

IN the very interesting communication by Mr. Wallace, in NATURE, *ante* p. 86, on some difficult cases of mimicry, there is one statement which apparently challenges comment.

Mr. Wallace states that although it has been so suggested, it is highly improbable that young birds have a hereditary instinct enabling them to distinguish uneatable butterflies antecedent to experience. Mr. Wallace has not alluded to the very thorough and careful experiments made by the late Mr. Dougl. A. Spalding on this point. It is unnecessary to refer to the results obtained by Mr. Spalding in proving the inherited acquisition of ideas and experience in young chickens, it will at least suffice to repeat the observations made by him, on the actions of a young turkey which he had adopted—"When chirping within the uncracked shell." Now this young turkey, not only on the tenth day of its life, exhibited the most intense terror at the sound of a hawk's voice which was confined in a cupboard but also proved its *inherited* knowledge of uneatable insects.

"When a week old my turkey came on a bee right in its path—the first, I believe, it had ever seen. It gave the danger chirp, stood for a few seconds with outstretched neck and marked expression of fear, then turned off in another direction. On this hint I made a vast number of experiments with chickens and bees. In the great majority of instances the chickens gave evidence of instinctive fear of these sting-bearing insects, but the results were not uniform, and perhaps the most accurate general statement I can give is, that they were uncertain, shy and suspicious."

If domesticated fowls and turkeys exhibit such inherited "instinct," may we not postulate a much greater exccss of the same in purely insectivorons birds in a state of nature. And if this is so, it will be unnecessary to explain away, what appears to be one of the most philosophical considerations in the doctrine of "mimicry." W. L. DISTANT

Deaf-Mutes

J'APPRENDS seulement aujourd'hui par M. Graham Bell que *La Nature* à bien voulu mentionner mes communications à l'Académie des Sciences sur l'accent des sourds muets. Je regrette que les *Comptes Rendus* n'aient pas reproduit mes communications *in extenso* et que M. le Secrétaire perpétuel se soit borné à en faire une analyse incomplète. Je prends donc la liberté de vous adresser ces quelques lignes afin que vos lecteurs sachent au juste la portée de ma communication.

J'ai dit que nous sommes frappés de la ressemblance des visages et quelquefois aussi des mains parce que se sont les seules parties du corps, qui ne soient pas couvertes par les vêtements, mais qu'évidemment la ressemblance s'etend à toutes les parties du corps. J'ajoute même que la ressemblance ne s'arrête pas aux traits extérieurs, on doit la retrouver entre les organes. Pourquoi les organes de la voix feraient-ils seuls exception à la règle générale?

M. le sénateur Robin et M. Milne-Edwards, de l'Institut, à qui on ne saurait refuser la compétence en ces matières, nous disaient qu'il ne comprenaient pas qu'on pût faire des objections sérieuses au fait que j'ai signalé touchant la transmission héritaire de l'accent; que la voix, avec ses diverses propriétés, hauteur, intensité, timbre, accent, est une manifestation des organes vocaux au même titre que toutes les manifestations dont notre corps est le siége. Rien ne se produit au dehors qui n'ait sa cause ou son siége au dedans; c'est dans la constitution intime de notre corps qu'il faut chercher la raison de tous les phénomènes externes. Ainsi s'expliquent les transmissions par voie d'hérédité, soit des aptitudes comme celles pour les mathématiques, les arts graphiques, etc.; soit des affections maladives comme la goutte, le cancer, la folie, etc.; soit des monstruosités comme les doigts surnuméraires, le bec-de lièvre, etc. Pourquoi dans les ressemblances, les organes vocaux seraient-ils exceptés?

Il faut chercher la ressemblance dans la cellule; sans doute, il n'est pas facile de la saisir, mais nous n'osons pas dire, que c'est chose impossible. Une longue expérience est nécessaire pour arriver à saiser des nuances imperceptibles au grand nombre. Ne sait-on-pas qu'un berger reconnait et distingue chaque mouton de son troupeau, tandis que pour nous tous les moutons sont les mêmes à fort peu près.

Ne serait-il pas possible, d'ailleurs, qu'il y eût moins de nuances d'accent chez les sourds-muets et les entendants-parlants americains que chez les Français du Nord et du Midi, de l'Est et de l'Ouest. La voix de nos chers Alsaciens est teintée de sons germaniques, tandis que celle de nos Provençaux a acquis une sonorité et un timbre particuliers qui lui viennent sans doute du long séjour des Romains dans le Midi. Peut-être nous est-il plus facile de constater ces nuances dans la voix chez les sourds-muets de notre pays.

Voici un nouveau fait très curieux sur lequel j'appelle votre attention.

Nanterre (Seine) FELIX HÉMENT

Caution to Solar Observers

IN the interest of solar observers I send you a caution. A first-class sample of black glass was set with a bit of white paper behind it, and exposed for an instant to the focus of a 7-inch lens. The paper was charred where an eye would be placed. A longer exposure of a few seconds made the glass burst asunder.

J. F. CAMPBELL

Niddry Lodge, Kensington, London, W.

Aurora Borealis

WHAT was, probably, the termination of the aurora seen at Worcester and Dublin on May 14 was observed here, by me, between midnight and 1 a.m. of the morning of the 18th. At that time, and for some time after, I saw along the north-west horizon a strong, green, auroral glow. The evening of the 14th was bitterly cold; the sunset clouds threatened snow, wind, light north-north-east light, cloudy. At dawn, the sky was cloudless and wonderfully clear. The 15th was warm and pleasant.

Glasgow, May 24 S. MAITLAND BAIRD GLENNILL

ON THE MUTUAL RELATIONS OF CARBON AND IRON IN STEEL[1]

IN this paper the author sets himself to prove the following four propositions concerning steel: (1) the carbon of steel is (primarily) in a state of simple absorption in the iron; (2) the hardening of steel is due to a metamorphic change in the condition of the carbon, which then assumes a crystalline form closely analogous to the diameter; (3) the varying temper of steel results from the dissociation of this crystalline carbon, at varying but low temperatures; (4) the real strength of steel does not vary to any material degree with a varying content of carbon—that is, *ceteris paribus*, steel is not increased in tensile strength by an increased percentage of carbon.

With regard to No. 1, the author rejects the idea that carbon in steel can be in chemical combination. The only possible hypothesis would be that it is found as a carbide of iron dissolved in excess of iron; and this no modern author holds. It may be alleged in its support that hydrocarbon gas is evolved on dissolving steel in hydrochloric acid; but the great variation in the results and the fact that more or less carbon is at the same time deposited, forbid us to suppose that we have here a definite chemical decomposition. The Eggerty colour test, again, which was supposed to be founded on the same theory, has been in great measure abandoned on account of its inaccuracy. The

[1] Abstract of paper by Mr. George Woodcock, read before the Iron and Steel Institute.

phenomena of the conversion of iron into steel in the cementation process all point to the conclusion that the carbon is simply absorbed, as the varying rate of impregnation with variations of temperature, the gradual change from the outside to the inside, and the large deposition of free carbon from such steel, if dissolved in hydrochloric acid, or chloride of copper, or cold dilute nitric acid.

As to No. 2, the author adopts the theory of Jullien, that the hardening of steel is due to the crystallisation of the so-called combined carbon (really absorbed) in a form resembling the diamond. He observes that cemented steel only becomes hard when heated and quenched, and that the fracture then shows innumerable small crystals, which, under the microscope, present physical features very much like small diamonds. These crystals do not appear in wrought iron, increase in number as the proportion of carbon increases, and as the hardening increases, and are more numerous at the outside of the piece, where the hardness is also less. They are therefore crystallised carbon, in other words, diamond. Estimations of carbon in the different layers of a piece of hardened steel have always shown that the actual proportions, as formed by combustion, are the same throughout, but that, as examined by the colour test, they increase gradually from the outside to the inside. This shows that some change has taken place in the carbon. The author's theory is that at a red heat the molecules of iron are expanded and partially separated; that in this state the absorbed carbon is partially dissociated from the iron, and upon the steel being suddenly quenched, the carbon is not re-absorbed, but takes up a small amount of hydrogen, and is fixed in the state of diamond. It is known that hydrogen is present in the diamond, and also in steel, and it is submitted that it forms the active agent in reducing the carbon from the amorphous to the crystalline form. On analysing this hardened steel, it is supposed that the crystalline carbon goes off in all cases as gas; so that less "combined carbon will remain to be shown by the colour tests or deposited on solution in hydrochloric acid. It must follow from this view that carbon is the acting hardener of steel, and that the idea of other elements, as phosphorus hardening steel is a delusion. In support of this it is observed that phosphorus does not harden wrought iron and that probably the real effect of phosphorus and silicen is to cause dissociation of carbon, thus producing a larger extent of crystallisation and a harder metal. Thus it is found that the higher the proportion of phosphorus, the greater will be the difference between the carbon, as shown by the colour test, and as fixed by analysis. Again, English Bessemer or Siemens steel will require 20 per cent. less carbon to make it work and harden equally well with best Swedish steel; the explanation being that the phosphorus in the former assists the dissociation and crystallisation. To this effect of phosphorus many of the mysterious failures of steel may probably be traced.

With regard to No. 3, the author regards the variations of tempering as due solely to the completeness, or otherwise, of the decomposition of the crystalline carbon in the hardened steel. He observes that carbon and iron have no action on each other at the heat at which tempering is effected; while, even at such temperatures, the abstraction of hydrogen from carbon, in the presence of iron, cannot be deemed impossible. The tempering of steel by simply quenching it in hot water or oil, may thus be explained; the outer layers may be supposed to be hardened at first in the ordinary way, but then, as the interior heat does not pass away so rapidly, it has time to act on the crystalline carbon, and partly to dissociate it again, thus producing something between hardened and unhardened steel—in other words, tempered steel. The crystallised carbon in the hardened steel is supposed to be diffused in a state of molecular disaggregation, and to be less intimately united with the iron than before hardening.

As to No. 4, the startling statement that the ultimate strength of steel is very little dependent on its amount of carbon, is explained to refer to the strength as calculated upon the fractured area, not the original area. It is, therefore, equivalent to saying that the contraction of the fractured area in iron or steel is proportional to the diameter of ultimate strength. The author finds that this is the case, both in the various published tables of tensile strength of steel, and in his own experiments. Hence he holds that the contraction of area should be taken as the proper measure of ductility (as is usual on the Continent), and not the elongation. He looks upon hard steel as a metal of a certain strength, having diffused through its mass a greater or less number of particles of a very hard and rigid substance. Hence, as ductility means the power of contracting in area, and extending in length by molecular flow, the ductility will be less as flow is more difficult; and flow will be more difficult as there are more of the rigid crystals in the mass. The apparent strength per unit of original area is thus increased; but the strength per unit of fractured area is usually diminished, probably because the hard sharp crystals tend to cut the metal between them, and produce a sort of tearing action. For these reasons the use of ductile and mild steel, in structures of every kind, is much to be preferred to that of a brittle material, though of a higher apparent tenacity.

A CHAPTER IN THE HISTORY OF CONIFERÆ

THE ABIETINEÆ

THE most recent classification of the *Abietineæ*, and the one that will probably be chiefly adhered to, at least in England, is published in the "Genera Plantarum" of Bentham and Hooker, 1880. In it *Pinus*, *Cedrus*, *Picea*, *Tsuga*, *Pseudotsuga*, *Abies*, and *Larix*, are recognised as separate genera. The tribe comprises the cedars, larches, firs, pines, and contains some 150 species, and is almost exclusively confined to northern and north temperate regions. The genera are all cone-bearing, and with few exceptions produce winged samaroid seeds. No definite remains are known of earlier age than Jurassic, but with the Wealden and Cretaceous they become plentiful, and already in the Neocomian and Gault the ancestors of several existing genera were completely differentiated.

Pinus, Linn.—The cones in this genus vary from the size of a walnut to a length of 19 inches, or possibly even more. The scales are woody and persistent, and closed until the seeds are ripened, when they gape widely. The seeds are in pairs under each scale, and, with few exceptions, winged. The leaves are acicular, and in some cases very long, and are sheathed in bundles of two, three, or five. Nearly all classifications are mainly founded on the number of leaves that occur in a fasciculus, but this character is rejected in the "Genera Plantarum" as inconstant. Two natural divisions are, however admitted—*Pinaster* and *Strobus*.

The former and larger division is distinguished by the scales being very closely adpressed before shedding the seeds, and by their quadrate, umbonate, or elongate, conical heads. The *Strobus* section is comparatively small, and has elongated, often pointed cones, with hard and rigid, yet scarcely woody, loosely imbricated scales, thicker centrally than at the margins, and terminating in a minute or obsolete umbo. Cones of *P. strobus* and *P. excelsa*, representing this section, may be picked up in most botanical gardens, while the *Pinaster* section comprises all the pines commonly grown in plantations.

Besides the "Genera Plantarum," many excellent accounts of the tribe have recently been published. Among these are Gordon's "Pinetum" (1880), Veitch's "Manual of the Coniferæ" (1881), Dr. Maxwell Masters' "Coniferæ of Japan" (*Linn. Trans.* 1881), and an exquisitely illustrated essay on the "Coniferous Forests of the Sierra Nevada," in *Scribner's Magazine*, also in 1881.

Of the *Pinaster* division seventy-seven fossil species were enumerated by Schimper; none, however, are definitely assigned to the group from deposits older than the Eocene of Aix, and most are from the upper Miocene, and even later deposits. The oldest forms are from Solenhofen, and the Gault of Hainault is said to contain connecting-links between the two sections.

Of the *Strobus* division twenty species are enumerated, the oldest being from the Komeschichten of Greenland; but there are a number of additional species which cannot well be grouped in either section.

In England no cones are known that can be referred to Pinus, as now restricted, from rocks older than the Purbeck, but their number gradually increases until the close of the Tertiaries.

