NATURE

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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THURSDAY, MAY 5, 1870

TO OUR READERS

THE opportunity afforded by the commencement of a new volume is one we cannot allow to pass by without a few remarks on the work on which we are engaged, although it may be that such a course is not strictly in accordance with precedent, but our excuse lies in this—our journal is not according to precedent.

For, in fact, six months ago a scientific journal, in which the leaders of scientific thought, in this and other lands, gave week by week an account of their own and others' labours to their fellows and the general public, was a thing of the future, and, in the general opinion, to attempt to start such a journal was almost certain to end in signal failure. "Science is so small, her victories are so few," said some, "that a weekly account of them is altogether beside the question—the well would run dry." Others said: "Science is large, it is true, but her followers are not numerous. You may perhaps number your readers by hundreds, if you take care to appeal to scientific men only; but as for the outside world, they care nothing for science." On the other hand it was held that a popular scientific weekly journal would, be a certain success under certain conditions—some such as these: in the first place, the articles were to be light as air; each fact was to be clothed in a delicate atmosphere of adjective and imagery; next, each page was to be studded with beautiful pictures, correctness both in text and illustration giving way to a certain more or less subdued sensationalism; and lastly, and above all, every care was to be taken to spare the reader the least trouble in the matter of thinking.

We confess that we should have shrunk from our task in the face of such advice as this, had there not been certain Signs of the Times which did not seem difficult to read, and which were more in harmony with the encouragements we received to undertake it; and now that the first volume has been completed, we have the satisfaction of knowing that none of these gloomy forebodings have been realised.

A consideration of the facts brings us at once to our first duty, which is to tender to the scientific men, both at home and abroad, who have assisted us, our best thanks for all their help in the work we have undertaken. We willingly acknowledge the small part we have borne in what has been done. Thanks are due, not only for criticism and the contributions which have already appeared, but for many others which—Nature is so large, and our journal is so small—we have not as yet been able to place before our readers. It has been our endeavour to carry out our programme by making the journal useful to workers in science; worthy therefore of their perusal, and therefore, again, worthy of their contributions: and by thus extending our appeal beyond the limits of the scientific world on the one hand, and endeavouring to keep up the dignity of science herself on the other, we have already met with an encouraging response. Our subscribers now number nearly five thousand; that is, we have, on a moderate estimate, fifteen thousand readers. Though we think this an emphatic success, we shall not be satisfied if the increasing interest in Science, and an increased knowledge of the periodical, do not in a short time double our present circulation, and we trust not only that each worker will urge his neighbours to send us facts, but that each of our present readers will form a nucleus of new ones.

We state this, not only because the statement is almost due to our contributors as a justification of our demands upon their time, but because it indicates the work—we had almost said the noble work—which lies before them. Surely at a time when England would gain so much by the scientific education, not only of her Workmen but of her Ministers, an attempt to place Science before the Public, week by week, as Politics, Art, Music, and a hundred other things are placed before them, must not be suffered to flag; when the number of science-teachers and science-students is daily increasing, and the necessity for combined action and representation among scientific men themselves is being more and more felt, the popularisation of science becomes more important than ever, and every effort to gain these ends deserves a larger encouragement, for the most "practical man" will now soon be made to feel that Science dogs his every footstep, meets him at every turn, and twines itself round his life; nay, it may soon become evident that such a practical thing as a stagnation of trade may in some way be traced to the neglect of science.

Hence our endeavour in the future will be not only to make our journal a necessity in the Studies of the more thoughtful, and in our Schools, but a welcome visitor in the Homes of all who care for aught that is beautiful and true in the world around them.

EDITOR

THE VELOCITY OF THOUGHT

"As quick as thought" is a common proverb, and probably not a few persons feel inclined to regard the speed of mental operations as beyond our powers of measurement. Apart, however, from those minds which take their owners so long in making up because they are so great, rough experience clearly shows that ordinary thinking does take time; and as soon as mental processes were brought to work in connection with delicate instruments and exact calculations, it became obvious that the time they consumed was a matter for serious consideration. A well-known instance of this is the "personal equation" of the astronomers. When a person watching the movement of a star, makes a signal the instant he sees it, or the instant it seems to him to cross a certain line, it is found that a definite fraction of a second always elapses between the actual falling of the image of the star on the observer's eye, and the making of the signal—a fraction, moreover, varying somewhat with different observers, and with the same observer under differing mental conditions. Of late years considerable progress has been made towards an accurate knowledge of this mental time.

A typical bodily action, involving mental effort, may be regarded as made up of three terms; of sensations travelling towards the brain, of processes thereby set up within the brain, and of resultant motor impulses travelling from the brain towards the muscles which are about to be used. Our first task is to ascertain how much time is consumed in each of these terms; we may afterwards try to measure the velocity of the various stages and parts into which each term may be further subdivided.

The velocity of motor impulses is by far the simplest case of the three, and has already been made out pretty satisfactorily. We can assert, for instance, that in frogs a motor impulse, the message of the will to the muscle, travels at about the rate of 28 metres a second, while in man it moves at about 33 metres. The method by which this result is obtained may be described in its simplest form somewhat as follows:—

The muscle which in the frog corresponds to the calf of the leg, may be prepared with about two inches of its proper nerve still attached to it. If a galvanic current be brought to bear on the nerve close to the muscle, a motor impulse is set up in the nerve, and a contraction of the muscle follows. Between the exact moment when the current breaks into the nerve, and the exact moment when the muscle begins to contract, a certain time elapses. This time is measured in this way:—A blackened glass cylinder, made to revolve very rapidly, is fitted with two delicate levers, the points of which just touch the blackened surface at some little distance apart from each other. So long as the levers remain perfectly motionless, they trace on the revolving cylinder two parallel, horizontal, unbroken lines; and any movement of either is indicated at once by an upward (or downward) deviation from the horizontal line. These levers further are so arranged (as may readily be done) that the one lever is moved by the entrance of the very galvanic current which gives rise to the motor impulse in the nerve, and thus marks the beginning of that motor impulse; while the other is moved by the muscle directly this begins to contract, and thus marks the beginning of the muscular contraction. Taking note of the direction in which the cylinder is revolving, it is found that the mark of the setting-up of the motor impulse is always some little distance ahead of the mark of the muscular contraction; it only remains to be ascertained to what interval of time that distance of space on the cylinder corresponds. Did we know the actual rate at which the cylinder revolves this might be calculated, but an easier method is to bring a vibrating tuning-fork, of known pitch, to bear very lightly sideways on the cylinder, above or between the two levers. As the cylinder revolves, and the tuning-fork vibrates, the latter will mark on the former a horizontal line, made up of minute, uniform waves corresponding to the vibrations. In any given distance, as for instance in the distance between the two marks made by the levers, we may count the number of waves. These will give us the number of vibrations made by the tuning-fork in the interval; and knowing how many vibrations the tuning-fork makes in a second, we can easily tell to what fraction of a second the number of vibrations counted corresponds. Thus, if the tuning-fork vibrates 100 times a second, and in the interval between the marks of the two levers we count ten waves, we can tell that the time between the two marks, *i.e.* the time between the setting-up of the motor impulse and the beginning of the muscular contraction, was $\frac{1}{10}$ of a second.

Having ascertained this, the next step is to repeat the experiment exactly in the same way, except that the galvanic current is brought to bear upon the nerve, not close to the muscle, but as far off as possible at the furthest point of the two inches of nerve. The motor impulse has then to travel along the two inches of nerve before it reaches the point at which, in the former experiment, it was first set up.

On examination, it is found that the interval of time elapsing between the setting up of the motor impulse and the commencement of the muscular contraction is greater in this case than in the preceding. Suppose it is $\frac{2}{10}$ of a second—we infer from this that it took the motor impulse $\frac{1}{10}$ of a second to travel along the two inches of nerve: that is to say, the rate at which it travelled was one inch in $\frac{1}{20}$ of a second.

By observations of this kind it has been firmly established that motor impulses travel along the nerves of a frog at the rate of 28 metres a second, and by a very ingenious application of the same method to the arm of a living man, Helmholtz and Baxt have ascertained that the velocity of our own motor impulses is about 33 metres a second.* Speaking roughly this may be put down as about 100 feet in a second, a speed which is surpassed by many birds on the wing, which is nearly reached by the running of fleet quadrupeds, and even by man in the movements of his arm, and which is infinitely slower than the passage of a galvanic current. This is what we might expect from what we know of the complex nature of nervous action. When a nervous impulse, set up by the act of volition, or by any other means, travels along a nerve, at each step there are many molecular changes, not only electrical, but chemical, and the analogy of the transit is not so much with that of a simple galvanic current, as with that of a telegraphic message carried along a line almost made up of repeating stations. It has been found, moreover, that the velocity of the impulse depends, to some extent, on its intensity. Weak impulses, set up by slight causes of excitement, travel more slowly than strong ones.

The contraction of a muscle offers us an excellent objective sign of the motor impulse having arrived at its destination; and, all muscles behaving pretty much the same towards their exciting motor impulses, the results obtained by different observers show a remarkable agreement. With regard to the velocity of sensations or sensory impulses, the case is very different; here we have no objective sign of the sensation having reached the brain, and are consequently driven to roundabout methods of research. We may attack the problem in this way. Suppose that, say by a galvanic shock, an impression is made on the skin of the brow, and the person feeling it at once makes a signal by making or breaking a galvanic current. It is very easy to bring both currents into connection with a revolving cylinder and levers, so that we can estimate by means of a tuning-fork, as before, the time which elapses between the shock being given to the brow and the making of the signal. We shall then get the whole "physiological time," as it is called (a very bad name), taken up by the passage of the sensation from the brow to the brain, by the resulting cerebral action, including the starting of a volitional impulse, and by the passage of the impulse along the nerve of the arm and hand, together with the muscular contractions which make the signal. We may then repeat exactly as before, with the exception that the shock is applied to the foot, for instance, instead of the brow. When this is done, it is found that the whole physiological time is greater in the second case than in the first; but the chief difference to account for the longer time is, that in the first case the sensation of the shock travels along a short tract of nerve (from the brow to the brain), and in the second case through a longer tract (from the foot to the brain). We may conclude, then, that the excess of time is taken up by the transit of the sensation through the distance by which the sensory nerves of the foot exceed in length those of the brow. And from this we can calculate the rate at which the sensation moves.

Unfortunately, however, the results obtained by this method are by no means accordant; they vary as much as from 26 to 94 metres per second. Upon reflection, this is not to be wondered at. The skin is not equally sentient in all places, and the same shock might produce a weak shock (travelling more slowly) in one place, and a stronger one (travelling more quickly) in another.

Then, again, the mental actions involved in the making the signal may take place more readily in connection with sensations from certain parts of the body than from others. In fact, there are so many variables in the data for calculation that though the observations hitherto made seem to show that sensory impressions travel more rapidly than motor impulses (44 metres per second), we shall not greatly err if we consider the matter as yet undecided.

By a similar method of observation certain other conclusions have been arrived at, though the analysis of the particulars is not yet within our reach. Thus nearly all observers are agreed about the comparative amount of physiological time required for the sensations of sight, hearing, and touch. If, for instance, the impression to be signalled be an object seen, a sound heard, or a galvanic shock felt on the brow, while the same signal is made in all three cases, it is found that the physiological time is longest in the case of sight, shorter in the case of hearing, shortest of all in the case of touch. Between the appearance of the object seen (for instance, an electric spark) and the making of the signal, about $\frac{1}{5}$; between the sound and the signal, $\frac{1}{6}$; between the touch and signal, $\frac{1}{7}$ of a second, is found to intervene.

This general fact seems quite clear and settled; but if we ask ourselves the question, why is it so? where, in the case of light, for instance, does the delay take place? we meet at once with difficulties. The differences certainly cannot be accounted for by differences in length between the optic, auditory, and brow nerves. The retardation in the case of sight as compared with touch may take place in the retina during the conversion of the waves of light into visual impressions, or may be due to a specifically lower rate of conduction in the optic nerve, or may arise in the nervous centre itself through the sensations of light being imperfectly connected with the volitional mechanism in the brain put to work in the making of the signal. One observer (Wittich) has attempted to settle the first of these questions by stimulating the optic nerve, not by light, but directly by a galvanic current, and has found that the physiological time was thereby decidedly lessened; while conversely, by substituting a prick or pressure

* Quite recently M. Place has determined the rate to be 53 metres per second. This discordance is too great to be allowed to remain long unexplained, and we are very glad to hear that Helmholtz has repeated his experiments, employing a new method of experiment, the results of which we hope will soon be published.

on the skin for a galvanic shock, the physiological time of touch was lengthened. But there is one element, that of intensity (which we have every reason to think makes itself felt in sensory impressions, and especially in cerebral actions even more than in motor impulses), that disturbs all these calculations, and thus causes the matter to be left in considerable uncertainty. How can we, for instance, compare the intensity of vision with that either of hearing or of touch?

The sensory term, therefore, of a complete mental action is far less clearly understood than the motor term; and we may naturally conclude that the middle cerebral term is still less known. Nevertheless, here too it is possible to arrive at general results. We can, for instance, estimate the time required for the mental operation of deciding between two or more events, and of willing to act in accordance with the decision. Thus, if a galvanic shock be given to one foot, and the signal be made with the hand of the same side, a certain physiological time is consumed in the act. But if the apparatus be so arranged that the shock may be given to either foot, and it be required that the person experimenting, not knowing beforehand to which foot the shock is coming, must give the signal with the hand of the same side as the foot which receives the shock, a distinctly longer physiological time is found to be necessary. The difference between the two cases, which, according to Donders, amounts to $\frac{66}{1000}$, or about $\frac{1}{15}$ of a second, gives the time taken up in the mental act of recognising the side affected and choosing the side for the signal.

A similar method may be employed in reference to light. Thus we know the physiological time required for any one to make a signal on seeing a light. But Donders found that when matters were arranged so that a red light was to be signalled with the left hand and a white with the right, the observer not knowing which colour was about to be shown, an extension of the physiological time by $\frac{154}{1000}$ of a second was required for the additional mental labour. This of course was after a correction (amounting to $\frac{9}{1000}$ of a second) had been made for the greater facility in using the right hand.

The time thus taken up in recognising and willing, was reduced in some further observations of Donders, by the use of a more appropriate signal. The object looked for was a letter illuminated suddenly by an electric spark, and the observer had to call out the name of the letter, his cry being registered by a phonautograph, the revolving cylinder of which was also marked by the current giving rise to the electric spark.

When the observer had to choose between two letters, the physiological time was rather shorter than when the signal was made by the hand; but when a choice of five letters was presented, the time was lengthened, the duration of the mental act amounting in this case to $\frac{170}{1000}$ of a second.

When the exciting cause was a sound answered by a sound, the increase of the physiological time was much shortened. Thus, the choice between two sounds and the determination to answer required about $\frac{50}{1000}$ of a second; while, when the choice lay between five different sounds, $\frac{88}{1000}$ of a second was required. In these observations two persons sat before the phonautograph, one answering the other, while the voices of both were registered on the same revolving cylinder.

