THURSDAY, JULY 18, 1878

THEODORE SCHWANN

ON Sunday, June 23 last, a very interesting ceremony took place at the University of Liége, in Belgium, in honour of Schwann, the famous author (with his fellow-worker Schleiden) of the so-called "cell theory." So rapid has been of late years the progress in our knowledge of the minute structure of animals and plants that Schwann's name seems already to belong to the distant past, and not a few biologists appear to have been, up to the last few months, under the impression that the distinguished author of the "Microscopical Investigations into the Identity in Structure and Growth of Animals and Plants" had long ago been laid in the grave. We rejoice to say that, on the contrary, he is alive and to outward appearance hale and vigorous, though he has had some warnings which have led his *confrères* at Liége to celebrate this year, as a sort of premature jubilee, the fortieth anniversary of his professoriate rather than wait till the full tale of fifty years had been told.

Theodore Schwann was born at Neuss, near Düsseldorf, on December 7, 1810. In 1829 he entered the University of Bonn, first as a student of philosophy, but afterwards as one of medicine. The illustrious Johannes Müller was at that time a privat-docent at Bonn, and Schwann, like so many other of the distinguished biologists of the present day, owes much of his success in life to the vivifying influence of that distinguished teacher. From Bonn Schwann migrated to Würzburg and thence to Berlin, whither Müller had been called to fill the chair left vacant by the death of Rudolphi. Here Schwann, working with the support and under the guidance of Müller, carried out several physiological investigations, the most notable of which were those on the respiration of the chick in the egg, on artificial digestion, on the structure of muscular fibre and of elastic tissue, on the contractility of the arteries, on the mechanics of muscular contractions, and on spontaneous generation. All these researches made their mark and added to our knowledge. Many readers will doubtless remember the ancient myograph employed by Schwann, which was exhibited at the collection at South Kensington two years ago. Besides this, Schwann appears to have largely assisted Müller in the experiments and observations necessary for the construction of the well-known text-book of physiology. Lastly, in 1838, he began to publish, in Froriep's "Notizen," the views which had arisen in his mind concerning the cellular structure of organic beings, and in 1839 laid them before the world in a complete form under the title of "Microscopische Untersuchungen über Die Uebereinstimmung in der Structur und dem Wachsthum der Thiere und Pflanzen." It is unnecessary here to point out the immense effect which the "cellular theory" has had on the progress of all branches of biology. It has made itself felt throughout the whole domain of physiology and pathology, and in a very remarkable manner prepared the way for the more recent doctrines of evolution. During the forty years which have elapsed since it was first enunciated, it has undergone considerable changes: it has been hammered by the blows of repeated labours into a form more durable than that in which it first appeared; but it still remains as the cellular theory. And this at least may be said, that Schwann himself, in expounding his views, kept remarkably clear of the many vagaries in which his immediate followers indulged, and which for a while threatened to make the cellular theory a reproach rather than an honour.

While engaged in these labours Schwann held at Berlin the post of assistant to the Museum, giving as well private courses on histology, and he was on the point of being made Professor Extraordinary when he received an invitation to the chair of General and Descriptive Anatomy at the University of Louvain. This he accepted, and entered upon his duties at the close of the year 1838. In 1848 he was made professor of the same subject in the University of Liége, and here he has remained ever since, exchanging in 1858 his chair for one of Physiology.

During his stay in Liége his life has not been an idle one, but the fame of his earlier labour somewhat throws his later work into the shade, and he is now enjoying the repose which is not only fitting to his age, but which has in every way been most thoroughly earned. The enthusiastic reception which he received at his jubilee from the students of the university showed very clearly how dearly he is loved and how highly he is honoured by those who have still the privilege of being taught by him.

The ceremony of the 23rd began at one P.M., when the Rector of the University delivered in the Aula an oration laudatory of Schwann, at the close of which he unveiled a very successful bust. A large audience was present, among them a considerable number of ladies and students. Prof. Edouard van Beneden then gave an admirable account of the scientific labours which were that day being honoured; after which a student, in a speech which was repeatedly applauded with much enthusiasm, described how greatly Schwann was admired and beloved by his pupils. Then followed the presentation of addresses from various universities and learned bodies. It would be impossible to enumerate these, for they came from all parts of the world, those from Berlin, Vienna, and Heidelberg being especially elaborate; a goodly number arrived from Great Britain. The time of year chosen for the ceremony being unfortunately in the middle of the academical summer session very few representatives were able to attend in person. There were present, however, as bearers of addresses which they delivered with suitable speeches, Prof. Waldeyer, from Strassburg, Prof. Gussenbauer, from Prague, Mr. F. M. Balfour from Cambridge, England (charged personally, in the unavoidable absence of Dr. M. Foster, with congratulations from the Royal Society, from Trinity College, Cambridge, from the Physiological Society, and from the professors and lecturers of the University of Cambridge), and Prof. Pilar, from Agram.