Seven species of pine are known from our British Eocenes. They are enumerated here for the first time :—

P. Prestwichii, sp. nov. mihi ... ... *P. macrocephalus*, (Lind. and Hutton) *P. ovata*, (id.)	Woolwich and Reading Beds.
P. Dixoni, Bowerbank	Bracklesham to Bembridge.
P. Bowerbankii, Can.	London Clay to Bracklesham.
P. Plutoni, Baily ... ... *P. Graingeri*, id.	Eocene of Antrim.

I am not sure that the two latter may not be identical with species already described abroad, but they seem distinct from the other British species.

It will be remarked that all the English species are from marine or estuarine deposits, and it is a singular fact that no trace whatever of leaves or fruit of the Abietineæ have been found in those plant beds of freshwater origin in England, which have recently yielded such exceedingly rich floras. It is equally strange that all our Eocene cones from the London clay and strata beneath have been imbedded before shedding their seed, while those from the Middle and Upper Eocenes are gaping and seedless. If inference upon such slender ground were permissible, it would seem as if those that were imbedded during the cooler Lower Eocene period had grown near to where they were imbedded, and their leaves may yet be found in our little-known Lower Eocene floras, while those that were imbedded during the hottest Eocene periods had drifted a long way. The well-ascertained absence of pine foliage during the Middle Eocene in England, and the constantly-decayed condition of the cones, are the data upon which this view may be grounded. Farther north, at Antrim, as we should anticipate, the cones seem more perfect.

It appears desirable to test the relative length of time that ripe and unripe pine cones, seeds and foliage will float, especially in sea-water, and the length of time required to reduce them to the decayed condition of the Barton and Bracklesham specimens, and it is to be hoped that some one possessiug facilities, will undertake experiments.

It will also be interesting to trace out why cones so frequently fall in a closed unripe condition. A Bournemouth resident writes to me that it takes three years for the cone to come to perfection, and that if it remains on the tree all that time, the scales open wide as it hangs, beginning at the base, and making a plainly audible crackling noise as they separate. This occurs chiefly on sunny summer days. The seeds being liberated, either fall or are picked out by tom-tits.

CEDRUS.—Only four species, or varieties according to some, are known—the Himalayan, Lebanon, Atlas, and Cyprus cedars. The cones are globose and erect on the upper side of the branches. The scales are thin, leathery, and closely pressed together, and persist for some time after the seeds are shed. The cones break up on the trees, and fall piecemeal, the scales falling separately, except near the apex, where they remain together as a rosette. This habit may account for the absence of fossil cedars in the Tertiaries, the older forms from the Greensand of Shanklin and Maidstone having possibly possessed a different habit.

PICEA has twelve to twenty-four species. The leaves are solitary, acicular, and more or less in two rows, while the cones somewhat resemble those of the cedar. They inhabit temperate regions throughout the northern hemisphere, almost to the confines of vegetation. Two Gault forms from Hainault are doubtfully referred to the genus, while fossil species are met with in Iceland and Greenland, the Wetterau, the amber-beds, and a few other Miocene localities.

TSUGA possesses five species. The leaves are not very different to those of Picea, and the cones are like those of Cedrus, but pendent and terminal, persisting for several years, and with scales more loosely imbricated and persistent. They inhabit Japan, the Himalayas, and North America, and have been found fossil in the same beds as Picea. *Pinus Crameri*, Heer, related to Tsuga, is the most widely-spread fossil in the Arctic Cretaceous.

PSEUDOTSUGA has only one species, inhabiting from Mexico to Oregon.

ABIES contains eighteen species. The scales are leathery, loosely imbricated, and fall with the seeds and the leaves, as in Tsuga. It extends over the northern temperate regions of both hemispheres, chiefly in mountainous districts. It is known from the Wealden, and even Jurassic, and from Greenland, Iceland, and in European Miocenes.

LARIX possesses seven to ten species. The cones are small, with leathery persistent scales, and fall in clusters with the dead branches. The leaves are linear, solitary, or in bundles, and deciduous in all but one species. The larch extends over the colder regions of Europe, Asia, and America. But four fossil forms have been noticed—three from the Miocene of Francfort, and one from Austria.

The Abietineæ in the existing state in northern regions of Europe, Asia, and America, outnumber the broad-leaved trees by ten to one, for pine-barrens in North America stretch 300 to 500 miles uninterruptedly, and, in the Old World, form a nearly continuous belt from Scandinavia to the east coast of Asia.

Some grow to gigantic size. Sections from two American species of Abies, two of Picea, and one of Pinus, have been exhibited, and officially stated to have been cut from trees considerably over 300 feet in height. In the Himalayas, the cedar and *Pinus excelsa* exceed 200 feet, and other species almost rival these, and even in Europe the heights of several species have been stated at from 120 to 180 feet. The greatest longevity ascribed to any of the Abietineæ belongs to the cedars, which have been estimated at from 600 to 900 years old.

Many of the species are exceptionally hardy, and pass the Arctic circle, and the larch in Siberia extends, as a trailing shrub, to latitude 52°. In Mexico, pines grow at an elevation of nearly 13,000 feet, and in Central Asia, of 10,000 feet.

The economic value of the Abietineæ surpasses that of all other forest-trees, and they supply a very large proportion of the timber in use. Their wood is valuable for all purposes, and some of it is of immense durability, while the money value of that imported into England alone is 9,000,000*l*. per annum, exclusive of other products, such as pitch and tar, which reach nearly another million. The nuts of some species of pine are used as food, and the bark, woody fibre, and secretions are more or less utilised in different countries, and for most varied purposes. Only one species of the whole family is indigenous to England, *Pinus Sylvestris*, the common Scotch pine. the larch and the spruce having been introduced, though both were, I believe, indigenous here in the Pliocene age.

J. STARKIE GARDNER

THE BRUSSELS CHRONOGRAPH

ON November 18, 1880, a description was given in NATURE of certain great galvanic chronographs which were then being constructed by Messrs. E. Dent and Co., of the Strand and Royal Exchange, London. The second of these instruments—that for the Royal Observatory of Brussels—has now been completed. The arrangements for pricking upon the chronograph barrel are much improved, and as they overcome a serious constructive difficulty, we propose to give some account of them.

It will be remembered that the main feature in the chronographs referred to was a cylinder (or barrel) 12 in. in diameter, and 2 ft. 6 in. long. That cylinder, which was covered with paper, rotated once in two minutes. Beneath it (see Fig. 1) was a pricker placed in electrical connection with the standard clock, and alongside another pricker placed in electrical communication with an observer at any of the instruments. At every second of the standard clock, the clock pricker rose and punctured the paper. Meanwhile, as the cylinder rotated, the carriage, K, on which the prickers were mounted slowly, travelled along the length of the cylinder; and this motion of K, combined with the rotation of the cylinder, caused the succession of clock pricks to arrange themselves around the cylinder in the form of a spiral. The time of any observation was reckoned by comparing the puncture

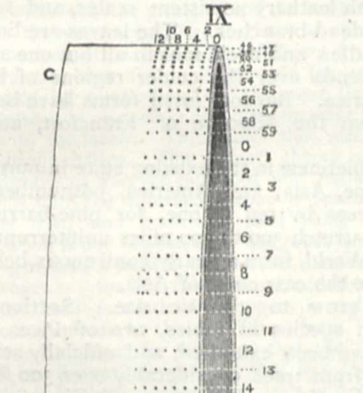


Fig. 1.

of the observation pricker with the two adjacent clock pricks. The distance between each successive turn of the spiral of clock pricks was $\frac{3}{20}$ inches, and it was within this space (which was limited by the consideration of the size of the cylinder, and the number of hours of observation it should contain) that the two prickers worked.

In the Brussels chronograph, by the directions of M. Houzeau, the Belgian Astronomer-Royal, provision had to be made for *three* observation prickers, in addition to the clock-pricker. The space available for the prickers to work in was only $\frac{3}{8}$in., and it was obviously impossible to place them side by side. The difficulty was surmounted by arranging them in the form of a fan, so that they should converge into the space, which then became amply sufficient for the disposition of the punctures.

N_1, N_2, N_3, N_4 (see Fig. 2), are the prickers. As may be seen, they take the form of pins with very large heads. Each is mounted in a sheath, S S. Each sheath is jointed (see side section), and swings about an axis A A. It is kept to its bearing by a spring. This arrangement allows the pricker to swing forward a little as it enters the moving paper. It corresponds to the action of the old form of pricker shown in Fig. 3. The pricker, however, that we are describing has an important advantage.

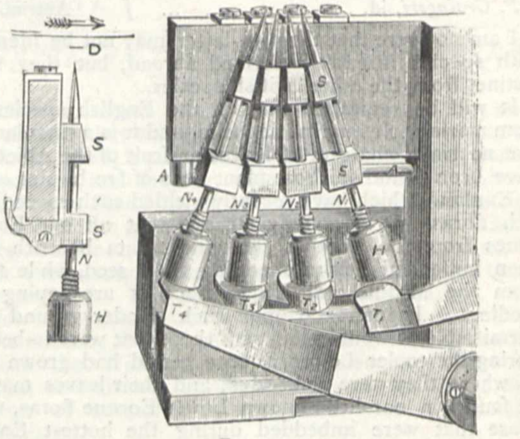


Fig. 2.

It might happen that an observer on pressing down the electric button which worked the pricker, would keep his finger on it. In that case, with the old form, the pricker would be kept against the paper, and would very likely cause damage. But in the new case nothing of the kind would happen, for each pricker, N_1, N_2, N_3, N_4, is *projected* by the blow of its corresponding striker, T_1, T_2, T_3, T_4, and travelling beyond the reach of the striker, pierces the paper by its own momentum only. On falling back,

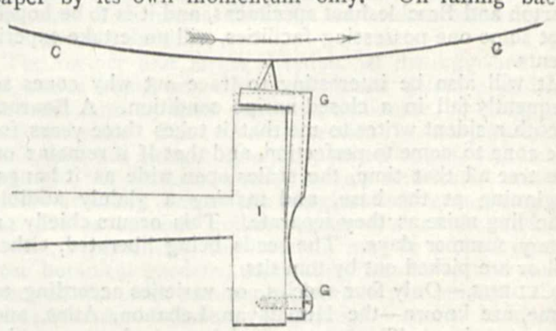


Fig. 3.

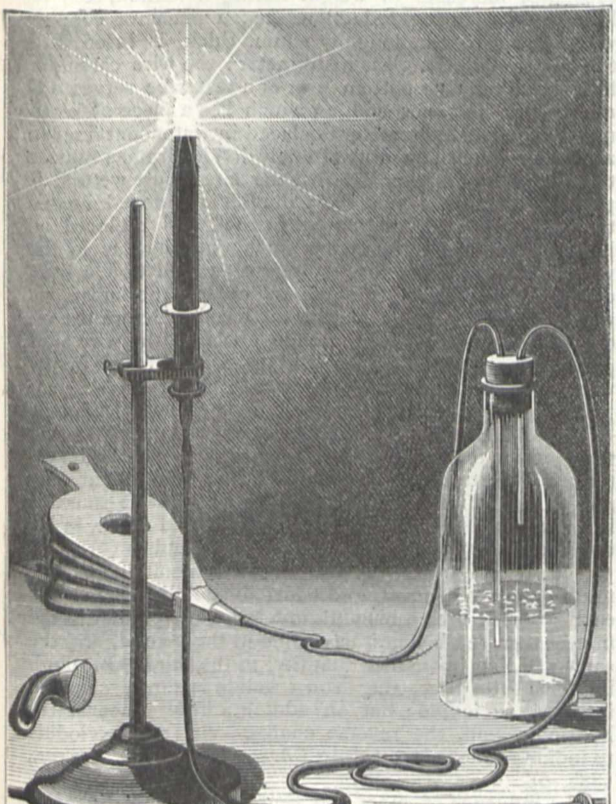
should the striker, T, be still kept raised, the pricker will rest upon it, but its point will be free of the cylinder, and at some distance, D, below it. The strikers, T_1, &c., are worked by electro-magnets: the spiral spring shown just above the head of each pricker, is compressed when the pricker is projected between the head and sheath, and assists in the disengagement of the pricker from the paper. The punctures of the prickers are very marked and distinct.

A NON-ELECTRIC INCANDESCENT LAMP

A BRIGHT light, easily obtained and sufficient for projections, has frequently been regarded as a *desideratum*, where it has been impracticable to procure either the electric or the lime-light. The French Minister of Public Instruction lately appointed a special commission to indicate the apparatus most suitable for projection in primary schools; and it appeared that while there was no lack of simple arrangements for the projection proper, the problem of easy production of an adequate luminous source was hardly solved.

Dr. Regnard has lately conceived the idea of getting a bright light by burning on platinum gauze a mixture of air and petroleum vapour. The intense heat which results raises the platinum to bright incandescence, giving a light equal to about half the lime-light.

The apparatus (described in *La Nature*, to which we are indebted for the accompanying figure) is very simple. There is an ordinary Bunsen burner, terminated by a small cage of platinum wire. The mixture of air and petroleum vapour is admitted below, in place of the gas; it is produced by a familiar method, and the current is generated by means of a pair of bellows or a Richardson "pear." With a ventilator or "trompe," several of the lamps may be maintained in action at once, for lighting halls, workshops, &c., where there is no gas. The aspect



Regnard's Incandescent Lamp.

is that of electric incandescent lamps. In this case, it is well to augment the volume of the carbonator, so that the supply of petroleum vapour is abundant. To send all the light in one direction, the Bunsen burner may be fitted with a bent trumpet-shaped nozzle closed with platinum gauze. One has merely to regulate, with the ring of the burner, the admission of the mixture of air and vapour, to have, whenever the current is produced, an extremely bright light.

With a large loaded bag of air under the table the lamp may be kept in action for several hours, without requiring attention.

The apparatus should be useful to medical men in examination of the larynx, ear, &c.

The expenditure is very small, only a few centimes an hour, with maximum action.

OBSERVATIONS OF THE SOLAR ECLIPSE OF 1882, *MAY* 16, *MADE AT THE RADCLIFFE OBSERVATORY, OXFORD*

THE weather was very favourable, the sky being quite clear.