These observations may be regarded as the beginnings of a new line of inquiry, and it is obvious that by a proper combination of changes various mental factors may be eliminated and their duration ascertained. For instance, when one person utters a sound, the nature of which has been previously arranged, the time elapsing before the answer is given corresponds to the time required for simple recognition and volition. When, however, the first person has leave to utter any one, say of five, given sounds, and the second person to make answer by the same sound to any and every one of the five which he thus may hear, the mental process is much more complex. There is in this case first the perception and recognition of sound, then the bare volition towards an answer, and finally the choice and combination of certain motor impulses which are to be set going, in order that the appropriate sound may be made in answer. All this latter part of the cerebral labour may, however, be reduced to a minimum by arranging that though any one of five sounds may be given out, answer shall be made to a particular one only. The respondent then puts certain parts of his brain in communication with the origin of certain outgoing nerves; he assumes the attitude, physical and mental, of one about to utter the expected sound. To use a metaphor, all the trains are laid, and there is only need for the match to be applied. When he hears any of the four sounds other than the one he has to answer, he has only to remain quiet. The mental labour actually employed when the sound at last is heard is limited almost to a recognition of the sound, and the rise of what we may venture to call a bare volitional impulse. When this is done, the time is very considerably shortened. In this way Donders found, as a mean of numerous observations, that the second of these cases required $\frac{75}{1000}$ of a second, and the third only $\frac{39}{1000}$ over and above the first. That is to say, while the complex act of recognition, rise of volitional impulse, and inauguration of an actual volition, with the setting free of co-ordinated motor impulses, took $\frac{75}{1000}$ of a second, the simple recognition and rise of volitional impulse took $\frac{39}{1000}$ only. We infer, therefore, that the full inauguration of the volition took $\frac{75-39}{1000} = \frac{36}{1000}$. In rough language, it took $\frac{1}{28}$ of a second to think, and rather less to will.

We may fairly expect interesting and curious results from a continuation of these researches. Two sources of error have, however, to be guarded against. One, and that most readily appreciated and cared for, refers to exactitude in the instruments employed; the other, far more dangerous and less readily borne in mind, is the danger of getting wrong in drawing averages from a number of exceedingly small and variable differences.

M. FOSTER

CHOICE AND CHANCE

Choice and Chance. By the Rev. Wm. Allen Whitworth, M.A., Fellow of St. John's College, Cambridge. 2nd ed. Enlarged. 1870. (Deighton, Bell & Co.)

WE should think that not a few copies of the first edition of this work must have been purchased under the impression that it was an interesting story; and it is surprising that so neat and suggestive a title had not been long ago appropriated by some needy novelist. This work, however, is a very able elementary treatise on those puzzling branches of mathematics which treat of combinations permutations, and probabilities. The earlier chapters are quite within the comprehension of a schoolboy with a moderate knowledge of arithmetic; the appendices, which treat of distributions, derangements, the disadvantage of gambling, and a proof of the Binomial Theorem, founded purely on the doctrine of combinations, require some knowledge of algebra in the reader. So great is the clearness with which Mr. Whitworth states and explains the problems throughout, that it is almost impossible to misunderstand him. The appendix in which the disadvantage of gambling is demonstrated is very interesting, and often novel; and his explanation of the Petersburg problem is the most satisfactory which we have met.

Our only regret concerning the work is that Mr. Whitworth has not attempted more. Though the doctrines of combinations and probabilities lie at the basis of all mathematical and physical science, their value is chiefly theoretical, and it is hardly likely that time can be spared for their study in a school education. Had Mr. Whitworth enlarged his work so as to make it a pretty complete handbook of the theory of probabilities, he would have performed a great service to science. It is strange how little attention has been paid at Cambridge to the theory of probabilities. If we except Mr. Todhunter's valuable history, and Mr. Airy's special work upon its application to observations, we cannot call to mind any recent separate work devoted to rendering the subject of probabilities accessible to students. Mr. De Morgan's article in the Encyclopædia Metropolitana, his excellent work in the Cabinet Cyclopædia, the Useful Knowledge Society's essay, Galloway's treatise, and the translations of Quetelet's work, are what we have to depend upon as introductions to the subject; but they are all twenty or thirty years old at least, and difficult to meet with. Mr. Venn's logic of chance, being purely metaphysical, is not to be counted. We wish that Mr. Whitworth, or some mathematician at once as able, and possessed of as clear a style of exposition, would fill this gap in mathematical literature by producing a student's handbook of probabilities, including the theory of errors, the method of least squares, &c., with some of the applications to practice.

W. S. JEVONS

OUR BOOK SHELF

F. Hoppe-Seyler. Handbuch der physiologischen u. pathologischen Analyse. Third edition. (Berlin, 1870.)

WHILST modern chemical literature is abundantly supplied with publications on the analysis of mineral substances, works on the methods of chemical investigation of the products of animal life are comparatively few. Physiological chemistry is still in its infancy. By far the greatest number of the substances occurring in the animal body have as yet to be discovered, and even those already known exhibit but in few instances such characteristic reactions as serve for their detection and quantitative estimation equal in reliability to those we find in mineral chemistry. But however incomplete the analytical methods of the physiological chemist may be, they are highly valuable, not merely from a scientific, but also from a practical point of view, inasmuch as they aid the physician in the detection of those important changes in the chemical composition of animal fluids and excreta, which almost invariably accompany certain forms of disease. The scientific man as well as the medical practitioner will, therefore, take an equal interest in the re-publication in an enlarged form of a work on the application of chemical analysis to physiology and pathology, which has proved very valuable in its former editions.

The "Handbook" of Mr. Hoppe-Seyler's is adapted to the use of the advanced medical student as well as of the physician. That part of the book treating on the analysis, properly speaking, of animal fluids, tissues, &c., is preceded by some very useful chapters on the employment of chemical and physical apparatus; on re-agents and the mode of ascertaining the purity of the same; and on the composition, the properties, and detection of inorganic and organic chemical compounds occurring in the animal body. The great attention paid to the optical properties, of the various substances occurring in the body to the methods of their examination by means of the polariscope and spectroscope, forms a very remarkable and important feature of the book. Physiological chemistry claims a large share of the results which natural science owes to the application of these instruments, and a more extensive use of optical methods of research will certainly lead to further important discoveries. The author does not include the analysis of gaseous products, nor does he give an account of the methods used for the detection of poisons. The detection of blood-spots on wood, cloth, &c., is treated in an appendix. A chromolithograph, representing the spectra of the alkali metals, the absorption bands of hæmoglobine, and various tables and engravings, contribute to the usefulness of the work.

B. FINKELSTEIN

Search for Winter Sunbeams in the Raviera, Corsica, Algiers, and Spain. With numerous illustrations. By Samuel S. Cox. (London: Sampson Low, Son, and Marston. New York: D. Appleton and Co.)

THIS interesting book will be welcome to those who are seeking to find a home in a sunnier clime than our own The author points out the beauties and the medicinal qualities of the south. In his preliminary chapter he explains the title, "Sunbeams," giving the functions of light, music of light, analogy between light and sound, speaking especially of the life-giving power of the golden sunbeam. Quoting Prof. Maury's thoughts on light, he says, "that the organs of the human ear are so ordered that they cannot comprehend colour any more than the eyes can see sounds; yet, that we may hear over again the song of the morning stars, for light has its gamut of music! The high notes vibrate with the violet of the spectrum, and the red extremity sounds the bass; and though the ear may not catch the song that the rose, lily, and violet sing, it may, for aught we know, be to the humming-bird the butterfly, and the bee, more enchanting than that which 'Prospero's Ariel' sung to the shipwrecked mariner."

The author rapidly describes the well-known winter resorts, Nice, Mentone (of which, with its lovely flowers and fruits, he draws a most inviting picture), Monaco, with its roulette table, myths, and beautiful scenery; then comes Corsica, its chief town, Ajaccio, being renowned as the birthplace of Napoleon. Many interesting facts are here given of his mother, Madame Letitia, with incidents of his boyhood. The author then proceeds to Africa, passing through Algiers, visits the Kabyle people and Arabs, giving a description of the Blidah orange orchards, Algerine desert, the magnificent cedars and oaks on Mount Atlas, the Arab and Moorish women, different interesting old tombs, mosaics, and inscriptions. Our author travels on to Spain and compares it with Algiers.

Arrived at Murcia he witnesses a bull-fight, then he visits the Alhambra with its graceful architecture; *en route* for Madrid he passes many curious towns and castles. The following is a description of one:—"A mist obscured the mountains above. That old Moorish castle near the hill of the Pharos is called the Alcazaba. Its Puerta de la Cava is renowned, if not in history, in legend, as the scene of the suicide of Count Julian's daughter, whose woes brought on the Moorish invasion, and whose Iliad has been sung in prose by Irving. This castle is hid under a veil, even as Irving dropped over its rigid outlines the drapery of his genius. . . . The mist lifts a little. We see a streak of sunlight on a bleak, bright mountain ahead of us. We pass by gardens of immense fig-trees. The mountains begin to shine white. We are in the vine-hills again. . . . Cactus, oleander, orange, and pomegranate—all these appear." He then passes through the Basque country, St. Sebastian, and Biarritz, which the author considers "the very pearl of a summer resort." The work is ended with a fable recorded by Ford: "When San Ferdinand captured Seville from the Moor and bore the conquest to heaven, the Virgin desired her champion to ask from the Supernal Power any favour for Spain. The King asked for a fine climate and sweet sun: they were conceded. For brave men and beautiful women: conceded. For oil, wine, and all the fruits and goods of this teeming earth. This request was granted. 'Then will it please the beauteous Queen of Heaven to grant unto Spain a good Government?' 'Nay, nay, that can never be. The angels would then desert heaven for Spain!'"

The book is plentifully interspersed with good illustrations.

LETTERS TO THE EDITOR

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

The Sources of the Nile

FROM Mr. Keith Johnston's communication to NATURE of the 14th April, it appears that he agrees with me in opinion—though quite independently of me and by a different process of reasoning—that the great river Kassabi, Kassavi, or Kasai, of South-Western Africa, instead of flowing to the north and north-west, as it has hitherto been shown to do in all maps, has its course north-eastward as far as about the meridian of 27°30′ east of Greenwich, where it is joined by the river system of the Chambeze. Such being the case, the only material question between us is with respect to the lower course of the united stream of the two rivers, which Mr. Johnston carries round by a sharp curve to the north-west and west, so as to join the Zairé or Congo river, whereas I regard it as continuing northwards, and uniting with the Albert Nyanza, so as to form the upper course of the Nile.

While thus disputing the claim of the Kassavi and Chambeze to be the head-streams of the Nile, Mr. Keith Johnston advocates the rival claim of "the feeders of Lake Liemba." I do not, however, understand him to mean that these rivers, four in number, are to be considered the head-streams of the main body of the Nile, or to be anything but tributaries of that river, as is, in fact, shown in the map accompanying his paper. It being upon this point that the whole difference between us really hinges, I beg to be allowed to offer the following observations on the subject.

Dr. Livingstone, the discoverer of Lake Liemba, describes it as lying at an elevation of 2,800 feet above the sea, on the northern slope of the Balungu upland, in a hollow with precipitous sides 2,000 feet down, and as going away in a river-like prolongation, two miles wide, N.N.W., to Tanganyika, of which he rightly considers it to be an arm; the difficulty with respect to the elevation of the latter having been removed by Mr. Findlay, who makes it to be 2,800 feet, or the same as that of Lake Liemba.

Captain Burton, the discoverer of Tanganyika, says respecting this great lake: "The general formation suggests, as in the case of the Dead Sea, the idea of a volcano of depression—not like the Nyanza or Ukerewe formed by the drainage of mountains. Judging from the eye, the walls of this basin rise in an almost continuous curtain, rarely waving and infracted, to 2,000 or 3,000 feet above the water-level;" from which description it is evident that Liemba and Tanganyika are portions of one continuous fissure or "crack" in the table-land, of which table-land the elevation is 5,000 feet, or perhaps more, above the ocean.—Dr. Livingstone says 4,000 to 6,000 feet, sloping towards the north and west, but he had not seen any part of it under 3,000 feet of altitude. Further, Lake Tanganyika is described by Dr. Livingstone as passing northwards, by a river named Loanda, into Lake Chowambe, which lake he identifies with Sir Samuel Baker's Albert Nyanza.

The last-named expanse of water was found by its discoverer to have an elevation of 2,720 feet above the ocean, with a precipitous cliff of 1,200 to 1,500 feet on the east shore, whilst on the opposite side the faint blue mountains rose about 7,000 feet above the water-level.

The Albert Nyanza is, however, in nowise a continuation of the system of which Liemba and Tanganyika form parts; for whilst the direction of these two lakes is from north to south, or nearly so, the general bearing of the Albert Nyanza is from about north-east to south-west; so that, as is shown on Mr. Keith Johnston's map, the former joins the latter at an angle of 45°; whilst the main body of water extends probably a hundred miles beyond the junction, or to about the 28th meridian. And the Albert Nyanza does not terminate here; for, in the latitude of Karagwe, between 1° and 2° S., it was said by the natives to turn to the west, in which direction its extent was unknown even to Rumanika, the King of Karagwe.

Quite independently, then, of the question of the junction of the joint stream of the Kassavi and Chambeze with the Nile, there is this preliminary question, which I would propound for Mr. Keith Johnston's consideration and answer:—Where would he place, even if only conjecturally, the head of this unknown western extension of the Albert Nyanza?—or, in other words, where would he trace the western limits of the Upper Nile basin?

As regards his objection to "the northward wall-like continuation of the Mossamba mountains on the 20th meridian to beyond the equator," shown in my sketch-map of the Upper Nile basin, in Part xv. (for March 1st last) of the "Illustrated Travels," I must explain that the same is so marked merely conjecturally, and that I do not think of maintaining it against—I will not say proof—but any reasonable argument. In my former maps of 1849, 1859, and 1864, I placed the conjectural western limits of the basin of the river somewhere about that meridian on or near the equator, thence continuing to about 10° N. lat., where the line was made to curve inwards towards the valley of the river. When I found the Kassavi, which I look on as the head-stream of the Nile, actually rising in the Mossamba mountains, on about the meridian thus indicated, I naturally extended my conjectural limits of the basin of the river along the same meridian from the equator southwards. But I repeat that, beyond what we actually know, all the rest is purely conjectural. If there is reason to carry the limits of the basins of the rivers of the West Coast of Africa to the east of the 20th meridian, on the equator or even as far south as the fifth parallel of south latitude, I have nothing to object to it, except that care must be taken to leave sufficient space for the western flank of the basin of the River Nile.

And this brings me to what I regard as an insurmountable objection to Mr. Keith Johnston's hypothesis. By causing, as he does, the Kassavi and Chambeze, after their union on the meridian of 27° 30′, to make a curve round to the north-west and west, so as to form the main-stream of the Congo River, he actually brings the course of this supposed river within 150 miles of the south-western extremity of the Albert Nyanza, as laid down on his own map. But to enable him to do this, he must, in defiance of Sir Samuel Baker's authority, deny the great westerly extension of this immense body of water; and by closing it up in that direction he renders it merely a "back-water" to Tanganyika, as Captain Speke imagined it to be to his Victoria Nyanza, instead of its being the main-stream of the Nile. Mr. Keith Johnston evidently has misgivings on this head, for he says: "If, however, the Albert Nyanza prove to have a great south-westerly extension, this one difficulty would be removed,"—namely, the sole difficulty in the way of the junction of the Kassavi and Chambeze with the Nile, for which I contend.

The argument founded on the comparative levels of Lakes Moero and Tanganyika I fail to appreciate. If the upland, 2,000ft. below which Liemba and Tanganyika lie, has a general elevation of 5,000ft., the waters of Lake Moero, instead of passing as they do through the crack in the mountains of Rua, could not by any possibility unite with those of Tanganyika, except by means of a similar crack in the mountains forming the western side of the latter; unless, indeed, Moero were supposed to lie on the upper level, to which supposition Mr. Johnston's argument is diametrically opposed.