Ref.	Phenomenon.	Observer.	Greenwich mean solar time.	Instrument.	Aperture.	Clock or chronometer used.	Power used.
			h. m. s.		inches.		
(*a*)	Beginning of eclipse.	Mr. Wickham.	18 12 53·1	Heliometer.	7½	Clock, Dent, 952.	140
(*b*)	"	Mr. F. Bellamy.	18 12 59·6	Dollond.	3½	Chron., Birch.	80
	"	Rev. S. J. Perry.	18 12 58·8	Cooke, No. 1.	6	" Black and Murray, No. 609.	60
	"	Mr. Luff.	18 12 52·6	—	2¾	" Pocket Solar.	60
(*g*)	Disappearance of a Lunar Mountain.	Mr. Stone.	19 7 2·2	Cooke, No. 2.	6	" Frods. and Baker, No. 6149.	120
	Disappearance of a Lunar Mountain.	Rev. S. J. Perry.	19 7 1·9	Cooke, No. 1.	6	" Black and Murray, No. 609.	120
(*c*)	Ending of Eclipse.	Mr. Wickham.	19 21 55·5	Heliometer.	7½	Clock, Dent, 952.	140
(*d*)	"	Mr. Robinson.	19 21 56·8	Cooke, No. 3.	6	Chron., Dent, 2188.	150
(*e*)	"	Mr. F. Bellamy.	19 21 51·3	Dollond.	3½	" Birch.	80
(*f*)	"	Rev. S. J. Perry.	19 21 47·4	Cooke, No. 1.	6	" Black and Murray, No. 609.	60
	"	Mr. Luff.	19 21 52·4	—	2¾	" Pocket Solar.	60

Remarks.—(*a*) The first contact was detected as the merest trace of an indentation on the sun's limb, and the time recorded is considered precise. (*b*) Limbs very steady; the time noted may be a very little late. (*c*) The recorded time of last contact considered accurate, as the moon's limb was followed steadily till the last. The tremor of the sun's limb did not very materially affect the definition. (*d*) Just before contact limbs slightly tremulous; observation considered fairly good. (*e*) Observation good. (*f*) If anything a fraction of a second too soon.

(*g*) This mountain was the highest peak of a ridge of mountains which were conspicuous on the moon's limb.

E. J. STONE

CHEMICAL LECTURE EXPERIMENTS

SEVERAL interesting and instructive experiments have been described of late in the chemical journals: we propose to give a short account of the more important.

I.—Physico-chemical Experiments

A. *Mixing of Gases by Diffusion.*—That gases do not mix very rapidly by diffusion alone, may be illustrated by placing a strip of white paper moistened with lead acetate solution inside a tall glass stoppered cylinder, so that when the cylinder is inverted the paper extends from the bottom (which now forms the uppermost end) not more than one-third of the total length of the cylinder. A little sulphuretted hydrogen water is placed in the hollow stopper of the cylinder, and the stopper is inserted loosely into its place. After ten to fifteen minutes the production of brown lead sulphide on the white paper shows that the sulphuretted hydrogen gas has risen two-thirds of the height of the cylinder. Paper moistened with starch and potassium iodide, and chlorine water, may respectively replace the lead acetate paper and the sulphuretted hydrogen water (C. von Than, *Berichte*, xii. 1414).

B. *Liquefaction of Gases by Increasing Pressure or Lowering Temperature.*—Ethylic chloride, which boils at 12°, is easily liquefied. A Hofmann's lecture eudiometer, with one limb about 100 cm. and the other 50 cm. in length, serves as apparatus. The eudiometer is filled with mercury; ethylic chloride gas is led into the shorter limb through the upper stopcock, while the mercury flows out by the other stopcock; when the smaller limb is partly filled with gas, the mercury is adjusted to the same level in both limbs, the gas is liquefied by pouring ether over the shorter limb, and any air which has entered with the gas is allowed to escape by opening the upper stopcock for a moment. The liquid ethylic chloride is gasified by running out as much as possible of the mercury in the larger limb, and so reducing the pressure. If the temperature is lowered—by pouring ether on to the outside of the shorter limb—or if the pressure is increased—by pouring mercury into the longer limb, equal to an extra half atmosphere of pressure—the ethylic chloride becomes liquid (Hofmann, *Berichte*, xii. 1124).

C. *Absorption of Heat Accompanying Change from Liquid to Gaseous Form.*—A test tube, partly filled with water, is placed in a small glass cylinder containing ether sufficient to completely cover that part of the tube in which there is water. A brisk stream of dry air is driven through the ether, which rapidly evaporates; in a few minutes the water in the tube is completely frozen (Hofmann, *Berichte*, xii. 1125).

D. *Thermal Changes Attending Solution of Salts in Water.*—A small flask of about 100 cc. capacity is fitted with a cork carrying a glass tube, 3-4 mm. diameter, bent twice at right angles; the larger limb of the tube is about 70 cm. in length, and passes through a cork nearly to the bottom of a wide-mouthed bottle, of about 40 cc. capacity, containing coloured water. A straight piece of similar tubing of about the same length passes through a second hole in the cork, and also reaches nearly to the bottom of the wide-mouthed bottle. The salt under examination is placed in the flask, water is added, and the cork is inserted. If heat is evolved during solution, the coloured water rises in the straight glass tube, which is open at the upper end; if heat is absorbed during solution, the water rises in the tube connected with the small flask (Rosenfeld, *Berichte*, xiii. 1475).

II.—Experiments Illustrative of Chemical Action in General

A. *Conservation of Mass.*—Two small glass tubes, about 15 cm. long by 2 cm. wide, are sealed and rounded off at one end and drawn out at the other to tubes about 3 mm. diameter. About two centigrams of freshly heated charcoal is dropped into one tube, the air is replaced by dry oxygen, which is led in by a capillary tube passing through the narrow opening, and the tube is sealed. The other tube is also sealed at a point such that the weights of the two tubes are equal. The tubes are placed on the opposite pans of a balance, and the balance is shown to be in equilibrium: that tube which contains charcoal is heated by a small gas-flame, the charcoal burns brilliantly, and by carefully shaking the tube is all, or almost all, consumed. When the tube is cold it is replaced on the balance pan, on releasing the beam it is found that no change has occurred in the mass of matter in the tube, although the form of the matter has undergone most marked change. Sulphur, or a very small quantity of gun-cotton, may be employed in place of charcoal in this experiment (C. von Than, *Berichte*, xii. 1413).

B. *The Individual Substances taking part in a Chemical Change Gain or Lose Weight.*—To demonstrate that a substance increases in weight during oxidation, &c., or loses weight during reduction, &c., a piece of copper-wire, about 10 cm. long by 1 mm. thick, is fused into the upper end of a glass hydrometer: the wire carries a little glass cup (the bottom part of a test tube serves admirably) on its upper end, on which lies a piece of platinum foil. The hydrometer is placed in water contained in a cylinder. Such a quantity of finely divided iron as suffices to sink the hydrometer, so that the wire is just wetted, is placed on the platinum foil; the foil is removed, heated till the iron is oxidised, allowed to cool, and replaced on its support: the hydrometer sinks considerably in the water. To illustrate loss of weight on reduction, a little cylinder of copper oxide, made by mixing the substance with gum and drying, may be employed. Before the reduction is commenced, nearly the whole of the wire supporting the platinum foil ought to be immersed in the water (Rosenfeld, *Berichte*, xiv. 2102).

C. *Influence of Mass, Time, etc., on a Chemical Change.*—The influence of *time*, *temperature*, and *mass*, as also the meaning of the phrase *reverse action*, may be qualitatively illustrated as follows:—Three beakers are arranged on white surfaces and with white backgrounds; in beaker (1) is placed about 100 cc. of cold water, in (2) the same quantity of water at 90°–100°, and in (3) about 500 cc. of cold water. A few drops of a solution of bismuth iodide in concentrated hydriodic acid is poured into each beaker; brown bismuth iodide is precipitated in the first beaker, red bismuth oxyiodide in the second, and the same salt, but in smaller quantity, in the third. On standing for a little time, the brown iodide is slowly changed into red oxyiodide; but on adding a little concentrated hydriodic acid, the reverse change—viz. from oxyiodide to iodide—takes place (Muir, *Chem. Soc. Journ. Trans.*, 1882, 6).

The influence of mass and time on a chemical change may be quantitatively exhibited by arranging a series of similar glass cylinders filled with water, and inverted in glass basins: a stoppered retort of about 100 cc. capacity is supported close to each cylinder. The retorts are carefully cleaned, and 50 cc. of pure sulphuric acid, regularly diminishing in concentration by a fixed amount, is placed in each. Sheet zinc is cut into squares of equal sizes, which are rolled into slit cylinders (by bending round a glass rod), cleansed in soda solution, then washed, immersed in strong sulphuric acid, again rapidly washed in a stream of water, and dropped into the retorts, which are then stoppered. The hydrogen which is evolved is collected as long as the areas of the zinc remain visibly constant. The upper surfaces of the water in the cylinders exhibit, in the form of a curve, the influence of the mass of sulphuric acid on the change under consideration. As the evolution of hydrogen may be stopped at any moment by withdrawing the stopper of a retort, the experiment may be arranged to show the influence of time on the change (Mills, *Chem. Soc. Journ. Trans.*, 1880, 454).

III.—EXPERIMENTS ILLUSTRATIVE OF COMBUSTION PHENOMENA

A. *Burning Oxygen in Sulphur Vapour.*—A two-necked balloon is fitted with corks, each carrying a tube, one of which passes towards the bottom of the balloon, and has its tip slightly bent upwards, the other, beginning flush with the inner surface of the cork, passes downwards into a cylinder containing water. The first of these tubes communicates, by means of a long piece of caoutchouc tubing, with a supply of dry oxygen. About 40 to 50 grams of dry sulphur are placed in the balloon, and heated till the vessel is quite filled with reddish vapours, the oxygen delivery tube being meanwhile withdrawn. Oxygen is allowed to flow from the delivery tube in a stream sufficiently rapid to cause a glowing chip of wood held 2 to 3 millims. from the end of the tube to burst into flame; a small piece of charcoal is attached by platinum wire to the tip of the oxygen delivery tube; the charcoal is ignited, and the cork carrying the tube which delivers oxygen is inserted into the neck of the balloon. The oxygen is soon seen burning in the vapour of sulphur which fills the vessel; the product of combustion, viz. sulphur dioxide, is led by the second tube into the water in the cylinder, the presence of sulphurous acid in which is easily exhibited (C. von Tham, *loc. cit.*).

B. *Burning Sulphuretted Hydrogen in Vapour of Nitric Acid.*—60 to 80 c.c. of concentrated nitric acid (sp. gr. 1·53) are placed in a flask of 500 c.c. capacity. A rapid stream of sulphuretted hydrogen is passed, through water, into the acid, whereupon red fumes are copiously produced. The delivery tube is slowly raised from the surface of the acid towards the neck of the flask; at a certain distance from the acid the sulphuretted hydrogen takes fire and burns with a blue flame; the upper part of the flask becomes filled with white fumes of sulpuric acid, the lower part with red fumes of oxides of nitrogen, little or no sulphur separating (Kessel, *Berichte*, xii. 2305).

C. *Burning Ammonia in Oxygen.*—A wide-mouthed flask is fitted with a cork, which carries a tube passing nearly to the bottom of the flask, and also a large straight drying tube, which contains solid caustic soda and is closed at its upper end by a cork carrying a little piece of tubing drawn out to an opening about 2 mm. in diameter. A quantity of strong ammonia liquor is placed in the flask and heated nearly to boiling, the lamp is withdrawn, and the cork with its tube inserted. A stream of oxygen is passed into the hot liquor, and the dry ammonia, mixed with oxygen, is ignited as it issues from the caustic soda tube. As the amount of ammonia diminishes, the flame becomes smaller, but very hot; a piece of platinum wire may be melted, or a lime cylinder may be caused to give out much light, by holding it just above the central zone of the flame (Rosenfeld, *Berichte*, xiv. 2104, and xv. 169.)

D. *To show that Water is produced by Burning Hydrogen in Oxygen.*—A small platinum flask (as is figured in Roscoe and Schorlemmer's "Chemistry," I., p. 339) is furnished with a good cork carrying two tubes of ordinary pipe-clay, which reach towards the bottom of the flask: one of these tubes communicates by caoutchouc tubing with a supply of dry hydrogen, the other with a supply of dry oxygen. The exit-tube of the flask is attached to a piece of glass tubing which connects with a glass worm condenser, underneath which a beaker is placed. Dry hydrogen is passed into the flask until the air is completely replaced from the entire apparatus: while this is being done, the caoutchouc tubing which connects the clay tube with the oxygen supply is securely clamped just above its junction with the clay pipe, to prevent hydrogen from diffusing backwards into the oxygen tubes, and so forming an explosive mixture. When the air is all driven out of the apparatus, the platinum flask is heated to redness, dry oxygen is passed into it, and the lamp is withdrawn. By properly regulating the streams of oxygen and hydrogen, so much heat is produced that the flask becomes nearly white hot; water is quickly formed and trickles, and after a little, flows in a continuous stream through the glass worm into the beaker beneath (Hofmann, *Berichte*, xii. 1122).

E. *Unburning of Water-gas by Iron and by Magnesium.*—3-4 grams very finely divided iron (*Ferrum alcoholisatum*) are placed in a small piece of hard glass tubing about 12 cm. long and 14 mm. diameter. One end of this tube is connected with a flask containing hot water, the other with an ordinary gas exit-tube and small pneumatic trough. The iron is heated, the water brought to, and just maintained at the boiling-point, and the end of the delivery-tube is plunged under the water in the trough. Hydrogen is obtained in a rapid stream. As thus arranged the decomposition of water-gas by iron is readily shown without the use of a furnace or porcelain tube.

A similar apparatus serves to show the decomposition of water-gas by magnesium; a piece of magnesium-ribbon about 60 cm. long is folded on itself so as to form a bundle about 1 cm. in length, which is placed in the glass tube; the water is kept nearly boiling; the magnesium is heated until it begins to melt and burn at the edges, at this moment the water is rapidly boiled (and the exit-tube is plunged under the water in the trough), when the magnesium is found to burn vividly in the steam and hydrogen to be evolved in quantity (Rosenfeld, *Berichte*, 15, 160. M. M. P. M.

NOTES

WE are glad to learn that one of the evening (Friday, August 25) discourses at the Southampton meeting of the British Association will be given by Sir William Thomson, and that the subject will be "Tides." Prof. Moseley's discourse on "Pelagic Life" will be given on Monday evening, August 28.

THE honour of Companion of the Order of St. Michael and St. George has been conferred upon Mr. W. T. Thiselton Dyer, F.R.S., Assistant Director of the Royal Botanical Gardens, Kew, for services rendered to Colonial Governments.

THE FRENCH Minister of Public Instruction has again appointed a Commission to direct the deep sea exploration of the Atlantic in the *Travailleur* in July and August next; the investigation will include the ocean bed along the coasts of Spain, Portugal, and Morocco. The members of the Commission are MM. A. Milne-Edwards, L. Vaillant, E. Perrier, Marion, Folin, and P. Pischer.

A FLORENCE correspondent writes:—"On Sunday, May 21, the students and professors of the Faculties of Science and Medicine of Florence assembled to celebrate the memory of Charles Darwin. The large aula of the "Istituto" was crowded with auditors, and many had to be content with standing-room in the corridor outside. An address was read by the representative of the students, and an eloquent study of the genius and character of the great man of science by Prof. Mantegazza. I was struck by the note of religious solemnity that marked the proceedings." Similar testimonies of the high veneration in which the name of Darwin is held abroad come to us from other parts of Italy, as well as France, Germany, Norway, and Russia.

WE lately noticed the death of Mr. T. Donovan, lecturer on physiology and other scientific subjects at the Working Men's College and at the Birkbeck Institution. We learn that he has left a widow and two children, whose position has excited the sympathy of some of those who know the value of the work he did, and that a committee has been formed to collect a fund for their assistance. Mr. R. B. Litchfield, Bursar of the Working Men's College, whose address is 4, Bryanston Street, Portman Square, W., is Treasurer of the Fund.

MESSRS. HACHETTE AND CO. have just published two "map-size" chromo-lithographic plates of the "Phylloxera de la Vigne," one of which illustrates the habits of the insect, whereas the other represents it in its varied stages and conditions. They are especially suitable for the lecture-room, and their distribution in some of our colonies might serve to nip unnecessary panic in the bud. All the figures are enormously enlarged, and highly (perhaps a little *too* highly) coloured, with full explanatory text.

MISS ORMEROD'S "Reports of Observations on Injurious Insects during the year 1881" (W. Swan Sonnenschein and Co.) is far more bulky than its predecessors. This is mainly due to a lengthy and valuable series of reports on the Turnip Fly, which we commend to the notice of all who are likely to be directly influenced by this pest. Other old friends (?) receive their usual share of attention. Miss Ormerod was recently appointed honorary consulting entomologist to the Royal Agricultural Society.

THE following is the programme of the Davis Lectures on zoological subjects which will be given in the lecture-room in the Zoological Society's Gardens, in the Regent's Park, on Thursdays at 5 p.m., commencing June 8:—June 8, Armadillos, living and extinct, by Prof. Flower, LL.D., F.R.S.; June 15, the British Lion, by Prof. Boyd Dawkins, F.R.S.; June 22, Crocodiles, by Prof. Parker, F.R.S.; June 29, British Snakes and Lizards, by Prof. Mivart, F.R.S.; July 6, Frogs and Toads, by W. A. Forbes, B.A.; July 13, Insects and their Metamorphoses, by Prof. Martin Duncan, F.R.S.; July 20, Foreign Zoological Gardens, by P. L. Sclater, M.A., F.R.S.

WE are glad to notice that the Principal of the Royal Agricultural College at Cirencester has supplemented the teaching of biology in that institution, by establishing a thoroughly equipped and efficient biological laboratory. One of the largest and best lighted rooms in the college has been devoted to this purpose, and under the direction of Prof. Harker, has been furnished with dissecting tables and apparatus suited to modern requirements for the effective teaching of the subject. A number of microscopes have been provided; and practical demonstrations in the laboratory now form a necessary part of the course. The students are afforded every opportunity of acquainting themselves with the methods of microscopic manipulation. A special collection of types and a reference library in biology are to form part of the new institution. In view of the growing importance of biology in relation to agriculture, we think this is a wise step in the interests of the student.

ACCORDING to the *Golos* correspondent at Singapore, M. Miklukho Maclay was at that place on April 10, on his return from Australia and on his way home. But his visit home is to be short, as he expects soon to return to Australia, where he has left his large collections. His health is very bad in consequence of continuous fever and neuralgia, and notwithstanding his being only thirty-seven years old, he looks an old man. His twelve years' travel, accompanied with all possible privations, has broken his health. It is to be feared therefore that the publication of the results of his journeys and the description of his extensive collection will be considerably delayed.

IN the Scandinavian Exhibition now being held at South Kensington, there is a very fine and complete collection of objects in prehistoric archæology.

WE have received the second part of the "Descriptions of new Indian Insects from the Collections of the late Mr. W. S. Atkinson," by Mr. Frederic Moore (published by the Asiatic Society of Bengal). The remarks that have already appeared in NATURE, concerning the first part, apply equally to this, and we defer a longer notice until the completion of the work.

"HUMAN MORPHOLOGY" is the title of a work in three volumes, by Mr. H. A. Reeves of the London Hospital, the first volume of which Messrs. Smith, Elder, and Co. will immediately publish.

THE Göttingen Royal Society of Sciences have announced the following subject for prize competition (Beneke-foundation): Comprehensive researches are desired on the microscopical, that is, the anatomical and micro-chemical structure of vegetable protoplasm. The two prizes offered are about 85*l*. and 34*l*. respectively. Papers, written in German, Latin, French, or English, to be sent in in the usual way, before August 31, 1884. The prize award takes place on March 11, 1885.

THE Ben Nevis and Fort-William meteorological observations will be recommenced to-day by Mr. Clement L. Wragge, under the auspices of the Scottish Meteorological Society. A new fixed station is to be established near the lake, about 1,840 feet above the sea, the observations made at which, together with additional observations by means of travelling instruments at certain fixed hours and places to be taken during the ascent and descent, will the better enable atmospheric disturbances existing in the stratum of air between the summit of Ben Nevis and Fort-William to be observed, and discussed with some fulness. The hours of observation at Fort-William will be 5 a.m., 6 a.m., 7 a.m., 8 a.m., 8.30 a.m., 9 a.m., 9.30 a.m., 10 a.m., 10.30 a.m., 11 a.m., 11.30 a.m., noon, 1 p.m., 2 p.m., 3 p.m., 6 p.m., and 9 p.m. The observations to be taken on the journey to Ben Nevis will be 6 a.m. on the peat moss, 7 a.m. at the lake, 8 a.m. about 300 feet, and 8.30 a.m. at Buchan's Well. On the summit of Ben Nevis, Mr. Wragge will observe at 9 a.m. 9.30 a.m., 10 a.m., 10.30 a.m., and 11 a.m. During the descent, or homeward journey, the observations will be at Buchan's Well at 11.30 a.m., about 300 feet at noon, at the lake at 1 p.m., and on the peat moss at 2 p.m. Thus all these observations will be simultaneous with those taken at the low level station at Fort-William. Specially constructed thermometers to record the temperature by clockwork on the top of Ben Nevis at 9 p.m. have been most kindly placed at Mr. Wragge's disposal by Messrs. Negretti and Zambra, London. The indications of these instruments at that hour on the Ben will be of especial value to meteorologists, since the means of temperature and humidity at 9 a.m. and 9 p.m., the observing hours adopted by the English and Scottish Meteorological Societies, will thus be obtained for the top of the Ben. Mr. John Browning, of the Strand, London, has kindly presented a rain band spectroscope, to be used in the Ben Nevis investigations, from the use of which, in the hands of Mr. Wragge, valuable observations bearing on weather forecasting may be expected. Dr. R. Angus Smith, F.R.S., Manchester, has generously undertaken to supply apparatus for measurement of the actinism of the sun's rays and of daylight; and it has further been arranged that a very complete system of ozone observations at the foot, on the slopes and top of the Ben shall be carried out. The ordinary observations on Ben Nevis, at Fort-William, and at intermediate points will be of atmospheric pressure, temperature of the air, earth, lochs, and wells, direction and force of wind, kind, and amount of cloud, movements of the various strata of cloud, rainfall, ozone, and optical phenomena. Additional rain gauges will be fixed on the summit of Ben Nevis to ascertain if the rainfall is the same with various winds at different points of the plateau, particularly from near the edge of the tremendous cliffs inward over the plateau. The work of arranging and opening the stations has already been commenced, and Mr. Wragge will doubtless have the entire system in full working order by 9 a.m., June 1, as stated above.

WE learn from *Naturen* that the authorities at Washington have availed themselves of the presence in the capital of Herr L. Stejneger, of Christiania, to secure the services of this eminent

Norwegian naturalist to conduct a scientific mission to Kamchatka. At two days' notice, Herr Stejneger started, on March 22, well supplied by the U.S. Signal Service Department with all the instruments and appliances necessary for carrying out his instructions which emanate conjointly from the Smithsonian and the U.S. Meteorological Institutions. A year and a half has been suggested as the term of his mission, but in this, as in other matters, he is left to follow his own judgment in regard to the best way of attaining the objects it is proposed to secure. These are: (1) the erection of a meteorological station, of the first class if possible, on the coast of Kamchatka, and one of the second or third class on Behring Island, and at Petropawlovsk, for each of which he is to make arrangements that will secure their permanent efficiency after his departure; (2) in the capacity of a member of the U.S. Fish Commission, to draw up a report of the fishing-grounds, more especially with reference to the condition of the cod-fisheries; (3) to collect, for the national museum the largest attainable number of the remains of the now extinct Rhytina, or Arctic sea-cow, good skins of *Phoca leonina*, *Otaria ursina*, and other sea-animals, together with a few skeletons and a large number of the crania of these and other marine mammals, and of the local birds and fishes. Herr Stejneger promises to keep the readers of *Naturen* acquainted with the success that may attend him in the prosecution of his various and arduous labours.

WE are glad to observe that the telegraph is making rapid way in China. The Shanghai-Tientsin line has been working now for a few months, and a line is being constructed in the south between Canton and Hongkong—a distance of about 100 miles. The first section is to connect Canton, which is practically the commercial capital of China, with the frontier of British Kowloon, situated opposite the town of Victoria. After some consideration it has been decided that a land-line is preferable to a submarine cable, as it will be more economical, and the latter also would seriously interfere with the enormous junk traffic and fishing operations in the estuary of the Canton River. It is interesting to remark that this line is purely a private undertaking of a company of Chinese merchants in Canton, who, doubtless, want to be on a level with their brethren in the north, in rapidity of communication with the markets of the world. The line, as above stated, will for the the present terminate on the confines of British territory. It seems hardly credible—but the fact is stated in the Hongkong journals—that opposition is made by the British authorities to the further construction of the line, and especially to the cable across the harbour necessary to connect Kowloon with Hongkong, unless it is constructed by a British company.

WE regret to see that the project of a meteorological observatory in Hongkong, which we have already described in NATURE, is still "under consideration." Major Palmer's very complete scheme, on which we commented at the time, was in the hands of the Colonial Office six months ago, but nothing has since been done, and there seems to be grounds for the fear that a work of much importance, local as well as general, for which funds are amply provided by the colonial authorities, will be postponed so long that the officer to whose knowledge and ability the scheme is chiefly due will have left the colony. It will be difficult and may be impossible to find a well-qualified substitute in a small community such as that of Hongkong.

THE Aëronautical Society of Great Britain propose to hold next year an exhibition similar to the one held in the year 1868 at the Crystal Palace, with the object of ascertaining the position of the science of aëronautics, and with the view of affording an opportunity to inventors to embody and exhibit the results of their labours. Several prizes will be offered, and an exhibit of balloons and all the appliances connected therewith will be invited; also of any methods for propelling a balloon or any gas vessel, influencing its direction, prolonging its life, improving its utility, &c. The Council will be glad to have an intimation addressed to the secretary, from members or others, that they are likely to exhibit, or to assist in raising the funds which will be necessary to carry out the project.

IT has been decided by the Chancellor of the Upsala University to purchase the botanical collection belonging to the famous Swedish botanist, the late Prof. Elias Fries, for a sum of 1250*l.*; the collection, however, does not include a Scandinavian Phanerogam herbarium, a collection of mosses and algæ, as well as some other objects, which have been purchased by some one, who desires to be unknown, and presented to the Botanical Museum in Upsala.

THE Swedish Diet has voted a sum of about 300*l.* towards a geological expedition to Spitzbergen in the summer of 1883, which amount will be placed at the disposal of the Academy of Science in Stockholm; it is, however, stipulated that all objects collected shall be presented to the National Museum.

INTELLIGENCE from the island of Fayal, one of the Azores, states that a violent earthquake occurred there on May 3. The shocks continued during an hour, in which time churches, public buildings, and several houses were destroyed.

AFTER efforts to domesticate several species of wild ducks in America, capturing them young, or raising them from the eggs, Mr. Lindon says (Buffalo Soc. Nat. Sci.) that none adapted themselves thoroughly to the barnyard state except the mallard, dusky duck, and Canada goose, whose progeny prospered well, and attained a greater weight and size than the ordinary domesticated stock. Some of them betray a tendency to revert in plumage, to their original condition, but the majority have been completely metamorphosed into the ordinary barnyard fowl. No hybrids from any two different wild species, which bred only within the inclosure, were ever obtained, except from crosses between the mallard and dusky duck. The mallard has been supposed to be the originator of the common tamed ducks, but the dusky duck is now pronounced to be fully as domesticable.