In support of my own argument that the united stream of the Kassavi and the Chambeze continues northwards to join the Nile, instead of turning round to the north-west and west to join the Congo, I have really nothing to add. My opponent himself carries the joint stream for me to within 150 miles of the known south-western extremity of the Albert Nyanza: it is for him to show how the two are to be prevented from uniting. But in doing so he must bear in mind that the waters of Ulenge, made by him to be the recipient of the Kassavi, as well as of the Chambeze, are said by some of Livingstone's native informants to flow N.N.W. into Chowambe or Albert Nyanza, and that for the westerly extension of this body of water we have the authority of Baker.

On the subject of the Congo I have little to say. If it should be found that north of the fifth parallel of south latitude the basin of that river requires to be carried further eastward than the 20th meridian, I see no objection to it. Only I am bound to remark, that I do not consider there is any warrant for representing the Congo as a river having a low alluvial valley extending some 500 or 600 miles inland. I have not examined the subject of this river very closely, but my impression is, that, like the other rivers of the West Coast of Africa south of the equator, the rise of the level of its bed is rapid, and that it becomes considerable within a short distance from the ocean; so that there would not be sufficient fall for the waters of Ulenge in 27°30′ E. long. to join it. And, further, I cannot but entertain the opinion that the volume of water of the Congo has been greatly over estimated; in support of which opinion I will cite the following passages, in pages 147 and 148, of Captain Tuckey's Narrative :—"At the further end of the banza we unexpectedly saw the fall almost under our feet, and were not less surprised than disappointed at finding, instead of a second Niagara, which the description of the natives and their horror of it had given us reason to expect, *a comparative brook bubbling over its stony bed* .... The principal idea that the fall creates is, that the quantity of water which flows over it is by no means equal to the volume of the river below it; and yet, as we know there is not at this season a tributary stream sufficient to turn a mill below the fall, we can hardly account for this volume, unless we suppose, as Dr. Smith suggests, the existence of subterranean communications or caverns filled with water." Does this look like the lower course of the supposed second great river of Africa, with a basin of which the area is estimated to measure 800,000 square miles?

On a reconsideration, then, of the whole subject, I see no reason whatever to go from the opinion I have expressed, that the rivers Kassavi and Chambeze unite to form the upper course of the Albert Nyanza; that is to say, the main stream of the Nile; and as the former of those two rivers has the more direct course, and its source is the most remote of all, it is entitled to the honour which I claim for it, of being the hitherto undiscovered head of the great river of Egypt.

Bekesbourne, April 22 CHARLES BEKE

P.S., April 26.—Since the foregoing was written, Mr. Keith Johnston has obligingly sent me a copy of his "Map of the Lake Region of Eastern Africa," with notes, just published, in which I find a categorical answer to my question respecting the western limits of the Upper Nile Basin. He traces them as coming from the south of Lake Liemba and its feeders, and running close along the western side of Tanganyika as far as its northern end, where he gives them a curve to the westward not more than sufficient to include the south-western of the Albert Nyanza, and thence continuing along the high mountains on the west side of that body of water, the westerly extension of which, reported by Baker, he ignores entirely. To these views I need not reiterate my objections. C. B.

Why is the Sky Blue?

CAN any of your readers inform me why the sky is blue? Is it that the predominant colour of sunlight being orange, the regions devoid of sunlight appear of the complementary colour? If so, the planets of Sirius and Vega would have a black sky, those of Betelgeux a green sky, while those of the double stars would have different coloured skies at different times, according to their position with respect to their two luminaries. Or again, is the blueness merely the colour of our atmosphere, as Prof. Tyndall's experiments have led some to believe? In favour of the former explanation, is the fact that the maximum intensity of the light of the solar spectrum is in the orange, and indeed that the sun *looks* orange, and if we close our eyes after gazing a moment at him when high up in the sky, we see a blue image. When the sun is low, his colour changes from orange to red, and this would explain the green tints so often seen in the cloudless parts of the sky at sunset. Possibly Mr. Glaisher, who has seen the sky through a thinner stratum of air than most of us, could help us to a solution. H. A. N.

Hampstead, April 24

Curious Facts in Molecular Physics

SOME of the phenomena of photography present features of a very curious nature, yet seem to be very little known to philosophers who devote their time to researches in molecular physics. For instance, when a glass plate coated with collodion containing an iodide—say iodide of cadmium—is dipped into a "bath" solution of nitrate of silver, strength twenty-five grains to the ounce, in from three to four minutes a good dense precipitate of yellow iodide of silver is formed in the spongy collodion film, and the plate is ready for photographic use. But, let a plate be covered with collodion containing bromide of cadmium, (ten grains to the ounce) instead of iodide of cadmium, an immersion of ten or fifteen minutes is necessary to obtain a good film of bromide of silver, though the collodion skin upon the glass surface is only of the same thickness as in the former instance, and not only is this much longer immersion necessary, but the nitrate of silver solution must be increased in strength to about sixty grains to the ounce to get the best results. When the strength of the nitrate of silver is only twenty-five grains to the ounce, the bromide of silver forms more on the surface of the collodion than within it, and sometimes breaks away in scales from the collodion, and falls to the bottom of the bath.

Lastly, let chloride of cadmium be used instead of the bromide in the collodion, the strength of the nitrate of silver must be increased to about one hundred grains to the ounce of water, and an immersion of thirty or forty-five minutes is necessary to get a good photographic precipitate of chloride of silver. In this case, when a weak nitrate of silver solution is used, an uneven precipitate is formed upon the plate, and the tendency to burst out of film in scales is seen as in the former instance.

The three kinds of films just described vary in their photographic properties. The iodide of silver film requires the shortest exposure in the camera to produce a good picture, the bromide of silver film requires a longer exposure, and the chloride of silver film requires the most prolonged exposure to light of all.

Again, the iodide of silver film is more liable than the others to spots and markings, when there are particles of dust or other impurities on the glass plate or in the solution used; bromide of silver is not nearly so delicately sensitive to such disturbing influences; the chloride of silver film is even less sensitive in this respect than the bromide surface.

The reason of the differences of time of exposure just mentioned may possibly be accounted for on the supposition that chlorine binds itself to silver with more force than is exerted by bromine, and that the atom of bromine clings to the atom of silver with more tenacity than iodine clings to the metal. Hence the waves of light have more work to do in beating chlorine from silver than in beating iodine from silver. One very beautiful experiment, first made by Mr. M. Carey Lea, of Philadelphia, tends to prove that light will widen the distance between the hypothetical swinging atoms of iodine and silver, and that in darkness the atoms, with their attraction for each other thus partially overcome, will gradually fall together again. He prepared a film of absolutely pure dry iodide of silver, upon a glass plate, which film in the process of preparation had not been allowed to come into contact with the slightest trace of organic matter, in the washing water, or by any other means. On exposing such a film to light under a negative, and then applying what is known as the "alkaline developer," a picture came out; but if instead of developing the picture, the exposed plate were allowed to rest a day or two in the dark, the latent image died out, the film, so far as is known, returned to its primitive condition, and on exposure under another negative, a picture from it could be brought out, with no trace of the image impressed for a time through the first negative. The alkaline developer seems to "drink up" the iodine where its cohesion to the silver is loosened, thereby leaving a dark deposit of metallic silver, but where the light has not somewhat beaten the atoms asunder, the developer has no action, unless its strength be increased till it blackens the whole plate, whether the light has acted upon the film or not. The alkaline developer consists of a weak solution of pyrogallic acid, rendered alkaline by the addition of a few drops of carbonate of soda.

This is but one instance among many of the facilities offered by photographic phenomena to those who are trying to peer into the penumbral philosophical region of molecular physics.

WILLIAM H. HARRISON

SIR EDWARD SABINE'S CONVERSAZIONE

WHATEVER may be said by those to whom the grapes are sour, the gathering which met at Burlington House on April 23 to greet the President of the Royal Society, under animating circumstances, can hardly fail of beneficial results, whether regarded from the social, the moral, or the scientific point of view. It would not be easy to devise a happier way of bringing novelties at once under practical criticism—of making the outliers of science acquainted with the centre, of enabling investigators to compare operations and discuss facts and speculations, and of giving occasion for renewal of intercourse and removal of misunderstandings.

As usual, the range of articles exhibited was wide enough to include different branches of science, from astronomy to natural history, and from electro-magnetism to physiology, with achievements of fine art, and of arts mechanical. In an exhausted hydrogen tube placed across the poles of an electro-magnet, Mr. C. F. Varley produced a beautiful luminous arc, the dimensions of which he could vary at pleasure by a change in the size of the negative pole, and occasion a change of direction by a slight elevation of one end of the tube.

Spectroscopy, as we have more than once had occasion to record, owes much to the constructive skill of Mr. Browning. We shall return, on a future occasion, to his new automatic spectroscope.

Mr. C. W. Siemens's Electrical Resistance Pyrometer well maintains the reputation of the inventor for application of philosophical principles to mechanical uses. It is the very salamander of pyrometers, and will measure the temperature of the most highly heated fiery furnace; which must render it indispensable in operations where intense heat is required, and to all experimentalists who know the imperfections of the pyrometer in ordinary use. The construction of the new instrument is based on the physical fact that the resistance of pure metals to the electric current increases with increase of temperature in a simple absolute ratio. A platinum wire of known resistance is coiled upon a small cylinder of fireclay, and is covered by a tube of the same metal, which protects the wire from the destructive action of flame, without preventing access of heat. Thus constructed, the pyrometer is placed in the furnace, and is connected by wires with a Daniell's battery of two cells, and with a compact Resistance-measurer, specially devised by Mr. Siemens, on which the observer makes observations at his ease. As the fire burns, the electrical resistance of the platinum coil rapidly increases, communicates its progress to the measurer on which the indications of temperature may be read off as entirely trustworthy, even up to the melting point of platinum. The importance of such an instrument as this cannot fail to be recognised by practical men, whether among natural philosophers or workers in the pyrotechnic arts; and, for our part, we cordially welcome this new pyrometer as a logical sequence from the inventor of the regenerative gas-furnace with its fierce heat-producing capabilities.

Mr. Jerry Barrett, who relieves his hours at the easel with natural philosophy, exhibited an auxiliary air-pump, which appears to produce that essential desideratum, a perfect Torricellian vacuum. To an ordinary air-pump he attaches an air-chamber or reservoir, and, communicating therewith, two cylindrical glass vessels charged with mercury, and connected by a V tube. On working the pump the pressure of the air in the lower vessels compels the mercury to rise and fill the upper one, in which an ingeniously contrived platinum valve plays an important part. By continuing the process of filling and emptying (the details of which are not easy to describe), the desired vacuum is eventually obtained, and the exhausted tube on the top of the pump is ready for experiment. We learn that a well-known experimentalist was so favourably impressed by the capabilities of this pump that he intends to have a number of large tubes made for a series of experiments.

In these days of busy telegraphy, Mr. J. Parnell's new secondary battery is worth attention. It is so constructed as to be capable of a large amount of heavy work, having forty cells, each containing a pair of copper plates immersed in a solution of the impure carbonate of sodium, known in commerce as "soda." By this employment of an alkali, the electromotive force produced is supposed to depend on the electrolytic reduction of the sodium. The battery is arranged in ten compound cells of four couples each, and is charged by a small battery of five Grove cells, and after the connection has been established for a few seconds, a commutator of peculiar construction is brought into play, and excites the whole forty cells to activity. It is thought that a battery so constructed, which can be energised at pleasure by a brief communication with the small Grove, will be found of service in telegraphing through lines of great resistance.

Rear-Admiral Inglefield's contrivance for making the water in which a ship floats do the work of steering appeals to every Englishman, for are we not all interested in our navy, whether Royal or commercial? It is a contrivance which involves a large economy, for instead of a number of men labouring at two wheels, and with relieving tackles, it requires one small wheel only, and one man to steer the largest ship afloat; estimating roughly the pressure of the water as half a pound per square inch for every foot of the ship's draught. Admiral Inglefield admits the water through the bottom by a "Kingston valve" into a cylinder placed at the stern. The piston of this cylinder works a double-action force-pump, which sends the water to two hydraulic cylinders; these are connected with a tiller four feet in length, and thus, by movements of the small steering wheel, the ship is easily steered. Trials made with this apparatus on board the *Achilles*, one of the largest vessels in the navy, proved satisfactory; and in an improved form it is to be fitted to the *Fethi Bulend*, a corvette now building for the Turkish Government. Unfortunately for the visitors to the conversazione, the model exhibited, owing to lateness of delivery, could not be shown in work; but there was a skeleton of the corvette's stern, showing the position of the apparatus, and near it stood one of the small steering-wheels. By this and Admiral Inglefield's explanations, the naval men present could form an opinion of the new method, compare it with the existing method, and mark how surely the helm could be kept hard over during full speed, and how rapid and easy were its movements generally.

Mr. J. B. Rogers exhibited his life-saving apparatus, by which he has obtained the prize long offered by the Shipwrecked Mariners' Society, and furnished means of rescue, which, judging from the trials made near Portsmouth under authority of the Admiralty, are likely to render valuable service. With a mortar and a small charge of powder he throws out an anchor from the shore, and by means of the double rope thereto attached, a lifeboat can be hauled out through a heavy surf in weather when it would be impossible to launch her in the usual way; and with the further advantage that the hauling need not be done by the crew of the boat, who would consequently be fresh for their laborious task of rowing out to the ship in distress.

The Meteorological Office of the Board of Trade in carrying out their scheme of "ocean statistics," from which great advantage may be anticipated to navigation and to meteorological science, have constructed two charts, the value of which all whose business it is to go down to the sea in ships will appreciate. The wind chart is the first instalment of a series intended to show the best route for crossing the line in each month of the year. To facilitate reference, it is ruled in squares each representing a degree, with the direction and force of the prevailing winds. This is, we believe, the first attempt to show the *force* of the wind in a chart of this nature. The area embraced lies between the equator and 10°N. and 20° and 30°W., and contains the observations of five years for the month of November. When the other eleven months of the year are represented each by a chart, mariners will be able to choose a way across "the Doldrums" where they may be likely to find the most favourable winds and currents. From this it will be understood that the current chart is constructed in a similar style.

Principal Dawson, of M'Gill College, Montreal, who has just arrived with a fine collection of fossils, could not have desired a better opportunity for exhibiting them than was afforded by the conversazione. There, while showing his specimens to the *élite* of the scientific world, he could talk to them about the geological survey of Canada, and the Peninsula of Gaspé, with its cliffs of "Upper Silurian," 600 feet in height, its "Devonian sandstones" and "lower carboniferous deposits, and its arched rocks forming magnificent coast scenery. Among those fossils are two large tree-stems, *Protaxites Logani*, a species of *Psilophyton*, and a *Cyclostigma*, the latter a genus previously met with nowhere but in the Devonian rocks of Ireland. Other kinds include *Cordaites*, *Psaronius*, *Antholithes*, *Asterophyllites*, and a variety of ferns; and occurring in the animal remains, we find *Cephalaspis*, the first of the kind yet found in America, and *Machairacanthus*, and other large fishes. As Dr. Dawson is to read a paper on these important fossils at the Royal Society this evening, we may hope to see their story told in due time with suitable illustrations in the "Philosophical Transactions."

Dr. Carpenter exhibited with microscopes, with the actual specimens, and with a considerable breadth of well-executed diagrams, some of his treasures from the "deep, deep sea." In friendly neighbourhood, Prof. Tennant showed fossil specimens of some of the same creatures. And not far distant were hung Lieut. Palmer's clever drawings of living animals from the surface of the sea, captured in the China Sea, the Indian Ocean, and the Atlantic. These drawings testify to Lieut. Palmer's skill and industry. The animals are represented life-size and in their natural colours. Among them we observed the *Globigerina*, which may, perhaps, be taken as evidence that this creature does not, as some have supposed, exclusively inhabit the bottom of the sea. Considering that there is always room for natural history researches, the Admiralty should be able to find such employment for Lieut. Palmer as would exercise his artistic faculty and his habit of observation.