IN view of the vagueness of expression "rainy day" in meteorology, Prof. Schmeltz has lately devised an apparatus to register the actual duration of rain. (He was not aware of M. Redier's apparatus for this purpose). From a description in the *Journal de Physique* (May), we learn that a long band of Morse paper sensitised for rain is used. The paper is dipped in a solution of sulphate of iron, dried carefully, and coated with tannic acid, or pulverised ferrocyanide of potassium, mixed with powdered resin for better adherence. The strip is stretched between rollers, one of which is actuated by means of an endless chain from a toothed wheel on the axle of the minute hand of a common clock. It passes under a funnel in the top of a wooden case, which is open below and is fixed outside a window. By means of guide rollers it receives double inclination (longitudinal and transverse), and the rain in excess does not sensibly spread beyond the part passing under the funnel. The length which the rollers transfer during a whole day is divided into twenty-four equal parts, each corresponding, on an average, to an hour. When no rain has fallen during the day, the paper strip used may be utilised again, being easily wound on the delivering roller. This simple and cheap apparatus is said to act admirably.

A WELL-ARRANGED and instructive Popular Handbook to the Natural History Collection in the Museum of the Yorkshire Philosophical Society, has been issued by the keeper, Mr. Walter Keeping.

THE Council of the Society of Telegraph Engineers and of Electricians have determined that the Society shall offer three premiums annually for the best original papers sent in to the Society on Telegraphic or Electrical Subjects during the Session by any person not being a member of the Council of the Society. The 1st Premium will be called the Society's Premium, value 10*l.*; 2nd, the Paris Electrical Exhibition Premium, value 5*l.*; 3rd, the Fahie Premium, value 5*l.* The Premiums will consist of books or scientific apparatus. The first Premium will be awarded in 1883 for the best papers sent in between this date and the end of May next.

DR. F. A. FOREL, of Morges, informs us that the supposed lacustrine canoe referred to in NATURE, vol. xxvi. p. 67, was really a simple trough made out of a log, for the reception of spring water.

THE additions to the Zoological Society's Gardens during the past week include a Spotted Cavy (*Cœlogenys paca*) from South America, presented by Mr. V. Gibbs; a Red Brocket (*Cariacus rufus* ♂) from Trinidad, presented by Mr. H. Sandbach; a Black-breasted Sparrow (*Passer diffusus* ♂), a White-throated Seed Eater (*Crithaga albogularis*) from South Africa, presented by Mr. J. Abrahams; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Capt. E. C. B. Walker; three Midwife Toads (*Alytes obstetricans*), fourteen Alpine Newts (*Triton alpestris*) from Belgium, presented by M. G. A. Boulenger; a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♀) from West Africa, a Jackass Penguin (*Spheniscus magellanicus*) from the Falkland Islands, two Cape Crowned Cranes (*Balearica chrysopelargus*) from South Africa, a Flamingo (*Phœnicopterus antiquorum*) from North Africa, two Bernicle Geese (*Bernicla leucopsis*), two White-fronted Geese (*Anser albifrons*), a Ruddy Sheldrake (*Tadorna rutila*), a Herring Gull (*Larus argentatus*), European, a Bordeaux Snake (*Coronella girondica*), South European, deposited; a Koala (*Phascolarctos cinereus*) from Australia, two Javan Peafowls (*Pavo spicifer* ♂ ♀) from Java, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE COMET.—The following orbit of the present comet has been calculated by Mr. Hind, from observations at Harvard College, U.S., on March 19, Josephstadt (Vienna) on April 19, and one by Prof. Millosevich, at the Collegio Romano, Rome, on May 21; parallax and aberration were taken into account:—

Perihelion passage, June 10·52442 Greenwich M.T.

	° ′ ″	
Longitude of perihelion	53 55 18·0	From M. Eq., 1882·0.
,, ascending node...	204 53 56·9	
Inclination...	73 46 39·8	
Log. of perihelion distance ...	8·782864	

Motion—direct.

From these elements we find the positions near perihelion passage thus—

	d.	h.	R.A. ° ′	Decl. ° ′	Distance from Sun's centre. In R.A. ° ′	In Decl. ° ′	Intensity of Light.
June	10	0	74 58·4	+23 41·9	−3 33	+0 40	82·6
	10	6	75 50·8	+22 34·5	−2 56	−0 29	104·5
	10	18	78 0·2	+20 29·2	−1 18	−2 36	105·2
	11	0	79 16·1	+19 40·4	−0 17	−3 26	87·6

The intensity of light on May 21 has been taken as unity. The comet was then judged to have the brightness of a star of 5·6m. On May 18 Mr. G. Knott estimated it a little higher than 6·0, which fairly accords. Whence theory would raise it to over an average first magnitude at perihelion. With due precautions which will occur to most observers who have large refractors, it is now seen to be by no means improbable that the comet may be observed in full daylight, on June 10 and 11. Still it may be well to remark that as compared with the first comet of 1847, observed at noon, close to the sun, on March 30, by Mr. Hind, with a 7-inch refractor, stopped down to about 3 inches, the theoretical intensity of light at perihelion is not quite half as great; thus calling the brightness unity when the comet was first glimpsed with the naked eye, the brightness of the present comet at perihelion will be 186, while that of the comet of 1847 was 408.

By the above orbit the comet traverses the plane of the ecliptic at the ascending node 0·038 within the earth's track.

DOUBLE STARS.—No. 6 of "Publications of the Cincinnati Observatory" has been issued. It contains micrometrical measures of double stars made with the 11-inch refractor in 1879–80, consisting partly of observations preliminary to the formation of a general catalogue of known double stars situated between the equator and 30° south declination, and partly of observations of objects which Mr. Burnham has found to need re-observing. The cases of notable differences from previous measures are collected in the introduction. Mr. Ormond Stone is doing excellent work with his refractor, which appears to have been much improved since the object-glass was re-figured by Messrs. Alvan Clark and Son.

THE VARIABLE STAR U GEMINORUM.—Mr. G. Knott, writing from Cuckfield on May 29, states that he had caught a maximum of this apparently capricious variable on May 27 or 28; on both nights it was about 9·9 m. This, compared with the previous maximum noted by the same observer on February 28, gives a period of eighty-eight days.

Prof. Schönfeld finds that a star R.A. 16h. 13m. 36s., Decl. − 7° 21′·0 for 1855 is variable.

A star in R.A. 19h. 17m. 33s., Decl. − 21° 32′·3 for 1850, must be variable to a great extent—6·5 to 9·0 at least.

TEMPERATURE REGULATORS

BEFORE proceeding to the consideration of some of the means adopted for controlling temperature, more or less perfectly, it will be as well to notice two instruments, because although they are in reality only indicators, yet the latter is always referred to as a regulator.

Hall's aërometer[1] consists of a glass bulb 4½ c.i. in capacity, attached to a long tube whose capacity is 1 c.i. This tube is inserted into another of nearly equal length, and supported on a stand. The first tube admits of being sustained within the second at any given height by means of a spring. The outer tube is charged with mercury or water, according to circumstances, and the bulb and inner tube are arranged to contain, at the normal pressure and temperature, 5 c.i. of air. Any changes, therefore, in the atmospheric conditions will affect the level in the inner tube, and can be allowed for accordingly.

Doyere's regulator[2] (1848), which is on the same principle, consists of a glass bulb, to the bottom of which a fine tube is attached. This tube is bent, then carried upwards for a certain distance, is then bent again to form an inverted U-tube, the extremity is again bent upwards, and terminates in an open bulb. The lower bulb and the quill-tube are partly filled with water, the surface of which in the tube indicates by its change of position the alterations in the volume of the air contained in the bulb. The principle on which Fresenius' cast-iron drying-disk is constructed is the same which long ago led to the use of sand-baths, for it is obvious that if a large mass must be warmed before the heat can reach the substance, a rapid rise in temperature is impossible. The number of substances which can be conveniently dried at the temperature of boiling water, and the number of chemical operations which require that temperature, have led to the construction of every variety of water-bath and water-oven. With a temperature not much above the boiling point of water, the increase may be obtained by using solutions of various salts; but with these the evils of bumping and crystallisation are so great that Sprengel (1869)[3] replaced the water in a water-oven by sulphuric acid having a specific gravity of 1·55, and for that purpose constructed a leaden one of the following description: The outside case of the double-walled air-bath is a 6½-inch cube, the inside a 5-inch cube. The worm, made of about 30 feet of leaden piping of ⅜-inch diameter, is 15 inches high and 4 inches wide. The coils of the worm are kept apart from each other ⅛ inch by means of solder, and the worm is kept in its upright position by two iron supports soldered to the sides of the air-bath.

Laspeyres[4] (1874), using the same liquid, constructed two pieces of apparatus. One was a glass flask so arranged that

[1] *Q. J. Sci.* v. 52 (1818) Faraday's manip. 375.
[2] *Ann. Chim. Phys.* [3] xxviii. 5 (1850), Gerhardt 1,105.
[3] *Journ. Chem. Soc.* xxvi. 458 (1873). [4] *Pogg. Ann.* clii. 132 (1874).

the substance could be heated in a test-tube; and the other consisted of a platinum vessel so constructed that the substance could be inserted into a horizontal tube.

Although Laspeyres in the article just quoted argues most conclusively that an absolutely constant temperature cannot be maintained by controlling the gas-supply, and Jac. Myers concludes his considerations on the subject by saying, "For so long must we give up the hope of being able to regulate these temperatures at pleasure," yet the subject of temperature-regulators is one to which so many have at various times turned their attention, that a comparison of the different methods is not without interest. Most of the instruments constructed may be classified under one or another of the following heads, viz., as modified:—

Air thermometers, with mercury or other fluid arranged to control supply of gas:—(*a*) in which the mercury employed becomes more or less heated while in use; (*b*) in which the mercury or other fluid does not become heated.

Mercurial thermometers (*a*) acting directly on gas-supply; (*b*) acting on gas-supply through the intervention of electric arrangements.

Vapour-tension thermometers.

Air Thermometers (*a*).—Kemp's regulator (1852) consists of a glass tube, at one end of which an elongated bulb is blown; the part of the tube near the bulb is then bent so that the open end of the tube and the bulb are parallel.[1] Sufficient mercury is then introduced to partly fill the bulb, the remainder being occupied by air. To the open end of the tube is cemented a brass cap, which is provided at the side with the gas inlet tube, and in the centre with a stuffing box, through which the brass outlet tube slides. The temperature is adjusted by moving this tube up or down as the case may be.

Bunsen's modification made the apparatus more compact, but not so simple or easy of construction.[2] It consists of a glass cylinder whose lower part is closed, and serves as air-vessel which communicates with the upper portion by a tube reaching nearly to the bottom. In the upper portion is inserted a wide glass tube which is provided with a side-tube, and which dips into the mercury. Fastened to the upper end of this tube is the gas-supply tube, which is rather shorter, and which has a fine opening in it. The position of these tubes is adjusted by the screw-thread in a brass cap, which works on a corresponding thread in the supply tube. The two parts of the apparatus are held together by a spring (in the newer patterns this is replaced by a pin working in a groove).

His low-temperature regulator has a much larger air-chamber, so as to increase its sensitiveness.[3] It is also provided with a side-tube fitted with a stopcock, so that mercury may be added or drawn off at pleasure. Guthrie[4] (1868) constructed a regulator on Kemp's principle, but attached the top of the vertical tube to the bottom of an U-tube which the gas had to traverse, so that the mercury on rising checked the flow. The adjustment consisted of a side tube (bent at a right angle) attached to the vertical tube; in that tube a glass rod could be raised or depressed, being held in its position by passing through a perforated cork. Müncke's[5] (1876) is very similar to Bunsen's, but the brass cap and fittings are entirely dispensed with, as the gas-supply pipe works stiffly through a perforated cork which fits the top of the tube

Air Thermometers (*b*).—Schorer[6] (1870) used for an air-vessel a test tube 60 mm. × 14 mm., fitted with an india-rubber cork, and connected by a narrow tube with one limb of an U-tube, partly filled with mercury, the other limb being fitted with the control arrangement of Bunsen's pattern.

Clowes[7] (1871) constructed an apparatus on the same principle, but added a small outlet tube at the bottom of the U-tube, so that by means of an india-rubber tube, which is closed by a screw clip, the mercury level in the U-tube may be adjusted. In his apparatus the gas exit consisted of a glass tube passing through a perforated cork.

Jeannel[8] (1872) used a metallic air-vessel of 300–400 c.c. capacity, communicating, as in Schorer's, with an U-tube (charged, however, with glycerine instead of mercury). The pressure of the air in the vessel is regulated by means of an india-rubber ball, which is fitted (by means of a T-piece and stopcock) to the

[1] Williams, "Chem. Manip.," 49.
[2] Desaga's "Price List," Fig. 614.
[3] Desaga, Fig. 1,078.
[4] *Phil. Mag.* xxxvi. 30 (1868); Strecker's "Jahresb.," 78 (1868).
[5] *Ding. Polyt. Journ.* 219, 72 (1876).
[6] *Fres. Zeit. Anal. Chem.* ix. 213 (1870).
[7] *Journ. Chem. Soc.* xxiv. 639 (1871).
[8] *Ann. Chim. Phys.* [4]. xxv. 386 (1872).

connecting tube. The flow of gas is controlled by means of a float in the other limb of the U-tube, which approaches or recedes from the end of the gas-delivery tube. The float is held steady by a guide needle, which is fixed to the upper extremity by means of sealing-wax. He mentions Steling's regulator, but gives no reference.

Martenson[1] (1872) used an air-chamber 14 c.m. long × 2 c.m. diam., and connected it by means of a fine tube with a modified U-tube charged with mercury. The rough adjustment is made by a fine opening in the narrow tube, which is closed by slipping an india-rubber tube over it, and the final adjustment is made by means of the gas-delivery tube, which works air-tight through a cork. A side branch to the U-tube serves as a by-pass.