We are far from having exhausted the subject, but we must close here. Need we pause to draw a moral, or to point out that in such a conversazione as we have attempted to describe there is a tangible gain to science? It is well for inventors and experimentalists that they should hear what contemporaries say of their schemes and experiments, and much can be said and done with advantage amid the free talk of a general gathering which could not be permitted in the formal meeting of a scientific society. Let proper discrimination be used in the selection of articles for exhibition: science will then continue to benefit by soirées.

RECENT ACCESSIONS TO THE ZOOLOGICAL SOCIETY'S GARDENS

THE collection of living animals belonging to the Zoological Society of London and kept in their gardens in the Regent's Park contains, as most of the readers of NATURE are probably aware, by far the largest and most nearly complete living series of representatives of the various classes of Vertebrate animals that has ever been brought together in one spot. Great as the exertions that have been made of late years in some of the corresponding establishments on the Continent, the sister societies have never succeeded in rivalling the English collection as a whole, although they have occasionally bid fair to surpass it in some particular point.

The whole number of animals in the Zoological Society's Gardens usually somewhat exceeds two thousand—on the first of January last it was 2,031—consisting of 598 mammals, 1,245 birds, and 170 reptiles and batrachians, besides the fishes in the aquarium, which do not appear to be included in the annual census. Constant additions are made to the series, not only by purchase, but also by gifts of correspondents in every part of the world, and by exchange with the continental establishments. By these means the collection is kept up to its normal standard—the death-rate, as in all living zoological collections, being, in spite of every care and precaution, extremely heavy. During the past month of March 90 additions are recorded in the Society's register as having been made to the Menagerie. 33 of these were by gift, 33 by purchase, 4 by exchange, 5 by birth, and 15 were animals received "on deposit." The decrease during the same period by death and departures was 96, showing a total loss to the collection during the month of 6 individuals.

The most noticeable amongst the acquisitions to the Menagerie in March last were the four following:—

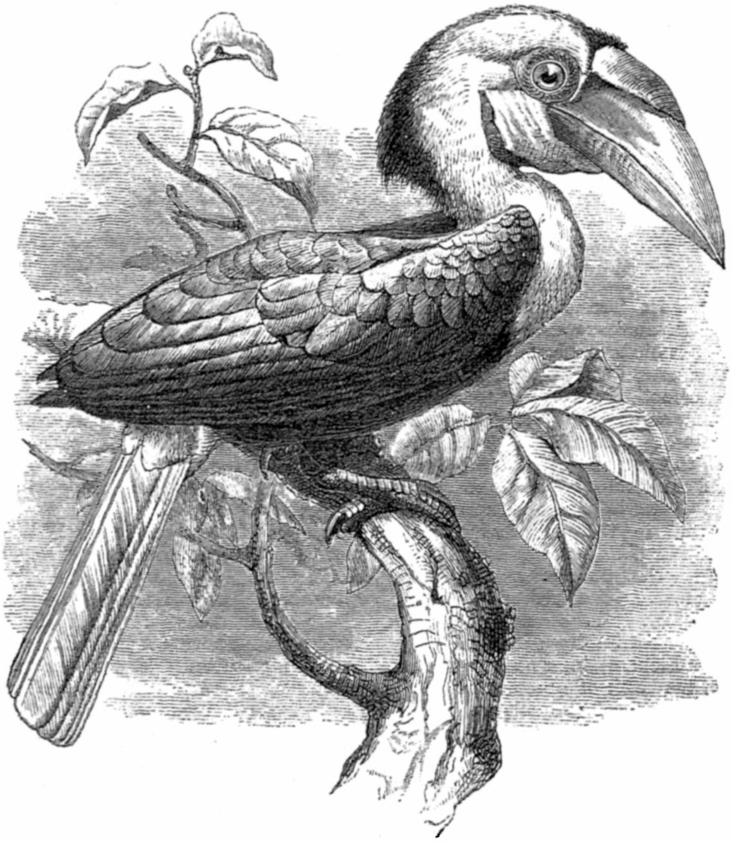
(1). Examples of two very fine new pheasants, recently discovered in Upper Assam by the well-known Indian ornithologist, Dr. J. C. Jerdon, and named by him *Lophophorus sclateri*, and *Ceriornis blythii*. These birds are both of very great interest, not only as being brilliant additions to the two magnificent groups to which they belong, but also as being *typical* specimens, *i.e.*, the identical specimens upon which Dr. Jerdon has founded these two species.

The "Monaul," or Impeyan pheasant of the southern slopes of the Himalaya, is one of the best known of Indian game-birds, and at the same time one of the most magnificently-coloured birds of British India, insomuch that Mr. Gould has chosen it as the representative bird for the cover of the numbers of his great work on the "Birds of Asia." For many years this bird was believed to stand quite alone, and to be the sole existing representative of the genus *Lophophorus*. A short time ago, however, Monsignor Chauveau, titular Bishop of Lhassa, who has recently found it necessary to retire from his Tibetan diocese into the confines of China, sent home from *Ta-tsien-lieu*, in the western part of the province of Sechuen, where he has taken up his abode, a collection of birds, amongst which were a pair of a very fine new species of Impeyan pheasant. These specimens, after being named in France *Lophophorus Lhuysi*, in compliment to M. Drouyn de Lhuys, the Minister of Foreign Affairs, whom we suppose the describer was anxious, for some good reason, to propitiate, passed into the collection of the British Museum, where they may be now seen in the Ornithological Gallery. It was thus proved that a second Impeyan pheasant is found on the northern slopes of the great central range of Asia, where it doubtless occupies a corresponding elevation and fulfils similar functions in the economy of nature to the well-known bird of the Indian Himalayas.

The discovery of the present bird by Dr. Jerdon, which, although somewhat different in certain details of structure from the two former, belongs strictly to the same genus, serves to further prove to us how much still remains to be done in zoological discovery, even amongst what are generally supposed to be the best-known divisions of the Vertebrata. Being crestless, Sclater's Impeyan, which has been named by Dr. Jerdon after the secretary of the Zoological Society of London, renders the old generic term *lophophorus* less applicable to the group. But in other points it does not materially differ, and at any rate is sufficiently near the common Impeyan to induce the only known individual of Sclater's Impeyan now in the Zoological Society's gardens to be quite ready to associate with a female of the latter which had been placed along with him.

Dr. Jerdon discovered this new bird during his residence at Shillong, a new sanitarium recently opened on the Khasya hills. The single example known was obtained from the Mishmees, a wild tribe which inhabits the hills of Upper Assam, by Major Montagu, of the Bengal Staff Corps, who, on being informed of the value of his acquisition, most liberally presented this unique specimen to the Zoological Society.

The new Tragopan which arrived in the Society's Gardens along with the last named bird, is hardly of less interest to the naturalist. and to the general observer a much more brilliant species in colour. It is likewise a gift of Major Montagu to the Society, having been obtained by him in the same district as the new Impeyan. The two Tragopans or "Argus Pheasants," as they are usually termed by Indian sportsmen, one of which



THE PLAIT-BILLED HORNBILL

(*Ceriornis melanocephala*) inhabits the western Himalayas, and the other (*C. satyra*) the Himalayas of Nipal and Sikim, have long been known as among the most splendid forms of the Gallinaceous order. The present bird, which has been named by Dr. Jerdon *Ceriornis blythii*, after one of the most distinguished of Indian naturalists, forms a third Indian species of the genus. There are likewise two Chinese Tragopans known—making in all five members of the group. Of one of these latter—Temminck's Tragopan (*C. temminckii*)—there are several pairs now in the Zoological Society's Gardens, and both this and the *Ceriornis satyra* have bred there in former years.

(2). Four young Hornbills belonging to three species (*Buceros bicornis*, *B. plicatus*, and *B. gracilis*), received March 18th.

A few years ago it was supposed to be impossible to keep alive in this country members of the great fruit-eating families of the Old-world and New-world Tropics—such as the Hornbills (*Bucerotidæ*), the Cotingas (*Cotingidæ*,) and others. Continued experience has, however, shown that the difficulties, formerly supposed to be insuperable, may be overcome by careful attention to diet and other matters, and in the case of the Hornbills the Zoological Society has succeeded in a very remarkable degree, some four or five of the finest species of the group having been successfully introduced into their aviaries, and kept in excellent health and condition. The most remarkable representatives of this group in the Society's Gardens at the present moment are, perhaps, the great Concave-casqued Hornbills (*Buceros bicornis*). A pair of these fine birds have inhabited one of the compartments of the large Eastern Aviary ever since the summer of 1864, and still show no symptoms of yielding to the inclemencies of the English climate. There are, indeed, great hopes of these birds breeding here, in which case the British public might have an opportunity of becoming acquainted with the very singular manners and customs of the Hornbills during the breeding season. No sooner has the hen commenced the labour of incubation, say several trustworthy observers on this subject, than the male walls up the hole in the hollow tree in which the hen is sitting on her eggs, until there is only room for the point of her bill to protrude, so that until her young birds are hatched she remains confined to her nest, and is in the meantime assiduously fed by her mate, who devotes himself entirely to this object. This habit has been testified to not only by Tickell, Layard, and other Indian naturalists concerning some of the Asiatic species, but is also spoken of by Dr. Livingstone in the case of Hornbills met with during his African explorations, and there appears to be no doubt of its authenticity. In Sumatra, in 1862, Mr. Wallace heard the same story from his hunters, and was taken to see a nest of the Concave-casqued Hornbill, in which, after the male bird had been shot while in the act of feeding its mate, the female was discovered walled up. "With great difficulty," Mr. Wallace tells us, "I persuaded some natives to climb up the tree, and bring me the bird. This they did, alive, and along with it a young one, apparently not many days old, and a most remarkable object. It was about the size of a half-grown duckling, but so flabby and semi-transparent as to resemble a bladder of jelly, furnished with head, legs, and rudimentary wings, but with not a sign of a feather, except a few lines of points indicating where they would come."

It would be certainly very delightful to be able to witness this imprisoning process in the Zoological Society's Gardens, and a fine moral lesson would at the same time be administered to such of the British matrons as are in the habit of running about neglecting their infant children.

Of the four Hornbills last received, one only belongs to the large species I have just spoken of. Two are the opposite sexes of a rather smaller bird, the Plait-billed Hornbill (*B. plicatus*), which is found in the Burmese peninsula, Sumatra and Java. The male, as in many other species, has the head and neck white or pale rufous, while the female these parts are black, like the rest of the body. It will be also remarked that the colour of the naked skin of the throat is not alike in the two sexes. The fourth and smallest bird is a female of the Slender Hornbill (*Buceros gracilis*.) Neither of these two last-named species have been previously exhibited in the Society's collection, which now contains twelve Hornbills of eight different species.

THE BURROWING OWL

(3.) Four Burrowing Owls (*Pholeoptynx cunicularia*), presented by George Wilks, Esq., C.M.Z.S., of Buenos Ayres. The Burrowing Owl is an American species of Day-Owl, well-known for its abnormal habits, and widely distributed in the New World. In the prairies of the far West, it lives in the "villages" of the Prairie-dog (*Arctomys ludovicianus*), residing in the forsaken burrows. "The burrow selected," says the well-known naturalist, Audubon, "is usually at the foot of a wormwood-bush (*Artemisia*), upon the summit of which the owl often perches, and stands for a considerable while. On being approached they utter a low chattering sound, start, and skim along the plain for a considerable distance. When winged they make for the nearest burrow, and when once within it, it is impossible to dislodge them." It is commonly said that rattlesnakes are likewise abundant in these "Prairie-dog villages," and that the beast, bird, and reptile, may not unfrequently be seen here in harmonious juxtaposition. In the pampas of South America, this little owl associates with another Burrowing rodent, which lives in communities in a similar manner to the Prairie-dog. This is the Vizcacha (*Lagostomus trichodactylus*). During the open day, Mr. Darwin tells us, but more especially in the evening, these owls may be seen in the pampas of the Argentine Republic in every direction, standing by pairs on the hillock next to their hole. If disturbed, they either retreat under-ground, or move with an undulatory flight to a short distance, and then turning round, steadily gaze at their pursuer.

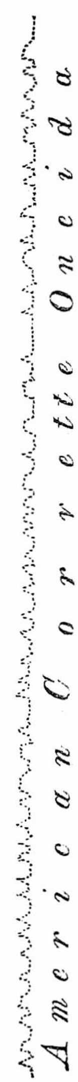
The Burrowing Owl is, however, perfectly capable of making its own burrow, as Mr. Darwin tells us it always does where the Vizcacha is not found, and as it has done in the Zoological Society's Gardens. The first individual of this species which was received in 1868 from the same donor, was no sooner placed in a cage with a sandy floor than, "true to its habits, it excavated a hole in the soil at the bottom, into which it always retreated when threatened." The same habit may be witnessed on alarming the specimens of this bird now in the Society's gardens, although the burrow in the present instance has been, at all events partially, made artificially for their use.

(4.) An example of a rather rare Antelope from Western Africa—the Woodloving Antelope (*Cephalophus sylvicultrix*)—received in exchange March 24th. This is a representative of a group of Antelopes of small size which are found only in tropical or subtropical Africa, and are peculiar for having a little tuft of hair between their horns, as their generic name imports. Some eighteen or twenty species of this genus are known to science, and several of them are usually represented in the Zoological Society's collection. But the present animal, which is well marked by its white dorsal streak, has not been previously received alive by the Society. P. L. SCLATER

NOVEL TELEGRAPHY—ELECTRIFICATION OF AN ISLAND

A CURIOUS discovery has been made by Mr. Gott, the superintendent of the French company's telegraph station at the little island of St. Pierre Miquelon. There are two telegraph stations on the island. One, worked in connection with the Anglo-American company's lines by an American company, receives messages from Newfoundland and sends them on to Sydney, using for the latter purpose a powerful battery and the ordinary Morse signals.

The second station is worked by the French Transatlantic Company, and is furnished with exceedingly delicate receiving instruments, the invention of Sir William Thomson, and used to receive messages from Brest and Duxbury. These very sensitive instruments were found to be seriously affected by earth-currents; *i.e.*, currents depending on some rapid changes in the electrical condition of the island; these numerous changes caused currents to flow in and out of the French company's cables, interfering very much with the currents indicating true signals. This phenomenon is not an uncommon one, and the inconvenience was removed by laying an insulated wire about three miles long back from the station to the sea, in which a large metal plate was immersed; this plate is used in practice as the earth of the St. Pierre station, the changes in the electrical condition or potential of the sea being small and slow, in comparison with those of the dry rocky soil of St. Pierre. After this had been done, it was found that part of the so-called earth-currents had been due to the signals sent by the American company into their own lines, for when the delicate receiving instrument was placed between the earth at the French station and the earth at the sea, so as to be in circuit with the three miles of insulated wire, the messages sent by the rival company were clearly indicated, so clearly indeed, that they have been automatically recorded by Sir William Thomson's syphon recorder. Annexed is a facsimile of a small part of the message concerning the loss of the steamship Oneida, stolen in this manner.



It must be clearly understood that the American lines come nowhere into contact, or even into the neighbourhood of the French line. The two stations are several hundred yards apart, and yet messages sent at one station are distinctly read at the other station; the only connection between the two being through the earth; and it is quite clear that they would be so received and read at fifty stations in the neighbourhood all at once. The explanation is obvious enough: the potential of the ground in the neighbourhood of the stations is alternately raised and lowered by the powerful battery used to send the American signals. The potential of the sea at the other end of the short insulated line remains almost if not wholly unaffected by these, and thus the island acts like a sort of great Leyden jar, continually charged by the American battery, and discharged in part through the short insulated French line. Each time the American operator depresses his sending key, he not only sends a current through his lines, but electrifies the whole island, and this electrification is detected and recorded by the rival company's instruments.