J. Myers[2] (1872).—In this apparatus the air-vessel consists of four tubes 15 c.m. long × 2 c.m. diam. connected together by small tubes, and which then communicate with a regulator similar to that which Schlösing uses.

Cresti[3] (1878) employs a glass apparatus consisting of a horizontal air-vessel 15 c.m. long × 2 c.m. diam.; to this is attached at right angles a glass regulator of the Bunsen-Kemp pattern, the communication between the two being made by a capillary tube which enters the upper part of the air-chamber of the regulator. It is however a form of regulator which would require to be well screened from draughts, as so much of it is exposed.

Mercurial Thermometers (*a*).—Carmichael's[4] (1870) arrangement consists of a tube 40 cm. long by 6 mm. diameter, closed at one end, so that when filled with mercury it forms an elongated thermometer. This is bent according to the bath in which it is immersed, but is so arranged that the open end is vertical; near this end is affixed a side tube of 2 mm. diameter. This tube, after bending upwards, bifurcates. Into the open end of the larger tube a cork is fitted, through a hole in which a glass rod slides. This rod serves as a regulator to adjust the level of the mercury in the side tube.

In Hannay's[5] (1874) arrangement the principle is the same as in the preceding, except that the adjustment is effected by means of a piston in the side tube, which is graduated, while the main tube is bifurcated. It is open however to the objection that the gas has to pass over heated mercury.

Schlösing[6] (1870) used a very fine tube of considerable length (suitably bent) as the mercury reservoir, and led the open end of it into one of the horizontal arms of a T-piece. The other horizontal arm carried the inlet-pipe of the gas, which passed to the burner through the vertical arm. The escape of the mercury from the reservoir was prevented by a piece of sheet india-rubber, which was tied over the end of the tube. As the mercury expanded it forced this elastic cap to assume a globular form, and thus checked the supply of gas. The quantity of mercury in the reservoir was adjusted by means of a side-tube provided with a stop-cock (Fig. 4). The outer tube of Fig. 1 is replaced by a four-branched bulb which contains the extremities of the reservoir and of the gas entrance tube; but these are separated by a small wooden disk with a handle attached, which is fixed in the upper branch, and which rests lightly on the india-rubber sheet. The diameter of the gas tube no longer depends on that of the india-rubber; it can be larger, and the opening gaining in circumference can be diminished to become so narrow that the slightest movement of the disk closes it. Total extinction of the flame is prevented by a small radial groove on the disk.

Reichert[7] (1872) constructed his regulator by expanding the top of the thermometer tube so as to form an elongated bulb. In the top of this bulb was fixed the gas-inlet tube, which nearly reached the lower extremity of the bulb. A side tube served as gas exit. The adjustment was effected by means of a screw which worked in a cap cemented on to a side tube in the stem of the thermometer.

Milne-Edwards[8] (1872) describes a regulator similar to Reichert's, but does not specify what shape or description of bulb he employs.

Schäfer's[9] (1874) is essentially the same as the preceding, except that the inlet tube is a small steel tube with slit at lower extremity.

[1] *Pharm. Zeit. f. Russ.* xi. 136 (1872); *Chem. Centr.*, 513 (1872); *Journ. Chem. Soc.* xxvi. 471 (1873).
[2] *Deut. chem. Ges. Ber.* v. 859 (1872); *Chem. News*, January 10, 1873.
[3] *Gazz. Chim. Ital.* viii. 292 (1878); *Journ. Chem. Soc.*, abst., 294 (1879).
[4] *Chem. News*. November 3, 1871.
[5] *Journ. Chem. Soc.* xxvii. 206 (1874).
[6] *Ann. Chim. Phys.* [4] xix. 205 (1870); *Fres. Zeitsch.* ix. 477 (1870).
[7] *Pogg. Ann.* clxiv. 467 (1872); *Fres. Zeitsch.* xi. 34 (1872).
[8] *Ann. Chim Phys.* [4] xxv. 390 (1872).
[9] *Quart. Journ. Micro Sci.* 354 (1874).

Page[1] (1876).—The regulating arrangement is the following: A piece of glass tube about seven-sixteenths of an inch diameter and 1½ inch long is fitted at one end with a short round cork; through the centre of this cork a hole is bored, so that the stem of the thermometer just fits in it; the other end of this glass tube is closed by a short tightly-fitting india-rubber cork, which is pierced by a fine brad-awl through its centre. Into the hole thus formed is forced a piece of fine glass tubing three inches long and small enough to fit loosely inside the stem of the thermometer. The gas enters by this fine tube.

Fletcher[2] (1876) stated that he had for some time used a similar regulator, but that the thermometer had an iron bulb capable of containing two or three pounds of mercury. He also reversed the direction of the gas.

Mercurial Thermometers (*b*).—Scheibler[3] (1865) devised the following arrangement. In the bath or chamber which is being heated is placed an electric thermometer; this communicates with an electro-magnet which is inclosed in a small metallic chamber through which the gas for the burner has to pass. When by a rise in temperature the circuit is closed, the hinged armature of the magnet is brought into contact with the opening of the gas inlet-tube, and is not liberated until a fall in the temperature breaks the circuit.

O. Zabel[4] (1867) placed in communication with an electric thermometer a contrivance which consisted of two electro-magnets acting on a hinged metallic screen. The completion of the circuit by a rise in temperature placed the screen over the flame, and thus checked the heat.

J. Maistre[5] (1866) recommended an electric thermometer connected with an electro-magnet, the armature of which could remove the gas-burner from under the bath, or which could be connected by means of a lever with the gas-supply tap.

Springmühl[6] (1871) arranged an electro-magnet with a hinged armature, so that on the completion of the circuit a weight attached to a lever closed the gas-tap, which was not opened until the release of the armature liberated a spring which acted in the opposite direction.

Vapour-tension Thermometers.—Appold's[7] consists of a glass tube having a bulb at each end. The tube is filled, as also about half of each bulb, with mercury; the lower bulb containing ether to the depth of half an inch, which floats on the mercury. The tube is secured to a plate of boxwood, supported on knife-edges, on which it turns freely. At the end of the plate, underneath the higher bulb, is a lever, which controls the supply-valve of a gas-stove or the damper of a furnace. With a rise in the temperature the increased tension of the ether-vapour drives more mercury into the upper bulb; this end then falls. With a diminished temperature the reverse action takes place.

Andreae's[8] (1878) is like Kemp's and various others, on the principle of an U-tube with one limb closed. It is, however, rendered more sensitive by the introduction of a certain quantity of a volatile liquid into the air space. It must be borne in mind that the liquid must be selected according to the temperature required, as it is obvious that the regulator cannot be used in any case where it has to be heated beyond the boiling-point of the liquid.

Benoit[9] (1879) constructed an apparatus in which he regulated the temperature by adjusting the pressure on the volatile liquid contained in the bulb. The following is the arrangement:—A small reservoir, which can be shaped to suit the oven or bath in which it is placed, holds the volatile liquid. This is connected by means of a tube from the bottom, to which is attached an india-rubber tube, to a regulator of the same pattern as that used by Reichert. The regulator is fixed on a board which can be raised or lowered, and is provided with two side tubes for adding or drawing off mercury at will.

By-pass.—Since it is obvious that in cases where the quantity of gas required to pass through the regulator is large, any perceptible increase in the pressure or the supply from the main must be accompanied by a rise in the temperature of the bath, it is advisable therefore to adjust the by-pass tap so that as small a quantity as possible shall have to pass through the regulator. Here, however, experience must decide how wide a margin must be left to the control of the regulator, for in some districts the difference between the day and evening pressures is so great that adjustment becomes a matter of great difficulty. In some laboratories, especially when near a suburban gas-works, the day pressure is so low and the evening pressure is so high that unless a pressure regulator be interposed between the main and the temperature regulator, the by-pass cannot be used.

[1] *Journ. Chem. Soc.* i. 24 (1876). [2] *Journ. Chem. Soc.* i. 488 (1876).
[3] Carl Repert, "Exp. Phys." iv. 122 (1868); *Fres. Zeit. Anal. Chem.*, vii. 88 (1868).
[4] *Ding. Polyt. Journ.* 186, 202 (1867); *Fres. Zeit. Anal. Chem.* vii. 239.
[5] *Les Mondes*, x. 271 (1866).
[6] *Ding. Polyt. Journ.* ccii. 242 (1871); *Fres. Zeit. Anal. Chem.* xi. 431.
[7] *Proc. Roy. Soc.* xv. 144 (1866). [8] *Ann. Phys. Chem.* iv. 614 (1878).
[9] *Séance de la Soc. Franc. de Phys.*, 6 (1879).

Bunsen's[1] thermostat is the vessel in which he maintains a constant temperature, and which is used by him in his vapour density method. It consists of a sheet-copper cylinder, from which at seven places equally distant from each other project pairs of copper rods 7-8 mm. thick, which are riveted and brazed into it. These rods are heated by gas flames, and the temperature is adjusted by moving the burners to or from the cylinder; but in order to maintain it as constant as possible, the apparatus must be carefully screened and the heights of the flames kept nearly equal by means of a gas-regulator, and the flames must reach a height sufficient to keep both the copper rods in the middle part of the flame, and not to have the upper rod heated only by the extreme point of the flame.

Hipp's[2] (1868) regulator, which is described by Hirsch (and is therefore sometimes referred to as Hirsch's), consists of a bent compound metallic strap, *steel* on the outside and brass on the *inside*. The ends thus approach with a falling temperature. The one end is fixed securely inside the air-bath, and the free end communicates by means of a fine copper wire with a regulating screw which connects it with a bent rod carrying the gas-control valve.

Flow of Liquid.—Dupré and Page[3] (1869). The water-bath contains a coil of metal-tube like an ordinary condenser. The lower end of this coil is connected with a second and smaller worm, which is contained in a small water-bath. The latter is heated by a lamp and kept gently boiling. The lower end of this second worm is bent upwards and terminates in a long funnel. Any water poured into this funnel will pass first through the worm surrounded by boiling water, and be thus heated, and then through the tube in the water-bath containing the specific-gravity bottle. By regulating the flow of water the temperature of this water-bath can be raised quickly, or kept constant at any desired point.

Stricker and Burdon-Sanderson[4] (1870).—In this apparatus, which is especially arranged for heating the stage of a microscope, the temperature is adjusted by regulating the flow of boiling water, through the hollow stage, by means of a compression clamp. As the water in the small boiler is kept at a constant level by means of an overflow, the supply when once adjusted remains uniform.

The exceedingly accurate method of maintaining a constant temperature by controlling the pressure under which a liquid in an outer casing is made to boil, is one that depends so essentially on pressure that its consideration must be reserved for the paper on Pressure-regulators.

J. T. BROWN

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The establishment of the Waynflete Professorship of Physiology was provided for by the late University Commission, it being arranged that the emoluments of the post should be paid out of the funds of Magdalen College, to which college the Professor is to be attached as a Fellow. Magdalen College had already shown interest in the development of physiology, and has for some years past maintained a physiological laboratory, in which Mr. Yule, Fellow of the College, has given courses of instruction in Practical Physiology, open to all members of the University, and his lectures have been attended by all candidates for honours in physiology, such instruction not having been available elsewhere in Oxford. Since the passing of the new statutes, the Linacre Professorship has become confined to Human and Comparative Anatomy, and there has been no University representative of physiology. The want of a Professor of Physiology has lately been very strongly felt, especially as the number of candidates in the subject has much increased. It is understood that Magdalen College, acting on the representations of the University to that effect, has determined to apply such surplus funds as are avail-

[1] *Liebig's Ann.* cxli. 273 (1867); *Phil. Mag* xxxiv. 1 (1867).
[2] Carl Bepert. "Exp. Phys." iv. 201 (1868); *Dingl. polyt. Journ.* cxci. 366 (1869).
[3] *Phil. Trans.* clix. 608 (1869). [4] *Q. J. Micro. Sci.*, 366 (1870).

able at once to the foundation of the professorship, and it is expected that an election to the post will therefore take place shortly. All praise is due to the college for having thus promptly acted in the best interests of science in the University, and given this professorship precedence amongst several other schemes which might have been carried out by it first instead. The Profesor is required by the Statutes to give instruction in Human and Comparative Physiology, with histology.

CAMBRIDGE.—The annual report of the Museums and Lecture Rooms Syndicate at Cambridge has contained in past years no more valuable record of work than that lately issued. Taking first the department of experimental physics, we learn that sixty-two students were attending the practical classes in the Lent term, doing work which few of the candidates for the mathematical or natural sciences triposes ever did at Cambridge before the establishment of the Cavendish Laboratory. The pupils in mechanism in Prof. Stuart's workshop have numbered thirty-six during the past winter. In chemistry the increase in the students has considerably exceeded the accommodation available in the University laboratory, notwithstanding the existence of several college laboratories. Professors Liveing and Dewar plead strongly for further provision as regards both buildings and appliances, such as may bear comparison with those of Zurich and Bonn; they believe that to delay building until other departments can be adequately dealt with will be most detrimental to the present flourishing prospects of chemistry. A new register of the specimens in the mineralogical museum is completed; but the want of additional apparatus is seriously felt. Prof. Hughes records the use of the Arts School as a lecture-room, and the arrangement for additional class and work-rooms in the Woodwardian museum. The accessibility of the collections, and the determinations being kept up to date, attract many geologists who wish to pursue special investigations. Among the additions to the collections are 700 species of Pliocene shells from Tuscany, casts of vertebrates from Lausanne Miocene, 270 species of Miocene shells from the Vienna basin; Upper greensand corals from Devonshire, many Cretaceous specimens from the neighbourhood of Cambridge, 450 specimens from Neocomian of Saint Croix, Switzerland, and casts of *Hesperornis regalis*, Marsh, from Kansas; several hundred specimens from Portland Sands, Swindon, Wilts, collected by Mr. H. Keeping, the curator of the museum; numerous specimens of rocks and building-stones.