No similar experiment could be made in the neighbourhood of a station from which many simultaneous signals were being sent; but it is perfectly clear that unless special precautions are taken at isolated stations, an inquisitive neighbour owning a short insulated wire might steal all messages without making any connection between his instrument and the cable or land line. Stealing messages by attaching an instrument to the line was a familiar incident in the American War; but now messages may be stolen with perfect secrecy by persons who nowhere come within a quarter of a mile of the line. Luckily, the remedy is simple enough. All owners of important isolated stations should use earth-plates at sea, and at sea only. This plan was devised by Mr. C. Varley many years ago to eliminate what we may term natural earth-currents, and now it should be used to avoid the production of artificial earth-currents which may be improperly made use of.

FLEEMING JENKIN

NOTES

WE regret to hear that Baron Liebig is very ill.

WE are informed that Messrs. Lyon Playfair, C.B., M.P., B. Samuelson, M.P., and Dr. W. A. Miller, will probably be among the members of the Royal Commission to inquire into the Present State of Science in this country.

PRINCIPAL DAWSON, of Montreal, who is now on a visit to this country, will deliver the Bakerian Lecture to-night before the Royal Society. The subject is the Pre-carboniferous Flora of North Eastern America. The opportunity of listening to so eminent a geologist on a subject which he has made especially his own, will doubtless draw together a large assembly of our men of science anxious to do honour to their distinguished *confrère*.

THE following gentlemen have been appointed by the University of London examiners and assistant examiners for 1870-

1871 in the various branches of science:—Logic and Moral Philosophy: Rev. Mark Pattison, B.D., and Prof. G. Croom Robertson, M.A. Political Economy: Prof. W. Stanley Jevons, M.A., and Prof. T. E. Cliffe Leslie, LL.B. Mathematics and Natural Philosophy: Prof. H. J. S. Smith, M.A., F.R.S., and Prof. Sylvester, M.A., F.R.S. Experimental Philosophy: Prof. W. G. Adams, M.A., and Prof. G. Carey Foster, B.A., F.R.S. Chemistry: Dr. Matthiessen, F.R.S., and Prof. Odling, M.B., F.R.S. Botany and Vegetable Physiology: Joseph Dalton Hooker, M.D., LL.D., F.R.S., and Thomas Thomson, M.D., F.R.S. Geology and Palæontology: Prof. Duncan, M.B., F.R.S., and Prof. Morris, F.G.S. Practice of Medicine: John Syer Bristowe, M.D., and Prof. J. Russell Reynolds, M.D., F.R.S. Surgery: Prof. John Birkett, F.R.C.S., and F. Le Gros Clark, F.R.C.S. Anatomy: Prof. William Turner, M.B., F.R.S.E., and Prof. John Wood, F.R.C.S. Physiology, Comparative Anatomy, and Zoology: Michael Foster, M.D., B.A., and Henry Power, M.B. Obstetric Medicine: Robert Barnes, M.D., and Prof. W. H. Graily Hewitt, M.D. Materia Medica and Pharmaceutical Chemistry: Thomas R. Fraser, M.D., F.R.S.E., and Prof. Alfred Baring Garrod, M.D., F.R.S. Forensic Medicine: E. Headlam Greenhow, M.D., and Thomas Stevenson, M.D.

PROFESSOR AGASSIZ is still seriously ill.

WE are rejoiced to hear that M. Janssen is to be provided with instruments wherewith to continue his observations on the sun by means of the new method. This was announced at the last meeting of the Paris Academy by M. Faye, who remarked: "El quelques mois il livrera à la Science cent fois plus de données précieuses que les astronomes n' auraient pu en recueillir, avant lui, par l'observation ordinaire des eclipses totales d'une vingtaine de siècles."

THE number of entries for the Examination for Women at the London University, which takes place during the current week, is 17, against 9 last year. Of these, 12 will be examined in London, and 5 at Cheltenham.

DR. A. VOELCKER and Mr. H. M. Jenkins, Secretary to the Royal Agricultural Society, reprint, from the Journal of the Society, a Report on the Agriculture of Belgium, containing much valuable information on its soil and climate, geological features, modes of agriculture, and rural economy.

"THE Body and its Health, a Book for Primary Schools," by E. D. Mapother, M.D., is a little elementary book on human physiology, prepared with greater care and attention to accuracy han is usually the case with primary scientific hand-books. It contains in a small space, and published at a low price, a mass of such information as ought to form a portion of the curriculum of all schools, both for boys and girls, and is illustrated by good woodcuts.

THE "Repertorium für Meteorologie," issued by the Imperial Academy of St. Petersburg, in the form of a 4to. volume, edited by Dr. H. Wild, Director of the Physical Central Observatory, contains a mass of tables respecting the meteorological phenomena of Russia, and a variety of other information.

WE have on our table the reports of several provincial scientific societies, and other papers of a like nature:—The Proceedings of the Berwickshire Naturalists' Club, for 1869; Transactions of the Norfolk and Norwich Naturalists' Society for 1869-70; the 37th Annual Report of the Royal Cornwall Polytechnic Society for 1869; and the Geology, Botany, and Zoology of the Neighbourhood of Alnwick, by George Tate, F.G.S. They all show the zeal with which the pursuit of natural history is followed in the provinces; these local societies have been the nursery of many a genuine naturalist who has rendered important service to the study of Nature.

AMONG the objects of interest exhibited at the soirée of the Linnean Society on the 27th ult., was a collection of plants made by Mr. W. W. Saunders, arranged in pairs; the plants forming each pair belonged to entirely different natural orders, but were so remarkably alike in the general form, and even in the marking of the foliage, as to be barely distinguishable even to a practised eye. One of the most strikingly "mimetic" pairs were a Conifer and a Selaginella, belonging to the two sub-kingdoms of flowering and flowerless plants.

ACCORDING to Mr. Kurtz, the Curator of the Herbarium of the Calcutta Botanical Gardens, the Andaman Islands are gradually sinking, the rate of subsidence being about one foot in a century. This inference is founded on the fact that trunks of trees still rooted in the ground may be seen in the water of the straits which separate the islands, belonging to species which never grow in mangrove swamps, but which are only found further inland. It is even possible to "trace in several places the stumps of the sunken trees in the sea, up to the state when the trees are just dying by the influence of the sea-water, and the subsequent change of the soil by the formation of the mangrove swamp." At the rate of subsidence indicated by Mr. Kurtz, a thousand years must elapse before the extensive convict establishment maintained on these islands will be in immediate danger of submersion.

IN a forthcoming number of his "Geographische Mittheilungen," by means of a map and a memoir, the geographer Petermann gives his rendering of the information contained in Dr. Livingstone's recent letters, taken in connection with the former travels of the Portuguese in Central South Africa. The new real geography of this map agrees remarkably well, in its general features, with a chart which lately appeared in this journal. There is, however, one main point of difference. A river named *Luvivi* was crossed by Pombeiro Baptista in his route to the Cazembe's town from that of the Muata Yanvo, and is distinctly stated by him to run into the Luapula, the river which is now known to unite Lakes Bangeweolo and Moero. Livingstone says that a large river named *Lufira* drains the western side of the great valley, and takes up the waters of Ulenge in the west of Tanganyika. On the foundation of the resemblance of these names—surely a very weak one in a region where duplicate river names are frequent—Dr. Petermann discards the Pombeiros statement, and uniting the Luviri with the Lufira, carries a great river through the midst of the country separating the valleys ruled over by the Muata Yanvo and the Cazembe, which all travellers here agree is a mountainous desert, and which the road joining these territories bends far southward to avoid. Again: The country of Usango is said by Livingstone to be on the east of the plateau which rises south of Tanganyika; on this map it is indicated to westward of that lake; and Lake Liemba, instead of being shown on the northern slope of that upland, is represented as lying in a valley directly continuing that of Tanganyika. The uncertainty as to the identity of the Chowambe Lake with the Albert Nyanza, and consequently of the union of Tanganyika with the Nile system, is considered too great to admit of any solution of the Nile problem as yet, and any attempt at this is characterised as plucking unripe fruit. This part also contains a very interesting account of a voyage by a Norwegian fisher named Captain E. H. Johannesen, who, in the summer of 1869, sailed completely round the island of Novaia Zemlia and through the Kara Sea. This gulf, believed till now to be constantly choked up by impenetrable ice-park, has been called the "ice-cellar" of the North Pole. In place of this, Johannesen found a mild atmosphere off the north-east of Novaia Zemlia, and throughout the whole Kara Gulf in July and August no ice was visible, but a heavy roll of the open sea came up from the south-east.

MR. B. WILLIAMSON, one of the Fellows of Trinity College, Dublin, is preparing a "Treatise on Mechanics," which will shortly be issued by the University Press.

MR. JAMES GLAISHER has given two lectures for the "Sunday Lecture Society" on the evenings of April 24th and May 1st., on "The Balloon" and on "Rain." In the latter he gave an interesting account of how rain is derived and how measured ; some most carefully prepared tables were exhibited, together with diagrams and some excellent photographs of the varied forms of snow crystals. The lecture for May 8th will be by Mr. Henry Moody on "The Prevention of Infectious Diseases." The importance of this subject, in reference to the great object of the society, the social welfare of mankind, will be illustrated by the example of Bristol. From being one of the most unhealthy, Bristol has become one of the most healthy of cities. In the summer and autumn of 1832 the ravages there by cholera were enormous ; the deaths alone approaching to 1000 ! In 1866, on the contrary, when the poor at the East-end of London were dying by hundreds, the deaths in Bristol were but 26 ; and it will be pointed out that this vast difference has arisen from the precautions and general sanatory measures adopted by the inhabitants and authorities of the City of Bristol.

M. QUENAULT reports the discovery at Hauteville-sur-mer, near to a rock called Mauheu, of a bed of vegetable mould in which repose trunks of trees, still holding by their roots, along with a layer of turf. At high tide this bed is covered to the depth of about twelve inches. The oak alone has preserved its hardness, the other woods having become quite soft, but still preserving their colour and even their bark. He supposes the immersion to have taken place in the eighth century.

THE ninth reunion of the learned societies of the Sorbonne took place on the 20th of April, when M. Le Verrier was appointed president, M. Milne-Edwards vice-president, and M. Blanchard, secretary of the Section of Sciences ; M. le Marquis de la Grange, president, M. Léon Renier, vice-president, and M. Chabouillet, secretary of the Section of Archæology ; M. Amédée Thierry, president, and M. Hippeau, secretary of the Section of History. M. Le Verrier stated that the lectures instituted at the Sorbonne, which have already been in existence ten years, have had already the most beneficial results ; they have formed bonds between the *savants* of France and of the other countries of Europe, and have contributed to raise scientific and literary labours to a higher and higher platform.

WE have received Washington papers of the 13th, 14th, and 15th of April, containing a report of the 13th semi-annual session of the National Academy of Sciences, held in that city. The most important papers read were : "On the coming transits of Venus," by Prof. Simon Newcomb ; "On meridional arcs, measured in connection with the United States coast survey," by Mr. J. E. Hilgard ; "Craniological observations," by Dr. George Otis ; "The Northmen in Greenland," by Dr. Hayes ; "Considerations of the apparent inequalities of long periods in the moon's mean motion," by Prof. S. Newcomb ; "On the influence of the interior structure of the earth on precession and nutation," by Prof. J. G. Barnard ; "On a new classification of clouds," by Prof. Poey, of Havana ; "On fluctuations of the barometer," by Dr. B. F. Craig. Prof. Joseph Henry occupied the chair. We purpose giving abstracts of some of these pages on a future occasion.

A NATURAL History Society has recently been established at Winchester College ; and a Botanical Section has been formed in connection with the Hants and Winchester Scientific and Literary Society.

MR. LLEWELLYNN JEWITT has issued a prospectus of a proposed publication, by subscription, of an entirely new, large, and comprehensive history, topography, and genealogy of the county of Derby.

A PAPER appears in the last number of the "Proceedings of the Royal Society," by Dr. Herbert Davies, on the law which regulates the relative magnitude of the areas of the four orifices of the heart. He remarks that although to ordinary observation these orifices appear to exhibit no mutual relationship of size, there can be no doubt that an instrument so accurate in the adaptation of its valvular apparatus, and so exact in the working of its different parts, must reveal on close examination the existence of laws which not only determine the force required to be impressed upon the blood traversing its chambers, but also the relative sizes of these apertures to one another. On converting Dr. Peacock's measurements of the circumference of the several orifices into numbers representing these areas it is found that in the male the respective mean areas are

Tricuspid	$1\frac{3}{4}$ sq. inch.
Pulmonic	1 ,,
Mitral	$1\frac{1}{4}$,,
Aortic	$\frac{3}{4}$

and on pushing the inquiry further, it is found that there is a distinct law presiding over them which is discovered on comparing the ratios of the areas of corresponding orifices. Thus—

$$\frac{\text{Area of tricuspid}}{\text{Area of mitral}} = \frac{1.78}{1.27} = 1\cdot4 \text{ nearly}$$

$$\frac{\text{Area of pulmonic}}{\text{Area of aortic}} = \frac{1}{78} = 1\cdot3 \text{ nearly}$$

or in other words, the area of the tricuspid appears from these calculations to bear nearly the same relation to the area of the mitral, which the area of the pulmonic does to that of the aortic orifice ; *i.e.*, were the tricuspid, for example, twice the size of the mitral orifice in area, the pulmonic would be twice the size of the aortic orifice in area, the two ratios differing from each other only by one-tenth. The same law probably holds in the hearts of most animals, the areas of the four orifices bearing an exact mathematical relationship to each other, so that if the areas of any three of the openings be known, the area of the fourth orifice can be correctly calculated. A knowledge of this law, it is obvious, may prove of great importance in estimating the amount of contraction or dilatation of orifice which may be present in disease. Dr. Davis then proceeds to give the reasons for this arrangement, for which we must refer our readers to the original.

THAT the white corpuscles of the blood can pass through the walls of the blood-vessels is now admitted by so many observers, that it may fairly be regarded as an established fact. But the entrance of a solid body from the outside of the capillaries into their interior has, so far as we know, only been observed in one or two exceptional instances. Quite recently, however, M. Saviotti has published a paper in the *Centralblatt*, in which he describes the passage of entire pigment cells from the parenchyma of the web of the foot of the frog through the walls of the capillaries and smaller veins, into their lumen, where having arrived, they are swept away by the blood current as a phenomenon of common occurrence, and easily followed. To render this evident he excites local inflammation in the web by the application of a dilute (2 per cent.) solution of sulphuric acid. After the lapse of some time the pigment cells of the part affected are found to have congregated together round the minute vessels in a somewhat contracted condition, their long branching process becoming materially shortened. The contractility which these cells are known to possess, however, is not entirely abrogated. One or more of the processes may be seen to insinuate itself through the wall of the adjacent capillary. After penetration it may become much elongated, and be even altogether carried away by the current of blood, to the movements of which for a time it offers an impediment ; or it may, so to speak, drag after it the rest of the cell, which after remaining a little while adherent to the inner surface of the vessel at the point where it has entered, is swept, or itself swims away. Is not this a singular fact? Of what nature must the capillary wall be, that will thus admit the ingress and egress of solid bodies, and yet retain the red blood corpuscles even under great increase of pressure.

M. E. LEFEVRE is engaged upon a monograph of the species of the genus *Clythra*, inhabiting Europe and its confines (including the Mediterranean region). As many new species have been discovered, especially in Algeria and the East, since the publication of Lacordaire's memoir in 1848, M. Lefèvre will be thankful for the loan of specimens of new or rare species, and for any information as to their geographical distribution. M. Lefèvre's address is 28, Rue Constantine, Paris-Plaisance.

WE quote the following from the *Scotsman*, of May 2:— "A correspondent writes: 'In Inverleith Row on Saturday night, exactly at a quarter-past eleven o'clock, my attention was attracted by a sudden and strange brightness overspreading everything around. Instinctively turning my eyes upwards, a grand sight met my gaze. A meteor of remarkable size, brilliancy, and distinctness, was seen shooting from the heavens, from about the zenith, and descending earthwards in a southerly direction. The form of this interesting object seemed elliptical, and it was of a bright yellow hue. It had a clearly-defined apex or point, which was of a deep red colour, and appeared to glow and sparkle in a wonderful manner. The phenomenon was visible for about two seconds, and lighted up everything around me. The night was fine and clear, with a decidedly frosty air, and there was a light, steady breeze blowing from the north-west at the time." On the same subject our Dunbar correspondent writes: 'A very brilliant meteor was observed here about eleven o'clock on Saturday night. When first seen, the meteor had the appearance of a star of the first magnitude. As it approached, however, it gradually increased in size until it assumed the appearance of a ball of five or six inches in diameter, and changing its colour from a pale silvery white to a bright blue flame. As it still increased, sparks seemed to be emitted from the circumference, giving it the appearance of being surrounded with a peculiar halo of dense silvery rays. It continued in this state for a second or two, and then shot across the heavens in a southerly direction, the ball increasing in brilliancy as it travelled, and leaving behind it a long train of lurid-coloured flame. From the time it was first seen approaching until it vanished about five or six seconds elapsed. The night was clear and cold at the time.'"

THE GRESHAM LECTURES

THE Lectures (three in number) were delivered by Dr. Symes Thompson, during the past week, at the Gresham College, Basinghall-street. The first was occupied with the consideration of Cough, an account being given of its etiology varieties, and general principles of treatment. The second was devoted to Tonics; whilst of the third, which treated of Climate and Health Resorts, we give an epitome as likely to prove interesting to some of our readers. Dr. Thompson remarked that the Romans very early discovered the use of mineral waters, as shown by many of their relics being found in the neighbourhood of such springs; whilst at Wiesbaden, tablets have been found with votive inscriptions. Some of the more common ingredients of mineral waters were then described, and their chemical properties demonstrated, including carbonic acid, iron, sulphuretted hydrogen, &c. The properties of ozone were then discussed in connection with pure air, and the lecturer passed on to the consideration of climate and health resorts, and said that it was a great mistake to suppose that any particular place was the best for a particular malady, for there is no specific action in the air of any place; and the physician, in recommending a resort to patients, had regard to the kind of climate there found, a dry climate being suitable for most bronchial membranes, and a moist climate for the reverse state of the membranes, and an approximation to such different climates can be obtained in our rooms. If the patient be feverish and excitable, he should be sent to an exciting varied climate; or, if languid and torpid, not to a quiet, mild, uniform climate. These two kinds of climate are obtainable at the south of France; for at Nice the climate is bright and exciting, while in the neighbourhood of the Pyrenees, at Pau, the atmosphere is very still, and eminently suitable to patients suffering from irritable membranes. The great advantage gained by persons going abroad is no doubt the regular daily outdoor exercise, not obtainable in the varied winter of our island, but found in Algiers, Riviera, Mentone, Nice, &c., at that season. Together with exercise may be linked the advantage derived from breathing pure air. There are, however, many places in England where almost the same benefit may be enjoyed. It was the former practice in cases of lung-disease, to shut up patients in close rooms, with fire burning, all through the winter, the consequence being that they became like hothouse plants, and on the first exposure to the open air in spring all these advantages were lost. Acting on the same principle, consumptive patients up to 20 years ago were sent to Madeira. Three years ago the inhabitants of Madeira, wishing to re-establish the value of their climate in lung-disease, solicited the authorities of the Brompton Hospital for Consumption to send them out patients as a matter of experiment. Twenty patients were sent out, and only those who were likely to be benefited by the climate of Madeira, being all in an advanced stage of lung-disease. Of this number 1 patient died suddenly, although up to the time of his death he seemed to be benefiting by the change; 4 were worse; 6 were stationary, and 7 were markedly benefited; 2 very much benefited. This has been regarded by some as unsuccessful; but Dr. Thompson was of different opinion, and thought it indicated that Madeira is a useful climate in certain cases. Since Madeira has been abandoned there has been a revulsion of feeling in favour of Canada as a resort for consumptives, but that this is no new doctrine is seen from the fact that the value of cold climates for consumption was advocated by Baron Larrey, Napoleon Bonaparte's physician. There are disadvantages as well as advantages in the most favoured health resorts; such as the dry, hot "mistral' of Nice, or the dry, dusty "brickfielder" of Melbourne,—winds which patients dislike as much as our east wind. Purity of air or absence of dust is of very great importance; and for this reason it is now the practice to send patients suffering from chest-disease for a long sea-voyage. It constantly happens that sick people—in whom the disease is far advanced—press their medical men to send them on a sea-voyage; but in their case the remedy has come too late, and so it happens that the death-rate at Melbourne is exceedingly high—more than half the deaths being due to consumption. Dampness favours consumption; so that dry air is another desideratum which can be obtained at certain altitudes —so that in certain districts it is found possible to resort to mountain-tops, where consumption does not occur. In the neighbourhood of the equator the so-called "immunity-level" is at a height of 9,000 feet; at Algiers, 6,000 feet; at London, 3,000 feet. The chief resorts in Europe are the Swiss mountains, where English people often go to spend the winter, in perpetual snow, but yet in an atmosphere so pure and clear that the most delicate invalids can go out in the open air. In Norway, Russia, &c., the immunity-level is only 1,000 feet above the sea.

SCIENTIFIC SERIALS

THE May number of the *Journal of Botany, British and Foreign*, commences with the first part of a *Clavis Agaricinorum* by the well-known fungologist, Mr. Worthington Smith. The general classification of the Agarics adopted by Fries and Berkeley is followed; but several new sub-genera are proposed. An ingenious tabular view accompanies the paper, presenting the salient features of the series and sub-genera of this vast genus at a glance. Dr. Seemann continues his revision of the natural order *Bignoniaceæ*; while the Hon. J. L. Warren contributes a paper on a sub-division of *Rubus*, a most intricate genus, to which he has paid special attention; and Dr. H. Trimen a description of a new British *Callitriche*. Other short notes and notices fill up the number, which maintains the interest for British botanists especially, promised on the commencement of the new series.

The *Revue des Cours Scientifiques* for April 23rd contains a report of an interesting address delivered before the University of Berlin, by M. du Bois Reymond on the Organisation of Universities; the conclusion of Fotherly's address to the Hunterian Society, and report of a lecture by M. Claude Bernard, on Suffocation by Charcoal. The number for April 30th is entirely occupied by M. Bouley's lecture at the Sorbonne, on Madness, and the conclusion of M. Bernard's lecture.

The third number of the new Italian Geological Journal, or *Bollettino*, published by the "Comitato Geologico d'Italia," opens with M. Igino Cocchi's paper on the stratified rocks of the isle of Elba. It especially relates to the lower secondary, eocene, cretaceous, and post pliocene strata, and is illustrated with engravings. Among the bibliographical notices, Professor Omboni's work on the Geology of Italy, with eight maps, is well spoken of. The number also comprises translations of extracts from foreign memoirs.

The *American Naturalist,* Vol, IV., No. 2, April 1870.—The April number of this Journal contains three exceedingly interesting articles, namely, a report on the Sea Otters of the north-west coast of America and Aleutian islands, by Captain C. M. Scammon; a paper on Parasitic Insects, from the able hand of Dr. A. S. Packard; and some notes on the Fresh-water Fish of New Jersey, by Dr. C. C. Abbott, which contains many valuable remarks. The last two papers are illustrated.—Dr. W. Wood contributes a popular article on Falconry.—The usual reviews and short miscellaneous notices complete the contents of the number.

SOCIETIES AND ACADEMIES

London

Royal Society.—April 28.—"On the Organs of Vision in the Common Mole." By Robert James Lee.

"On an Aplanatic Searcher, and its Effects in improving High Power Definition in the Microscope." By G. W. Royston-Pigott, M.A., M.D.

The Aplanatic Searcher is intended to improve the penetration, amplify magnifying power, intensify definition, and raise the objective somewhat further from its dangerous proximity to the delicate covering-glass indispensable to the observation of objects under very high powers. The inquiry into the practicability of improving the performance of microscopic object-glasses of the very finest known quality was suggested by an accidental resolution in 1862 of the Podura markings into black beads. This led to a search for the cause of defective definition, if any existed. A variety of first-class objectives, from the $\frac{1}{16}$ to the $\frac{1}{4}$, failed to show the beading, although most carefully constructed by Messrs. Powell and Lealand. Experiments having been instituted on the nature of the errors, it was found that the instrument required a better distribution of power; instead of depending upon the deepest eyepieces and most powerful objectives hitherto constructed, that better effects could be produced by regulating a more gradual bending or refraction of the excentrical rays emanating from a brilliant microscopic origin of light. It then appeared that delusive images, which the writer has ventured to name *eidola**, exist in close proximity to the best focal point (where the least circle of confusion finds its focus).

I. That these images, possessing extraordinary characters, exist principally above or below the best focal point, according as the objective spherical aberration is positive or negative.

II. That test-images may be formed of a high order of delicacy and accurate portraiture in *miniature,* by employing an objective of twice the focal depth, or, rather, half the focal length, of the observing objective.

III. That such test-images (which may be obtained conveniently two thousand times less than a known original) are formed (under precautions) with a remarkable freedom from aberration, which appears to be reduced in the miniature to a *minimum.*

IV. The beauty or indistinctness with which they are displayed (especially on the immersion system) is a marvellous test of the correction of the observing objective, but an indifferent one of the image-forming objective used to produce the testing miniature.

These results enable the observer to compare the known with the unknown. By observing a variety of brilliant images of known objects, as gauze, lace, an ivory thermometer, and sparkles of mercury, all formed in the focus of the objective to be tested with the microscope properly adjusted so that the axes of the two objectives may be coincident, and their corrections suitably manipulated, it is practicable to compare known delusions with suspected phenomena.

It was then observed (by means of such appliances) that the aberration developed by high-power eyepieces and a lengthened tube followed a peculiar law.

A. A lengthened tube increased aberration faster than it gained power (roughly, the aberration varied as v^2, while the power varied as v).

B. As the image was formed by the objective at points nearer to it than the *standard distance of nine inches,* for which the best English glasses are corrected, the writer found the aberration diminished faster than the power was lost, by shortening the body of the instrument.

C. The aberration became negatively affected, and required a positive compensation.

D. Frequent consideration of the equations for aplanatism suggested the idea of searching the axis of the instrument for aplanatic foci, and that many such foci would probably be found to exist in proportion to the number of terms in the equations (involving curvatures and positions).

E. The law was then ascertained that power could be raised, and definition intensified, by positively correcting the searching lenses in proportion as they approached the objective, at the same time applying a similar correction to the observing objective.

The chief results hitherto obtained may be thus summarised. The writer measured the distance gained by the aplanatic searcher, whilst observing with a half-inch objective with a power of seven hundred diameters, and found it *two-tenths of an inch increase;* so that optical penetration was attainable with this high power through plate-glass nearly one quarter of an inch thick, whilst *visual* focal depth was proportionably increased. The aplanatic searcher increases the power of the microscope from two and a half to five times the usual power obtained with a third or C eye-piece of one inch focal length. The eighth thus acquires the power of a twenty-fifth, the penetration of a one-fourth. And at the same time the lowest possible eyepiece (3-inch focus) is substituted for the deep eye-piece formed of minute lenses, and guarded with a minutely perforated cap. The writer lately exhibited to Messrs. Powell and Lealand a brilliant definition, under a power of four thousand diameters, with their new "eighth immersion" lens, by means of the searcher and low eyepiece.

The traverse of the aplanatic searcher introduces remarkable chromatic corrections displayed in the unexpected colouring developed in microscopic test objects. The singular properties, or rather phenomena, shown by eidola, enable the practised observer in many cases to distinguish between true and delusive appearances, especially when aided by the aberrameter applied to the objective to display excentrical aberration by cutting off excentrical rays. Eidola are symmetrically placed on each side of the best focal point, as ascertained by the aberrameter when the compensations have attained a delicate balance of opposite corrections.

If the beading, for instance, of a test object exists in two contiguous parallel planes, the eidolon of one set is commingled with the true image of the other. But the upper or lower set may be separately displayed, either by depressing the false eidola of the lower stratum, or elevating the eidola of the upper. For when the eidola of two contiguous strata are intermingled, correct definition is impossible so long as the aperture of the objective remains considerable.

One other result accrues: when an objective, otherwise excellent, cannot be further corrected, the component glasses being already closely screwed up together, a further correction can be applied by means of the adjustments of the aplanatic searcher itself, all of which are essentially conjugate with the actions of the objective and the variable positions of its component lenses; so that if δx be the traversing movements of the objective lenses, δv that of the searcher, F the focal distance of the image from the objective when δx vanishes, f the focal distance of the virtual image formed by the facet lenses of the objective, then

$$\frac{\delta v}{\delta x} = \left(\frac{F}{f_1}\right)^2$$

The *appendix* refers to plates illustrating the mechanical arrangements for the discrimination of eidola and true images, and for traversing the lenses of the aplanatic searcher. The plates also show the course of the optical pencils, spurious disks of residuary aberration and imperfect definition, as well as some examples of "high-power resolution" of the Podura and Lepisma beading, as well as the amount of amplification

* From εἴδωλον, a false spectral image.

obtained by Camera Lucida outline drawings of a given scale.

"On a Cause of Error in Electroscopic Experiments." By Sir Charles Wheatstone, F.R.S.

To arrive at accurate conclusions from the indications of an electroscope or electrometer, it is necessary to be aware of all the sources of error which may occasion these indications to be misinterpreted. In the course of some experiments on electrical conduction and induction which I have recently resumed, I was frequently delayed by what at first appeared to be very puzzling results. Occasionally I found that I could not discharge the electrometer with my finger, or only to a certain degree, and that it was necessary, before commencing another experiment, to place myself in communication with a gas-pipe which entered the room. How I became charged I could not at that time explain; the following chain of observations and experiments, however, soon led me to the true solution. I was sitting at a table not far from the fireplace, with the electrometer (one of Peltier's construction) before me, and was engaged in experimenting with disks of various substances. To ensure that the one I had in hand, which was of tortoise-shell, should be perfectly dry, I rose and held it for a minute before the fire; returning and placing it on the plate of the electrometer, I was surprised to find that it had apparently acquired a strong charge, deflecting the index of the electrometer beyond 90°. I found that the same thing took place with every disk I thus presented to the fire, whether of metal or any other substance. My first impression was that the disk had been rendered electrical by heat, though it would have been extraordinary that, if so, such a result had not been observed before; but on placing it in contact with a vessel of boiling water, or heating it by a gas-lamp, no such effect was produced. I next conjectured that the phenomenon might arise from a difference in the electrical state of the air in the room and at the top of the chimney; and to put this to the proof, I adjourned to the adjacent room where there was no fire, and bringing my disk to the fireplace I obtained precisely the same result. That this conjecture, however, was not tenable was soon evident, because I was able to produce the same deviation of the needle of the electrometer by bringing my disk near any part of the wall of the room. This seemed to indicate that different parts of the room were in different electrical states; but this again was disproved by finding that when the positions of the electrometer and the place where the disk was supposed to be charged were interchanged, the charge of the electrometer was still always negative. The last resource was to assume that my body had become charged by walking across the carpeted room, though the effect was produced even by the most careful treading. This ultimately proved to be the case; for resuming my seat at the table and scraping my foot on the rug, I was able at will to move the index to its greatest extent.