Turning, now, to the biological departments, the Woodward and Hepburn collections of shells have been carefully examined and catalogued by the curator, Mr. A. H. Cooke. The report gives notes upon the principal families of mollusca, as represented in the museum, with indications of gaps in the series; it should be widely circulated in the interest of the museum itself, as many old University students must have it in their power to supply deficiencies at a slight cost of trouble to themselves. Mr. Salvin reports that his catalogue of the Strickland collection of birds is complete, making an octavo volume of 653 pages. The species in the collection number 3125. Mrs. Strickland has presented a further portion of the valuable library of her late husband to the museum. In Amphibia and Reptilia the collection is still relatively poor. A beautiful skeleton of Menopoma has been prepared by W. Robinson, one of the assistants in the museum, and a considerable number of skeletons and skins of representative genera in these groups has been added. Among the mammalian acquisitions should be mentioned the skeleton of a male giraffe purchased from the Zoological Society; a skeleton of a mare, presented by Mr. R. Pryor, of Trinity College; skeletons of a ringed seal, a bladder-nosed seal, and a Polar bear, all carefully killed and preserved, so that the bones were neither injured nor missing, as is too often the case. A complete skeleton of an Indian elephant has been given by Sir John Phear, and a less perfect skeleton of an individual of the same species, sent from Calcutta through the kind exertions of Sir Joseph Fayrer. English additions of interest continue to be made, such as a male badger, an adult male otter from Norwich, and a female wild cat from Sutherlandshire.

The average number of students working at physiology practically is now over 100. Mr. Balfour's classes in practical morphology have very nearly attained the same numbers. More demonstrators are seriously needed. Mr. Vines has been assigned a small room for practical botany, but the advanced students can only do their work by the course being repeated two or three times, since only ten students can work at once. Elementary students are at present unprovided with any space for practical study.

Prof. Paget, in reporting on the department of medicine, strongly urges the speedy appointment of a Professor of Pathology, and the provision of a Pathological Laboratory. The Museum of Human Anatomy has been enriched by sixteen models of the brain and other models, prepared by the late Mr. Joseph Towne, modeller to Guy's Hospital, presented through Mr. T. Bryant.

One further note should be made, calling attention to the magnificent presents made to the Philosophical Library, on its transfer to the new room, and being made available for all students in the museums, by Mr. J. W. Clark, Prof. Humphry, Mr. F. M. Balfour, Prof. Babington, Prof. Newton, and others. Mr. Clark's gift is of priceless value to the science school, including as it does several hundreds of volumes of the most valued and superb editions of zoological and anatomical works.

The Hopkins Prize for the best original memoir, invention, or discovery in connection with mathematics physical or mathematics experimental science that may have been published during the three years immediately preceding, has been awarded to Lord Rayleigh, M.A., F.R.S., of Trinity College, Professor of Experimental Physics in the University, for his various important papers connected with the theory of vibrations, and particularly for his paper on "The Theory of Resonance."

Prof. Humphry announces practical classes in histology by the Demonstrator, Mr. Hill, and in osteology by Mr. Wheny, during July and August.

The Cavendish Laboratory will be open to students obtaining permission from the Professor during July and August, and the Professor or one of the Demonstrators will attend daily.

It has been decided to confer the Honorary Degree of LL.D. on Prof. J. P. Cooke, the eminent Professor of Chemistry in Harvard College, U.S.

The opening of the Botanic Garden during three hours on Sundays to members of the Senate and friends accompanying them has been confirmed by 88 to 76 votes.

MR. H. S. HELE SHAW has been appointed Professor of Engineering at University College, Bristol, vice Dr. J. T. Main, elected Assistant Professor of Mechanics at the Normal College of Science and Royal School of Mines, South Kensington. Mr. Sidney Young, D.Sc. London, succeeds Mr. W. L. Goodwin as Chemical Lecturer and Demonstrator, the latter having obtained the professorship of Sackville College, New Brunswick, Canada.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 11.—"On the Organisation of the Fossil Plants of the Coal-measures," part xii. By Prof. W. C. Williamson, F.R.S.

At the recent meeting of the British Association at York, Messrs. Cash and Hick read a memoir, since published in part iv. of vol. vii. of the *Proceedings* of the Yorkshire Geological and Polytechnic Society, in which they described a stem from the Halifax Carboniferous deposits characterised by a form of bark hitherto unobserved in those rocks. To this plant they gave the name of *Myriophylloides Williamsonis*. It was characterised by having a large cellular medulla, surrounded by a thin vascular zone composed of short radiating lamellæ. This, in turn, was invested by a cylinder of cortical parenchyma from which radiated a number of thin cellular laminæ, like the spokes of a wheel, separating large lacunæ. Each lamina generally consisted of a single series of cells. At their peripheral end, these laminæ merged in a thick, large-celled, cortical parenchyma. The generic name, Myriophylloides, was given to the plant because of the resemblance between sections of its cortical tissues and those of the recent Myriophyllum. Two reasons induced the author to object to this name (NATURE, December 8, 1881, p. 124), and to propose the substitution of that of Helophyton. Such substitution, however, was rendered unnecessary by the discovery, by Mr. Spencer, of Halifax, of some additional specimens which indicate that the supposed new plant was merely the corticated state of the Astromyelon, described by the author in his Memoir, part xi. (*Phil. Trans.*, 1878). These specimens showed that the plant was more complex than had been supposed, different ramifications of it having each their individual peculiarities.

In some of the new specimens the vasculo-medullary axes present no differences from those of the Astromyelon already described. The radiating lines of cells separating the laminæ prove to be transverse sections of elongated vertical laminæ composed of cells with a mural arrangement, and which separate large vertical lacunæ of varying lengths; a type of cortical tissue clearly indicating a plant of aquatic habits. So far as this bark is concerned, all the ramifications of the plant display similar features, but several of the specimens exhibit important variations in the structure of the vasculo-medullary axis. In them the central cellular medulla is replaced by an axial vascular bundle, which has little, or in some examples apparently no, cellular element intermingled with the vascular portions. In some examples this axial bundle is invested by the thick exogenous zone seen in Astromyelon. In others that zone is wholly wanting. Yet there appears to be no reason for doubting that these are but varied states of the same plant which branched freely, the differentiated branches having, doubtless, some morphological significances, as yet incapable of being explained. That the plant was a Phanerogam allied to Myriophyllum, is most improbable. It has several features of resemblance to the Cryptogamic Marsileæ, from which it does not differ more widely than the fossil Lepidodendra do from the living Lycopodiaceæ.

The author describes a new specimen of *Psaronius Renaultii*, found by Mr. Wild, of Ashton-under-Lyne. Those previously described, consisted almost entirely of fragments of the bark and its ærial rootlets. The present specimen contains a perfect C-shaped fibro-vascular bundle and a portion of a second one, resembling some of those described by Corda, and which leave no room for doubting that our British Coal-measures contain at least one arborescent fern, equal in magnitude to those obtained from the deposits at Autun.

In his Memoir, Parts IX. and X., the author described, under the provisional generic name of Zygosporites, some small spherical bodies with furcate peripheral projections. Similar bodies had been met with in France, and were regarded by some of the French palæontologists as true Carboniferous representatives of the Desmidiaceæ. The author was unable to accept this conclusion, deeming it much more probable that they would prove to be spores of a different kind. Mr. Spencer exhibited the specimen now described at the York meeting. It is a true sporangium, containing a cluster of these Zygosporites. Though they undoubtedly bear a close superficial resemblance to the zygospores of the Desmidiæ, their inclosure within a common sporangium demonstrates them to be something very different. There is now no doubt but that they are the spores of the strobilus, described by the author in his Memoir, Part V., under the name of *Volkmannia Dawsoni*. Hence the genus Zygosporites may be cancelled.

Another interesting specimen found by Mr. Wild, is a young Calamite, with a more curiously differentiated bark than any that has hitherto been discovered. The structure of the vascular cylinder and of the innermost layer of the bark, differs in no essential respect from those previously described; but the outermost portion displays an entirely new feature. It consists of a narrow zone of small longitudinal prosenchymatous bundles, each one having a triangular transverse section, the apex of each section being directed inwards, whilst their contiguous bases are in contact with what appears to be a thin epidermal layer. As in every previously discovered Calamite in which the cortex is preserved, the peripheral surface of this specimen is perfectly smooth or "entire." It displays no trace of the longitudinal ridges and furrows seen in nearly all the traditional representations of Calamites figured in our text-books.

It has long been seen that the medullary cells of the Lepidodendra, as well as the vessels of their non-exogenous medullary sheaths, steadily increased in number as these two organs increased in size correlatively with the corresponding general growth of the plants. But the way in which that increase was brought about has continued to be a mystery. The author now describes a Lepidodendron of the type of *L. Harcourtii* in which nearly every medullary cell is subdivided into two or more younger cells, showing that, when originally entombed, the pith was an extremely active form of meristem, though the branch itself had attained to a diameter of at least two inches. The numerous small young cells are of irregular form. Their development by further growth into a *regular* parenchyma would inevitably necessitate a corresponding increase in the diameter of the branch as a whole; and it must have been from these newly-formed cells that the medullary cylinder obtained the element out of which to construct the additional vessels, the increase of which has been shown to be the invariable accompaniment of the growth of the branch. As might be expected, the growth of the vascular cylinder, or medullary sheath, could only have been a centripetal one.

A new form of Halonia from Arran is described. Instead of its central portion consisting, as in previously-described examples, of the usual Lepidodendroid medulla surrounded by a vascular cylinder, it consists of a solid axis of vessels, resembling in this respect all the very young Lepidodendroid twigs previously described from the same locality. Many recently obtained specimens of Lepidodendroid branches sustain the author's previous observations that all examples from Arran having less than a certain diameter, have the solid axial bundle, whilst all above that diameter have a cylindrical vascular bundle inclosing a cellular medulla. The first type commences with the smallest twigs, and is found increasing gradually up to the diameter referred to. The second type begins where the other ends, and increases in diameter until attaining the dimensions of the largest stems, in none of which does the solid bundle reappear. Halonial branches have not hitherto been described attached to the branches of any true Lepidodendron, though in 1871 (Memoir, Part II.), the author gave reasons, based upon organisation, for insisting that Halonia was a fruit-bearing branch of a Lepidodendroid tree. This conclusion was sustained by Mr. Carruthers in 1873 in his description of a branch belonging to a Lepidophloios. The author now figures a magnificent example, from the museum of the Leeds Philosophical Society, of a dichotomous branch of a true Lepidodendron of the type of *L. elegans* and *L. selaginoides*. In this specimen every one of the several terminal branches bears the characteristic Halonial tubercles. The leaf scars of these latter branches have the rhomboid form, once deemed characteristic of the genus Bergeria, whilst those of the lower part of the specimen are elongated as in *L. elegans*, &c. These differences are not due to their appearance in separate cortical layers of the branch, but to the more rapid growth in length of its lower part compared with its transverse growth.

The author throws some additional light upon the structure of Sporocarpum ornatum, described in Memoir, Part X., as also upon the nature of the development of the double leaf-bundles seen in transverse sections of the British Dadoxylons, described in Memoir IX. After a prolonged but vain search for a structure similar to the latter amongst the twigs of the recent Conifers, the author has at length found it in the young twigs of the *Salisburia adiantifolia*. Sections of these twigs made immediately below their terminal buds exhibit this germinal arrangement in the most exact manner. Pairs of foliar bundles are given off from the thin, exogenous Xylem zone which encloses the medulla, whilst at the same points the continuity of the Xylem ring is interrupted, as was also the case with the Dadoxylons, by an extension of the medullary cells into the primitive cortex. Sections of the petiolar bases of the leaf-scales of the bud show that these bundles enter each petiole in parallel pairs, subsequently sub-dividing and ramifying in the Adiantiform leaf. This curious resemblance between Salisburia and Dadoxylon, accompanied as it is by other resemblances in the structure of the wood, bark, and medulla, suggest the probability that our British Dadoxylon was a Carboniferous plant of Salisburian type, of which Trigonocarpum may well have been the fruit. If so, the further possibility suggests itself that this plant may have been the ancestral form whence sprang the Baieras of the Oolites, and, through them, the true Salisburias of Cretaceous and of recent times.

Linnean Society, May 4.—Sir J. Lubbock, Bart., F.R.S., president, in the chair.—Dr. Cuthbert C. Gibbes was elected a Fellow.—The Council and Fellows passed a resolution of sympathy with the family of the late Mr. Chas. Darwin.—The Rev. R. P. Murray called attention to specimens of *Carex montana* obtained at Heathfield, Sussex, corroborating Mr. Roper's late rediscovery of the plant in that county.—Mr. J. Murison exhibited dried examples of *Helipterum eximium* from the Cape, of *Ixodia achilleoides* from South Australia, and of jungle cotton from Nagpoor.—A paper was read, on a collection of algæ from the Himalayas, described by Prof. G. Dickie.—A communication was made, referring to new varieties of the sugar-cane produced by planting in apposition, as asserted by experiments of the Baron de Villa Franca and Dr. Glass of Rio de Janeiro. In correspondence which had passed between the authors and Mr. Chas. Darwin, the latter had expressed doubts as to whether two varieties could affect the character of the buds produced by either, it appearing more probable to him that the so-called new variety was due to bud-variation. The Baron de Villa Franca thereupon forwarded a document signed by eight distinguished Brazilians, testifying to the fact that valuable varieties have been raised by the process in question. Dr. Glass furthermore describes in detail his early but fruitless attempts to graft two varieties of the sugar-cane, though he succeeded with another monocotyledon, viz. *Dracæna*.—Mr. S. Grieve gave a notice of the discovery of remains of the Great Auk (*Alca impennis*) on the Island of Oronsay, Argyllshire. Wing and leg-bones were obtained, along with a various assortment of remnants of the Guillemot, Red Deer, Otter, Seal, and other mammals, mingled with fish-bones and shells. These were dug out of a large mound, which, the author believes, must in early times have been occupied by man. The exceeding rarity of the Garefowl remains in Britain gives a special interest to the record of their being found in these western Scottish Isles.—Then followed the reading of notes on some Cape orchids, by Mr. Harry Bolus, wherein several new species were described, and details given in elucidation of particular structural points in the flowers of certain forms, accompanied by a full list of the Cape orchids named by previous writers.—A note was read, on the dimorphic florets of *Catananche lutea*, by Mr. B. D. Jackson, which was followed by a paper on the clasping organs auxiliary to the generative parts in certain Lepidoptera, by P. H. Gosse. After some general remarks the latter author mentioned his mode of manipulation, and proceeded to a description of the organs in question, finally dealing with the modification of the apparatus as investigated in a very considerable number of species.

Zoological Society, May 16.—Osbert Salvin, F.R.S., vice-president, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of April, 1882, and called special attention to the following birds, all of which were said to be new to the collection:—(1) a male Rifle-bird (*Ptilorhis paradisea*), in immature and worn plumage, changing very slowly into the adult dress, but apparently in good health; (2) a pair of Black-headed Tragopans (*Ceriornis melanocephala*); (3) four Rüppell's Parrots (*Pœocephalus rueppelli*), from Western Africa; (4) a Western Black Cockatoo (*Calyptorhynchus naso*), conspicuously differing from the eastern *C. banksi* in its smaller size; (5) a male Cabot's Tragopan (*Ceriornis caboti*), making a fine addition to the gallinaceous series; and (6) two of the recently described Uvæan Parrakeet (*Nymphicus uvæensis*).—There was exhibited, on behalf of Mr. Henry Stevenson, a specimen of the Dusky Petrel (*Puffinus obscurus*), which had been picked up dead in the neighbourhood of Bungay, Norfolk, in 1858.—A communication was read from the Rev. O. P. Cambridge on some new genera and species of *Araneidea*. Of the sixteen species described, two were from Caffraria, one from St. Helena, two from Ceylon, and the remaining eleven from the Amazons.—Mr. W. A. Forbes called attention to a peculiarity recently observed in a young male specimen of *Pithecia satanas*, in which the third and fourth digits of both hands were completely "webbed."—Mr. W. A. Forbes also read a paper on certain points in the anatomy of the Todies (*Todus*), and on the affinities of that group. He dissented from the views of most previous authors as to the close affinities of these birds to the *Momotidæ*, considering that they must form a group by themselves, to be called *Todiformes*, of value equivalent to the *Pici-*, *Passeri-*, and *Cypsëli formes* of Garrod. There were many grounds for supposing that *Todus* is a very ancient form, more nearly representing the ancestors of the whole group of Anomalogonatous birds than any other living form.—A communication was read from Mr. Roland Trimen, F.Z.S., containing a description of an apparently undescribed Sun-Bird obtained in the province of Mossamedes, South-western Africa, which he proposed to name *Cinnyris erikssoni*, after its discoverer Mr. Abel W. Eriksson.—Mr. P. L. Sclater read some notes on a species of Duck (*Anas gibberifrons*), examples of which had recently bred in the Society's Gardens.—Mr. W. E. Forbes gave an account of some points in the anatomy of a rare Australian Duck *Biziura lobata*) from examples that had recently died in the Society's Menagerie.

Physical Society, May 20.—Prof. Fuller in the chair.—Prof. W. Chandler Roberts, F.R.S. communicated the results he had obtained in repeating the experiments of M. W. Spring, Professor at the University of Liége, on the union of finely-divided particles of metal by pressure. M. Spring had shown that at a pressure varying from 5000 to 7500 atmospheres, metallic filings may be united into coherent discs. Thus at a pressure of 6000 atmospheres bismuth filings may be united into a disc which has a crystalline fracture and a density which is identical with that of the metal cooled from the molten state. Zinc again, also a very crystalline metal, will weld into a disc at a pressure of 7000 atmospheres, and the metal will even "flow" into cracks between the die and the collar surrounding it, just as in the experiments of M. Tresca, lead "flowed" under similar circumstances. Prof. Roberts had repeated and confirmed many of the experiments of M. Spring, whose more recent results are of special interest, as he has shown that if filings of bismuth, lead, and cadmium be *mixed* in suitable proportions, such, for instance, as in Wood's alloy; and if the mixture be submitted to a pressure of 7500 atmospheres, an *alloy* is obtained which will actually fuse at 70° C. the true fusing point of Wood's alloy being 63° C. Prof. Roberts showed to the Society an alloy he had prepared which melted below 100° C., although of the constituent metals the lowest melting-point is 230° C., and he pointed out the great interest both to the physicist and metallurgist of M. Spring's results.—Mr. Walter Baily then showed mathematically that the repulsion between the magnet and revolving copper disc in the experiment shown by Prof. Guthrie at the last meeting of the Society ought to vary as the square of the velocity of rotation of the disc, a result which Prof. Guthrie had found.—Mr. Lecky gave the results of tests of Mr. Bennet's cell (described at the last meeting) made by Prof. Guthrie. The electromotive force was 1·14 volts; the internal resistance 0·8 ohms, but both quantities vary under certain conditions. Prof. Macleod also gave the results of tests made by him. These show that the cell rose in E.M.F. from 1·005 volts on changing to 1·213 volts after standing three days. The internal resistance was then 1·007 ohms. Both quantities varied under different conditions of working.—Mr. C. V. Boys then exhibited an improved form of his vibratory meter for measuring electric currents, and specially designed for electric lighting purposes. He has applied to the form formerly shown to the Society, the contact-making device employed in Hipp's electric clocks, which, though imperfectly adaptable to the clocks, is perfectly adaptable to the meter. The force is proportional to the displacement. No sliding contacts are employed. Mr. Boys also explained some other plans for current meters, one of which he believes to be the final form for practice, and which, besides being remarkably simple in construction, is free from the objection of being tampered with by means of extraneous magnets. In reply to Prof. Foster he stated that self-induction does not disturb their action.

PARIS

Academy of Sciences, May 22.—M. Jamin in the chair.—The following papers were read:—Note on the application of a theory of Poncelet to approximate calculation of the arcs of plane curves, by M. Resal.—Researches on the absorption of gases by platinum, by M. Berthelot. He investigates the liberation of heat in absorption of hydrogen and oxygen by platina in different states. It is shown that the state of porous bodies changes continually while they absorb gases.—Action of oxygenated water on organic substances and fermentations, by MM. Bert and Regnard. *Inter alia*, dilute oxygenated water stops fermentations due to living organisms, and putrefaction of all substances which do not decompose it; it does not act on diastasic fermentations. It is rapidly destroyed (under 70°) by collagenous azotised matters, by musculine, blood fibrine, and azotised vegetable matters; but not by fats, amylaceous matters, soluble ferments, egg albumen, caseine, peptones, creatine, creatinine, or urea.—Reply to objections made by M. de Lesseps in the last *séance*, by M. Cosson.—A new scientific cruise of the *Travailleur* in the Atlantic, in July and August, as far as Madeira and the Canaries, was announced by M. Alph. Milne-Edwards.—M. Demontzey was elected Correspondent in Rural Economy, in room of the late M. Pierre.—On the measurement of carbonic acid contained in the atmosphere, by M. Mascart. He describes a method based on direct measurement of the diminution of pressure of a mass of air at constant volume and temperature, when the CO_2 is removed. Travellers may take about 500 cc. of air in glass tubes sealed at a lamp, and afterwards analyse at leisure.—Quantity of carbonic acid contained in the air at Colèves, near Nyon (Switzerland), altitude 430 m., by M. Risler. The general average for three years is 3·035 vols in 10,000.—Inoculability of tuberculosis by respiration of consumptives, by M. Giboux. In these experiments air expired by animals in phthisis was introduced twice a day for 105 days into a wooden case containing young rabbits, the grated apertures of the case being closed for two hours. Tubercles appeared in the rabbits' lungs. Other rabbits in a similar case, and similarly treated, except that the infected air was passed through carbolised wadding, showed no organic alteration.—Researches of pathological physiology on respiration, by MM. Grehant and Quinquaud. In the case of bronchial, pulmonary or pleural alterations, even in fever, the exhalation of carbonic acid is considerably diminished. The lesion, apparently, does not act by barring the elimination of CO_2, so that this accumulates in the blood, but by interfering with general nutrition at the various points where CO_2 if formed.—On the persistence of effects of preventive inoculation against symptomatic *charbon*, and on the transmission of immunity of the mother to her product in the bovine species, by MM. Arloing, Cornevin, and Thomas. The persistence of immunity for seventeen months has thus far been verified.—Observations serving in the study of phylloxera, by M. Lichtenstein. —Telegram from Cairo about the solar eclipse.—On the observations of the telescopic comet at the Imperial Observatory of Rio de Janeiro, by M. Cruls.—On a new case of formation of the dark ligament, and its utility for observation of the transit of Venus, by M. André. This was observed, during the recent eclipse, by MM. Gonessiot and Marchand, where the moon's disc came on three sun-spots. The ligament is much less dark than in the case of the transit. Here the laws of diffraction can alone explain it.—On a class of invariants relative to linear equations, by M Poincaré.—On uniform functions affected by sections, by M. Picard.—On the chemical work produced by the battery, by M. Tommasi.—On the employment of rotating discs, for the study of colour-sensations; relative intensity of colours, by M. Rosenstiehl.—Influence of introduction of the interior sea on the *régime* of Artesian sheets of water in the region of the Chotts, by M. Dru. These Artesian sheets would not be destroyed, but the general *régime* of waters in the country would be improved and protected.—Sulphhydrate of sulphide of nickel, by M. Baubigny.—Action of alkaline sulphides on proto-sulphide of tin, by M. Ditte.—Researches on cuproso-cupric sulphites, by M. Etard.—Basic salts of protoxide of manganese, by M. Gourgeu.—On the addition of hypochlorous acid to monochlorinated chloride of allyl, by M. Henry.—The odd eye of Crustaceans, by M. Hartog. It is composed of three simple eyes, anterior to the brain, with optic rods reversed, receiving the conductive fibres of the optic nerve on their external border, and having the pigment layer confounded in one mass. A similar structure is found in Chætognatha and in some Planaria. To this primitive and ancestral group of Turbellaria, the eyes of Crustacea and Chætognatha may probably be referred.—Researches on flagelliferous Infusorians, by M. Kunstler.—On a bed of tertiary mammalia at Aubignas (Andèche), by M. Torcarpel.—Influence of ethylic alcohol, and of essence of absinthe on the motor functions of the brain, and on those of the muscles of the life of relation, by M. Danillo. The influence of alcohol (in strong doses) referred to is similar to that of other anæsthetics (ether, chloral, morphine). Five periods are distinguished in the case of essence of absinthe, a tonic, a clonic, a choreïform, a period of delirium, and one of resolution. Thus the poisoning is like that from strychnine, in which, however, the period of delirium is absent.

VIENNA

Imperial Academy of Sciences, April 20.—L. I. Fitzinger in the chair.—The following papers were read:—Fr. Brauer, on the *segment mediare* of Latreille.—R. Maly, on the ratio of bases and acids in blood-serum and other animal fluids; a contribution to the theory of secretion.—Fr. Emich, on the behaviour of ox-bile to Huefner's reaction, and on some properties of glycocholic acid.—T. Mauthner, on the optic-rotatory power of tyrosine and cystine.—G. Becka, on the orbit of the planet Ino (No. 173).—E. Suess, on Fr. Bassani's work, "Discrizione dei pisci fossili di Lesina."—T. V. Rohon, on the origin of the nervus acusticus in Petromyzon.—F. T. Paulsen, on the path of the air-stream in the nasal cavity of man.—O. Simony, on a series of new mathematical principles derived from experience.

May 4.—L. I. Fitzinger in the chair.—The following papers were read:—C. Doelter, on the mechanical separation of minerals.—G. Gruss, on the orbit of the "Loreley" (165).—O. Seeliger, on the history of development of the Ascidia.—S. Lustgarten, on test for zodoform, naphthol, and chloroform in animal liquids and tissues.—A. Wassmuth, on the specific heat of strongly magnetised iron and on the mechanical equivalent of a diminution of the magnetism by heat.—T. V. Tanovsky and H. v. Perger, a sealed packet containing a paper on a new reaction of the azo-bodies.—A Brezina, report on some new and little-known meteorites (part iv.)—Z. A. Skraup, synthetical experiments on the chinolin series (part iii.).—R. Wegscheider, on the derivates and constitution of opianic and hemipinic acid. —A. Boehm, on the tertiary fossils of the Isle of Madura.

BERLIN

Physiological Society, May 19.—Prof. du Bois-Reymond, president.—Dr. Rabt Rückard spoke about the development of the brain in fishes, and about the import of its so-called lobi optici. He especially combated the view that the part covering these lobes is a part of the cerebrum; he is, on morphological, histiological, and embryological grounds, rather of the opinion that this portion of the brain belongs to the middle brain, and that it is an homologue to the corpora quadrigemina in the brain of the higher orders of animals. He endeavoured to establish this view by the history of the development of the brain in fishes, which he made a minute study of in the trout.—Prof. Hirschberg laid before the Society the results of his dioptric measurements of the eyes of fishes and amphibia (pikes and frogs), as a further contribution to the comparative dioptrics of the eye. According to his measurements, the cornea in the pike has a large radius of curvature which exceeds the length of the optic axis; consequently, these animals are very myopic in the air; when, however, the eye was ophthalmometrically examined under water, the distance of distinct image formation was much greater. The eye in fishes (both those of the pike and roach were examined) behaves quite differently in air and in water. This fact is a contradiction of Herr Rateau's statements, who also found the seeing distance of fishes almost the same in both media. The eye of the frog also behaves differently in water from what it does in air; the radius of curvature of its cornea is much smaller in proportion to the length of the optic axis, and its myopia in air is much less than in fishes. It is remarkable, that in the case of the eyes of both the frog and the pike, neither a solution of atropine nor of eserine produced any alteration in the distance of the formation of images; it is hence probable that the accommodation of the eye, if it occur at all in these animals, takes place by some other mechanism than that which affects it in the higher vertebra.

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