Before I proceed further I may state that a gold-leaf electrometer shows the phenomena as readily. When I first observed these effects the weather was frosty; but they present themselves, as I have subsequently found, almost equally well in all states of the weather, provided the room be perfectly dry. I will now proceed to state the conditions which are necessary for the complete success of the experiments, and the absence of which has prevented them from being hitherto observed in the striking manner in which they have appeared to me. The most essential condition appears to be that the boot or shoe of the experimenter must have a thin sole and be perfectly dry; a surface polished by wear seems to augment the effect. By rubbing the sole of the boot against the carpet or rug, the electricities are separated, the carpet assumes the positive state and the sole the negative state; the former being a tolerable insulator, prevents the positive electricity from running away to the earth, while the sole of the foot, being a much better conductor, readily allows the charge of negative electricity to pass into the body. So effective is the excitation, that if three persons hold each other by the hands, and the first rubs the carpet with his foot while the third touches the plate of the electrometer with his finger, a strong charge is communicated to the instrument. Even approaching the electrometer by the hand or body, it becomes charged by induction at some distance.

A stronger effect is produced on the index of the instrument if, after rubbing the foot against the carpet, it be immediately raised from it. When the two are in contact, the electricities are in some degree coerced or dissimulated; but when they are separated, the whole of the negative electricity becomes free and expands itself in the body. A single stamp on the carpet followed by an immediate removal of the foot causes the index of the electrometer to advance several degrees, and by a reiteration of such stamps the index advances 30° or 40°. The opposite electrical states of the carpet and the sole of the boot were thus shown: after rubbing, I removed the boot from the carpet, and placed on the latter a proof-plate (*i.e.* a small disk of metal with an insulating handle), and then transferred it to the plate of the electrometer: strong positive electricity was manifested. Performing the same operation with the sole of the boot, a very small charge was carried, by reason of its ready escape into the body. The negative charge assumed by sole-leather when rubbed with animal hair was thus rendered evident. I placed on the plate of the electrometer a disk of sole-leather and brushed it lightly with a thick camel's-hair pencil; a negative charge was communicated to the electrometer, which charge was principally one of conduction, on account of the very imperfect insulating power of the leather. Various materials, as India-rubber, gutta-percha, &c., were substituted for the sole of the boot; metal plates were also tried; all communicated negative electricity to the body. Woollen stockings are a great impediment to the transmission of electricity from the boot; when these experiments were made I wore cotton ones. When I substituted for the electrometer a long wire galvanometer, such as is usually employed in physiological experiments, the needle was made to advance several degrees.

At the meeting of the British Association at Dublin in 1857, Professor Loomis, of New York, attracted great attention by his account of some remarkable electrical phenomena observed in certain houses in that city. It appears that in unusually cold and dry winters, in rooms provided with thick carpets and heated by stoves or hot-air apparatus to 70°, electrical phenomena of great intensity are sometimes produced. A lady walking along a carpeted floor drew a spark one quarter of an inch in length between two metal balls, one attached to a gas-pipe, the other touched by her hand; she also fired ether, ignited a gaslight, charged a Leyden jar, and repelled and attracted pith-balls similarly or dissimilarly electrified. Some of these statement were received with great incredulity at the time both here and abroad, but they have since been abundantly confirmed by the Professor himself and by others. (See Silliman's American Journal of Science, July 1858.)

My experiments show that these phenomena are exceptional only in degree. The striking effects observed by Professor Loomis were feeble unless the thermometer was below the freezing-point, and most energetic when near zero, the thermometer in the room standing at 70°. Those observed by myself succeed in almost any weather, when all the necessary conditions are fulfilled. Some of these conditions must frequently be present, and experimentalists cannot be too much on their guard against the occurrence of these abnormal effects. I think I have done a service to them, especially to those engaged in the delicate investigations of animal electricity, by drawing their attention to the subject.

Royal Institution, May 2. Annual meeting.—Sir Henry Holland, Bart, M.D., D.C.L., F.R.S., President, in the chair. The annual report of the Committee of Visitors for the year 1869 was read and adopted. The books and pamphlets presented in 1869 amounted to 255 volumes, making, with those purchased by the managers, a total of 388 volumes added to the library in the year, exclusive of periodicals. Forty-seven new members were elected in 1869. Sixty-three lectures and nineteen evening discourses were delivered during the year 1869. The following gentlemen were unanimously elected as officers for the ensuing year:—President: Sir Henry Holland, Bart., M.D., D.C.L., F.R.S. Treasurer: William Spottiswoode, M.A., F.R.S. Secretary: Henry Bence Jones, M.A., M.D., F.R.S.

Royal Geographical Society, April 25.—Sir R. I. Murchison, Bart., President, in the chair. The following new Fellows were elected:—Baron Osten Sacken, Secretary to the Imperial Geographical Society, St. Petersburg (Hon. Corresponding Member); Thomas M. Blackie; Lieutenant Evelyn Baring, R.A.; Colonel Shuckburgh Denniss; George B. Hudson; Lord Lawrence, G.C.B.; and John Fenton Taylor.

A paper was read, entitled "An Expedition to the Trans-Narym Country," by Baron Osten Sacken. This paper, which had been translated from the Russian by Mr. Delmar Morgan, contained a narrative of a journey, undertaken for the purpose of a reconnaissance survey, by General Poltoratsky, across the

Thian-Shan Mountains to the vicinity of Kashgar. This territory became part of the Russian dominions by the treaty of Pekin in 1860, by which the frontier line was fixed as extending from the east of Lake Issyk-Kul, along the southern spur of the Celestial Mountains, to the Khokand country; but the terrritory had never yet been visited by a European. Starting from Fort Vernoë, north of Lake Issyk-Kul, the party turned the western end of the lake, and then marched nearly due south. The country was very mountainous and picturesque, five distinct lines of elevation belonging to the Thian-Shan system being crossed in succession, some of them by passes upwards of 12,000 feet in height. The intervening valleys are traversed by streams, forming the head-waters of the Jaxartes, the largest of which is the Narym; and on the elevated ridges lie two beautiful alpine lakes, the Sou-Kul and the Chatir-Kul. Game is very abundant along the banks of the rivers, and the country is but thinly peopled by tribes of Kirghizes. The Russians did not gain possession of the new territory without a severe struggle with the forces of the neighbouring independent state of Khokand, who, in October 1860, marched an army of 40,000 men against the small Russian force, but were defeated. Baron Osten Sacken paid great attention to the botany of the country passed through, and noted the various zones of vegetation, from the wooded lower slopes of the Thian-Shan to the treeless plains below the snow-line. The alpine flora he described as extremely rich and beautiful in colour and form—amongst the plants he mentioned *Anemone narcissiflora*, Ranunculi, Geraniums, Potentillas, Gentians, and other genera—showing a great resemblance between the productions of the Thian-Shan and the Himalaya. The expedition reached to within two marches of Kashgar, and then returned to Fort Vernoë.

A second paper, on "Recent Russian Explorations in Turkistan," was read by Mr. Delmar Morgan. In the discussion which followed, M. Bartholomei, of the Russian Legation, spoke of the friendly rivalry which now prevailed between Russians and English in the exploration of Central Asia. Sir Henry Rawlinson enumerated three new expeditions to different parts of Turkistan, in which the Russians were now engaged, and the scientific results of which were freely communicated; and he congratulated the President, Sir Roderick Murchison, on the actual realisation of his anticipations of former years, when Russia and England would be friendly rivals in completing our acquaintance with the geography of the respective boundaries of each in their Eastern possessions.

Ethnological Society, April 26.—Prof. Huxley, F.R.S., in the chair.—Dr. Donovan read a paper on "The importance to the Ethnologist of a careful study of the Characters of the Brain."—Mr. E. B. Tylor then read a communication "On the Philosophy of Religion among the Lower Races of Mankind." Generalising from the lower religions of the world, the author stated the principle on which, in his view, was developed the philosophy of what may be called Natural Religion. Taking the doctrine of spiritual beings as the minimum definition of religion, he described it as *animism*, a term which fits with the theory put forward, that the conception of the soul as recognised by the lower races, is the starting-point of their religious philosophy. Such a soul, combining the ideas of ghost and vital principle, explains the phenomena of life, disease, dreams, visions, &c. This idea is extended to animals and inanimate objects, which are considered to have souls capable of appearing after death or destruction. On the analogy of the body and soul, the actions of nature are explained on the animistic theory as worked or controlled by soul-like spiritual beings. Of these beings an immense number are held to be actually human souls or manes. To such beings are ascribed the phenomena of disease, especially epilepsy and mania. Similar in nature, though different in function, are the spirits of trees, springs, &c. Hence the savage polytheist rises to expanded conceptions of greater deities, as Sun and Moon. At an early period he separates the cause of good from that of evil, and hence Dualism is rooted deeply in the religion of the lower races. The culminating conception of a Supreme Deity is well known to many of the lower races.—The President, Mr. Pusey, Mr. Howorth, and Dr. Hyde Clarke, joined in the discussion on this paper.

N.B.—It should have been stated in the report of the last meeting, that the paper "On the Danish Element in the Population of Cleveland" was written by the Rev. J. C. Atkinson, of Danby.

PARIS

Academy of Sciences, April 25.—M. Chasles presented a note by M. H. Durrande, on surfaces of the fourth order, and a communication from Mr. Spottiswoode concerning a theorem brought before the Academy on the 21st of March last, and of which he now gives the following enunciation:—"Every point of a surface is sextactic in ten of the sections made by the planes of a bundle of which the axis passes through the point." —M. de Saint Venant presented a memoir on the pressure of soils, containing a comparison of his estimates from the rational consideration of the limit of equilibrium, and by the employment of the so-called principle of least resistance of Moseley. —Several papers on subjects connected with physics were read. M. Becquerel communicated some experimental researches by MM. Lucas and Cazin, upon the duration of the electric spark. M. Jamin presented a note by M. A. Trève, on electric currents, containing some curious and interesting experiments on the action of currents in opposite directions, and when crossed in vacuum-tubes. A note by M. Rénou, on the latent heat of ice, deduced from the experiments of Laplace and Lavoisier, was communicated by M. C. Sainte-Claire Deville. The author referred to a note by M. Jamin, in which the correctness of the experiments made by Laplace and Lavoisier was maintained, and stated that the accordance of results obtained by M. Jamin could only be fortuitous, as the thermometers employed by the old experimenters were inaccurate.—M. H. Sainte-Claire Deville presented a note on the formation of liquid drops, by M. Duclaux. The author described experiments with distilled water, and with alcohols of different strengths, and stated that in the formation of drops phenomena of cohesion have but little action. Drops of water are formed much more rapidly in vapour of alcohol than in the air, and yet the amount of alcohol dissolved is very small, and hence the author concluded that the effect is produced only upon a very thin superficial layer of the drop, the tension of which constitutes the resisting power determining the size of the drop. He extended these considerations to the formation of emulsions, and to various liquids in the organism.—A paper on the fixed characteristic notes of the different vowels, by M. R. Kœnig, was presented by M. Regnault. The author discussed the results obtained by MM. Helmholtz and Donders, and gave the following as that of his own investigations into the musical notes of the vowels.

OU	O	A	E	I
$(\text{si}\flat)_2$	$(\text{si}\flat)_3$	$(\text{si}\flat)_4$	$(\text{si}\flat)_5$	$(\text{si}\flat)_6$

giving in round numbers of simple vibrations: 450, 900, 1,800, 3,600, 7,200.—Numerous papers relating to astronomical subjects were communicated, and M. Delaunay read a note on the discovery of a new telescopic planet at the Observatory of Marseilles on the 19th April. This is the 110th asteroid of the group between Mars and Jupiter, and M. Delaunay proposes for it the name of *Lydia*. Its position on the 19th April, at $10^h\ 33^m\ 13^s$, mean time at Marseilles, was as follows:—

$$A\ R = 12^h\ 2^m\ 39^s,\ 22.$$
$$D = +6^\circ\ 50',\ 38''.\ 8$$

Horary movements { in right ascension — $1^s\ 77$ / in declination + $2''.\ 20$

Magnitude 12 — 13.

M. Faye presented three memoirs, namely: a report on the operations of M. Respighi in spectral observation of the solar protuberances; a note on the recent experiments of M. Wüllner on the spectra of hydrogen, oxygen, and nitrogen, with reference to those of the solar protuberances; and a note on the processes of photographic observation proposed by M. Paschen for the coming transit of Venus.—A letter from Father Secchi on the results of some spectral observations of the sun was also read.—M. Delaunay presented, on the part of M. Flammarion, a reply to the objections raised by M. G. Quesneville to his law of the rotatory movement of the planets.—M. Chapelas presented a note on a luminous meteor of great brilliancy observed at Paris on the night of the 19th of April. This meteor passed from near σ Herculis to the neighbourhood of $\delta\ \epsilon\ \zeta$ Cephei, describing a trajectory from S. to N. of 48°. Its colour was green, and it had a long train. Its disappearance was preceded by three noiseless explosions, accompanied by flashes which illuminated the hills round Paris. Its apparent size was 6 or 7 times that of Jupiter.—The subject of arctic explorations was treated by M. C. Grad, who suggested as an untried route for attempting to reach the North Pole, the passage through the Sea of Kara and the Siberian Ocean.—The chemical papers were the following: Researches upon new platinic derivatives of the phosphorus-bases, by MM. A. Cahours and H. Gall; on the utilisation of the secondary products obtained in the manufacture of chloral, for the preparation of the æthylamines on a large scale, by M. A. W. Hofmann; thermical investigations of iodic acid, by M. A. Ditte, communicated by M. H. Sainte-Claire Deville; and thermical investigations of the states of sulphur, by M. Berthelot, presented by M. Balard.—M. A. Béchamp communicated a memoir on geological "microzymas" of various origin, in which he described the action of different rocks in producing alteration and fermentation of starch-paste, and sugar. He maintained that in all limestones, from the Great Oolite to the most recent Tertiaries, there exist living organisms (for which he has proposed the name of *Microzymas*), of the nature of the molecular granules observed in certain fermentations, and that these are the agents which produce the changes described by him. He stated that pure carbonate of lime has no such action.—M. Milne-Edwards presented a note by M. Jourdain on the mode of action of chloroform, upon the irritability of the stamens of *Mahonia*. Exposure for from 1 to 3 minutes to the vapour of chloroform was said to destroy temporarily the irritability of the stamens; exposure for 10 minutes or a quarter of an hour kills the portion of the plant subjected to it.—A note on the primitive type of the mammalia, by M. A. Roujou was read.—M. C. Robin communicated a note by M. Girard-Teulon on the law of the rotations of the eye-ball in the associated movements of the eyes, in which the author supported the views of Donders, in opposition to those of Helmholtz and Listing, and indicated what, in his opinion, had led the latter writers to a false conclusion.—The Abbé Richard communicated an account of the discovery of a workshop for the manufacture of flint instruments in Palestine.—This workshop is near the village of El-Bire (the ancient Beëroth), about twelve kilometers from Jerusalem; the author found *haches*, scrapers, knives, and saws, the last said by him to be very remarkable.—Besides these, and two papers on medical and surgical subjects, several notes were read of which the titles only are given.

Vienna

Imperial Academy of Sciences, Feb. 3.—Prof. P. Redtenbacher presented on the part of Prof. H. Will, "An investigation of white mustard seed." In place of the myronate of potash of black mustard seed, the white mustard contains *sinalbine*, decomposable into sugar, a sulphocyanic compound and an acid sulphate. The sulphocyanic compound contains the radical *akrinyle* $C^7 H^7 O$, and when freed from sulphur and treated as nitryle with alkali furnishes ammonia and the salt of an acid = $C^8 H^8 O^3$, which melts at 277° F., and is not identical with any known acid of the same formula. The acid sulphate contains sinapisine, and the author contrasts the products of black and white mustard as follows:—

	Myronate of Potash.		Sugar.		Mustard Oil.		Sulphate of Potash.
1.	$C^{10} H^{18} NS^2 KO^{10}$	=	$C^6 H^{12} O^6$	+	$C^4 H^5 NS$	+	$SO^4 K H$
	Sinalbine.		Sugar.		Sulphocyanide of akrinyle.		Sulphate of sinapisine.
2.	$C^{30} H^{44} N^2 S^2 O^{16}$	=	$C^6 H^{12} O^6$	+	$C^8 H^7 NOS$	+	$SO^4 (C^{16} H^{14} NO^5) H$

February 10.—Mr. Joseph Rauter forwarded a memoir on the "Developmental history of some of the hairy structures of plants belonging to various families of *Dicotyledons*." He noticed that in some cases the hairs are simple products of the epidermal cells; whilst in others, although the first rudiment of the hair takes its origin from an epidermal cell, at a later period the subjacent parenchyma and the neighbouring epidermal cells take part in its structure; and in others, again—such as the spines and glandular hairs of roses—the first rudiment of the structure springs from the subcuticular tissue. As examples of the first mode of development, he cites the woolly hairs of *Ribes*, *Rosa*, &c., the stellate hairs of *Hieracium pilosella*, and the glandular hairs of *Hieracium*, *Azalea*, &c.; of the second, the stings of the nettle, the clinging hairs of the hop, and some other forms.—Dr. Boué presented the first portion of his mineralogico-geognostic observations made during his travels in Turkey in Europe, and relating to North Albania, Bosnia, Hergezowina, and Turkish Croatia.—Prof. J. Redtenbacher communicated the results of an investigation of some Austrian hydraulic magnesian lime which had been made in his laboratory by M. P. G. Hauenschild. The material contained about sixty per cent. of carbonate of lime, and thirty per cent. of carbonate of magnesia; when burnt at about 752° F. it furnished an excellent hydraulic cement.—Prof. Hlasivetz made a preliminary communication "Upon a new acid from grape sugar." He referred to his discovery of lactonic acid by the treatment of sugar of milk with bromine, and indicated that the only difference between the two bodies consists in the presence of one more atom of oxygen in the acid. A similar acid was produced by treating other sugars with bromine, but the hydrobromic acid formed in the reaction prevented its separation. The author induced M. Habermann to treat grape sugar with chlorine instead of bromine, and he has obtained the expected acid, having the formula $C^6H^{12}O^7$.—Dr. S. L. Schenk communicated a memoir "On the distribution of gluten in the wheat-grain," and Prof. Lang some "Crystallographic-optical determinations" relating to thirteen substances, chiefly of organic origin.

Imperial Geological Institution, April 5.—Th. Fuchs on the fossil shells of the Congeria-beds from Radmanest, near Lugas (Banat). A comparatively large number of species (48, 32 of them hitherto unknown in Austria), but of small size, characterise this fauna, and correspond to the fauna of the so-called Upper Steppen-Kalk (limestone of Odessa) in southern Russia. The small amygdaloid *Congeria simplex*, recently described by Barbot de Marny, which alone forms whole beds of the Odessa-limestone, is also found abundantly in Radmanest. Among the small Cardiadæ of the Odessa-limestone, some species differ from the usnal type of the genus by possessing a sinuated pallial line. Very interesting is therefore the discovery of a new species of *Congeria* at Radmanest, which differs in the same way from the generic type of Congeria.—Ch. v. Hauer on the coking of brown coal. A series of experiments with the brown coal from Fohnsdorf (Styria) gave very sati factory results. Cokes were obtained with a heating power equal to that of the cokes of good black coal; the proportion of sulphur was essentially diminished, and the cokes are firm enough to support the pressure of a high furnace. V. Hauer thinks that, mixed with cokes of black coal, they would be applicable to the smelting of iron, a problem the solution of which would be of the utmost importance for the iron manufacturers in the Alpine iron districts.

April 23.—Ferd. Baron v. Andrian on the Volcanic Rocks of the Bosphorus. An accurate investigation of the geological relations, the mineralogical characters, and the chemical constitution of these rocks, which border the mouth of the Bosphorus to the Black Sea, served to distinguish a series of different varieties which in part are almost perfectly identical with the trachytic rocks of Hungary and Transylvania. In both countries generally three types may be distinguished, viz.: green andesites and dacites; black augit-andesites, and rhyalithes.—Prof. Ch. Zittel from Munich contributed some remarks on the tithonic strata. His important memoir on the fossils of the Stramberg limestone will be followed within a few weeks by another on the fossils of the cliff limestone (Klippenkalk) of the environs of Rogoznik and Csarsztyn (Galicia), and the tithonic cephalopod-limestone of Southern Tyrol and Italy. His studies have brought him to the conclusion that an exact line of demarcation does not exist between the Jurassic and the Cretaceous formation. Prof. Ch. Hoffmann of Pesth announced the discovery of Triassic fossils in the older Dolomite—and limestone-rocks of the environs of Ofen, which had formerly been thought to belong to the Rhaetic series. — M. Ch. Paul has examined the Lignite-beds of western Slavonia. In a thickness of more than 6 feet they are to be found along a line of 15 German miles in length, they belong to the upper Miocene formation (Congeria or fresh-water beds of the Vienna Basin), which contains many fossils, among them chiefly to be noticed a very large new species of Unio.—Dr. Em. Tietze, of Breslau, spoke about the fossils of the carboniferous limestone of Silesia. Nearly two hundred different species have been found therein, they will be described in a special memoir.—M. Fr. Posepny on the lead-mines of Raihl in Carinthia. The ores are imbedded in irregular masses in a stratified limestone of Triassic age. They form neither layers nor true veins, but are dependent on dislocations in the limestone-strata, and the over-lying schists.

Berlin

German Chemical Society, March 28.—M. G. Krämer has investigated the products accompanying the formation of chloral from alcohol. Besides chloride of ethyl already recognised by Hofmann, both chloride of ethylene, and chloride of ethylidene, as also the monochlorinated substitution compound of both have been isolated. Chlorinated chloride of ethylene $C_2 H_3 Cl_3$ boils at 115° and yields with potash $C_2 H_2 Cl_2$ boiling at 37° and transforming itself into a solid polymeric modification, Chloride of ethylidene and ammonia produce collidene. Professor Hofmann, in continuance of former researches, has transformed methylated and amylated sulpho-ureas into trimethylated and triamylated melamines by the action of oxide of mercury. This reaction however is but secondary, the first products being substituted (neutral) cyanamides, which by repeated evaporisation become suddenly transformed into alealine melamides. The ethylic, and the phenylic sulpho-ureas behave in the same manner. The transformation consists in three molecules of cyanamide uniting into one of melamine—

$$3\,C\,H\,(C_2\,H_5)\,N = C_3\,H_3\,(C_2\,H_5)_3\,N_3$$

The same chemist, in conjunction with Dr. Olshausen, publishes researches on polymeric modifications of cyanetholine, and its homologues. These researches are connected with the foregoing paper by the following consideration. A certain analogy between ethylcyanamide $C\,N\,(C_2\,H_5)\,H\,N$ and cyanetholine—$C\,N\,(C_2\,H_5)\,O$ allows us to predict that the latter will treble, in the same way that the former does. This has been found to be the case. By passing chloride of cyanogen into methylate of sodium, the cyanetholine of the methylic series (an oil) forms at the same time, with crystals of the formula—

$$\left.\begin{matrix}(C\,N)_3\\(C\,H_3)_3\end{matrix}\right\}O_3$$

cyanurate of methyl. These crystals fuse at 134° but are transformed by distillation into the isomeric compound—

$$\left.\begin{matrix}(C\,O)_3\\(C\,H_3)_3\end{matrix}\right\}N_3$$

fusing at 175°. The former treated with potash yields cyanuric acid, and methylic alcohol; the latter carbonic acid and methylamine. The former, treated with ammonia, forms the dimethylic ether of amido-cyanuric acid—

$$C_3\,N_3\left\{\begin{matrix}C\,H_3\,O\\C\,H_3\,O\\H_2\,N\end{matrix}\right.$$

The same compound is formed (together with cyanurate of methyl) when chloride of cyanogen is passed into methylate of sodium, and may be separated from the cyanurate, by the action of ether, in which it is insoluble. The circumstance that the corresponding ethyl-compound dissolves in ether, renders the investigation of the transformation of cyanetholine more difficult. Analogous results have been obtained when chloride of cyanogen was passed into amylate and phenylate of sodium.

Professor Rammelsberg, in a paper on the phosphates of thallium, stated that isomorphism exists between

1. $H\,Tl_2\,PO_4\,H_2\,O$ and $H_2\,Na\,PO_4\,H_2\,O$
2. $H_2\,Tl\,PO_4$ and $H\,(NH_4)_2\,PO_4$
3. $H\,Tl_2\,PO_4$ and $H_2\,(N\,H_4)\,PO_4$

This he considers as the first proof of the isomorphism of hydrogen with monatomic metals. The same is stated of a phosphoborate of magnesium found in the saltlayers of Lüneburg, and analysed by Nöllner, who gives it the formula $Mg\,B_2\,O_4$. $2\,H\,Mg\,PO_4$, De Koninck and Marquardt have investigated Bryonicine, one of the two bases contained in the roots of *Bryonia dioica*, and give it the formula $C_{10}\;H_7\;N\;O_2$. P. Marquardt described polybromides of tetraethyl ammonium. Dr. Coninck described modifications of Bunsen's sucking apparatus for filtering, and of Mitscherlich's potash bulbs for combustion. M. Ballo recommends the preparation of binitronaphthol by oxydising naphthylamin with nitric acid. By the action of monobrominated naphthalin on rosaniline, he has produced a violet colouring matter, not yet analysed. W. Doer has prepared azonaphthaline by heating nitronaphthaline with zinc powder. F. Rochleder has found four new colouring substances in madder, $C_{14}\;H_8\;O_4$ isalizarine; and its homologue, a very similar substance, $C_{15}\;H_{10},\;O_4$; a third called hydrisalizarin, $C_{28}\;H_{18}\;O_8$, and a fourth, homologous with the foregoing, $C_{29}\;H_{20}\;O_8$. The proportions in which these substances occur in madder are minute. N. Bunge on electrolysis communicates that nitrophenate of potassium yields to the anode nitrophenol and oxygen. Thiacetic acid and thiobenzoic acid yield bisulphide of acetyle, and bisulphide of benzoyl. But sulphocyanide of potassium, instead of yielding bisulphide of cyanogen, gives pseudo-sulphocyanogen. L. Henry has proved the identity of tribromhydrine of glycerine with the tribromide of allyle, from which it has hitherto been considered to differ. N. Lubarin, in submitting chloraluric acid to a renewed investigation, has arrived at the conclusion that it is impure parabanic acid mixed with chloride of ammonium. A. Ladenburg has found that, in support of Dr. Wanklyn's opinion, acetic ether perfectly free from water is not attacked by sodium below 100° C., and that in this reaction no evolution of gas takes place. For decomposing the water and alcohol generally contained in what is called pure acetic ether, the chlorides of silicium or of phosphorus were employed. Lastly, M. Vogel reported on Camuzet's experiments on gun-cotton, which differ so entirely from everything hitherto asserted, that they require confirmation. According to Camuzet, water dissolves the greater part of gun-cotton, separating at the same time the remaining part into a flocculent mass (the explosive ingredient of gun-cotton), and a granular non-explosive powder, which falls to the bottom of the vessel.

DIARY

THURSDAY, MAY 5

ROYAL SOCIETY, at 8.30.—On the Pre-Carboniferous Flora of North-Eastern America, and more especially on that of the Erian (Devonian) Period (Bakerian Lecture): Principal Dawson, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30.—On the Date of the Discovery of the American Continent, by John and Sebastian Cabot: R. H. Major, F.S.A.

LINNEAN SOCIETY, at 8. CHEMICAL SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Electricity: Prof. Tyndall.

FRIDAY, MAY 6.

ROYAL INSTITUTION, at 8.—Star-grouping; star-drift; star-mist: R. A. Proctor.

SATURDAY, MAY 7.

ROYAL INSTITUTION, at 3.—Comets: Prof. Grant.

MONDAY, MAY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

LONDON INSTITUTION, at 4.—Botany: Prof. Bentley.

TUESDAY, MAY 10.

ETHNOLOGICAL SOCIETY, at 8.30.—(Special meeting at the Museum of Practical Geology). Opening address: Prof. Huxley. On the Influence of the Norman Conquest in the Ethnology of Britain: Rev. Dr. Nicholas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion on the Strength of Iron and Steel. Recent Improvements in Regenerative Hot Blast Stoves, for Blast Furnances: E. A. Cowper.

ROYAL INSTITUTION, at 3.—On the Principles of Moral and Political Philosophy: Prof. Blackie.

PHOTOGRAPHIC SOCIETY, at 8.

WEDNESDAY, MAY 11.

GEOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a new form of Binocular and Stereoscopic Microscope: Mr. Samuel Holmes.

ARCHÆOLOGICAL ASSOCIATION, at 8.

THURSDAY, MAY 12.

ROYAL INSTITUTION, at 3.—Electricity: Prof. Tyndall.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on some points in the anatomy of certain Kingfishers: Dr. Cunningham.—On the taxonomic characters afforded by the muscular sheath of the œsophagus in Sauropsida and other Vertebrates: Mr. George Gulliver.—Notes on the myology of *Platydactylus Japonicus*: Mr. Alfred Sanders.—On the Hirundinidæ of the Ethiopian region: Mr. R. B. Sharpe.

LONDON MATHEMATICAL SOCIETY, at 8.—On the Mechanical description of a nodal bicircular Quartic: Prof. Cayley.—Concerning the ovals of Des Cartes: Mr. S. Roberts.

BOOKS RECEIVED.

ENGLISH.—Choice and Chance: Rev. W. A. Whitworth (Deighton and Bell).—Blanford's Natural History of Abyssinia (Macmillan and Co.).—The Lifted and Subsided Rocks of America, by Catlin (Trübner and Co.).—The Yosemite Guide-book: J. D. Whitney.

FOREIGN (through Williams and Norgate).—Ornithologie Nordost Afrikas Th. von. Heuglin: Elektrische Untersuchungen, achte Abhandlungen über die thermoelektrischen Eigenschaften des Topases: W. G. Hanke.—Bestimmung der Sonnenparallaxe durch Venus-vorübergange vor der Sonnenscheibe: P. A. Hansen.—La psychologie anglaise contemporaine: T. H. Ribot.—Das Verhalten der Eigenwärme in Krankheiten: D. C. A. Wunderlich.—Verhandlungen der k. k. Zoologisch-botanischer Gesellschaft in Wien 1869.—Berichte über die Vorhandlungen Ost Afrika.

CONTENTS

ERRATUM.—By an error of the press, Prof. Duncan's Table of Madreporaria dredged up in the 'Porcupine' Expedition (No. 26, p. 660), was designated "Madreporaria of the Red Sea," instead of the "Deep Sea."

The INDEX and CONTENTS for Vol. I., will be published with an early number.