The ceremony was concluded by a genial speech from Schwann, in which he gracefully acknowledged the compliments which he had received. A banquet followed at which the toasts of "The King," "Schwann," "The Strangers," &c., were given, the latter being responded to by the distinguished biologists present. In the evening a pleasant excursion was made into the surrounding country.

A splendid album had been manufactured at Vienna for presentation to Schwann, containing the photographs of almost all living biologists. Unfortunately it arrived too late to be formally presented at the ceremony. The expense of the bust was defrayed by subscriptions in Belgium, though a few strangers (among them Mr. Darwin) had an opportunity of contributing.

The whole ceremony was extremely interesting and successful, and we trust the hero of it may still live many years in which he may have the pleasure of looking back upon his jubilee, and of feeling that his labours have been appreciated by his age.

A TRANSLATION INTO GERMAN

Grundzüge der Anatomie der wirbellosen Thiere. Von Thomas H. Huxley, LL.D., F.R.S. Autorisirte deutsche Ausgabe, von Dr. J. W. Spengel. (Leipzig, 1878.)

SO far as we know, amongst the many German text-books on anatomy and physiology there is not a single one which is at all carried out on the plan of Huxley's Manual of the Anatomy of Invertebrated Animals. The great merits of the work appear to us to be, firstly, that it combines up to a certain point the features of a treatise on comparative anatomy and on zoology, and secondly, that by the introduction of a description of a type selected from each group, the learner is both greatly assisted in the practical study of animal morphology and also supplied with certain definite centres round which to group the multitudinous facts which he learns in the course of his reading. We flattered ourselves that by the translation of this work into German we should to some extent repay our Teutonic neighbours for the many text-books we have received from them. Our belief that this work was likely to be appreciated in Germany has, however, been very rudely dispelled. We learn from the distinguished naturalist who has undertaken the translation, and whose large experience (we believe his name has been before the public for so long a period as two or three years) gives corresponding weight to his opinion that the work is neither a handbook nor a text-book. He informs us in his preface that "he has decided not to give the work the title of handbook, in order to avoid labelling it with a title which it does not deserve" (um dem Buche nicht einen Anspruch unterzuschieben, den es nicht erheben will). "It is," he goes on to say, "no handbook in the sense customary with us, and indeed can be regarded as a text-book (Lehrbuch) only in the sense that it is intended for learners." In fact, on the unimpeachable authority of Dr. Spengel, Prof. Huxley's Manual of Invertebrata, which has already become the acknowledged handbook in England, is quite unworthy of such a position. In this country we have been accustomed in our simplemindedness to think that Prof. Huxley possesses a singular talent for exposition, while his reputation amongst us as an anatomist is based on our belief that his knowledge of anatomical facts is as wide and extensive and as well kept up as his critical judgment is acute, and his treatment of morphological problems broad and original. We have for some time past been under the idea that Prof. Huxley has had a good deal to do with the progress of animal morphology during the last twenty or thirty years. But we live to learn, and we feel very grateful that a man of Dr. Spengel's standing should show us how imperfect and unequal (lückenhaft und ungleichmässig) is Prof. Huxley's treatment of the subject to which he has devoted his life.

So impressed apparently was Dr. Spengel with the faults of the work which he had obtained permission to translate, that, as he explains in his preface, he asked Prof. Huxley to rewrite the work, in order that the German translation might appear more worthy of the translator's reputation. Singularly enough, Prof. Huxley, with an indifference to the appearance of any translation at all, which must have seemed strange to the translator, declined this modest request. And we gather that he invited Dr. Spengel to modify the earlier chapters (written long ago) in accordance with the views based on later researches, and expounded in the later chapters. The labour involved in such a change was apparently, not congenial to Dr. Spengel, whose energies seem more at home in writing prefatory remarks.

It is with the illustrations, however, even more than with the text of the original, that Dr. Spengel is offended. He expresses the view that the choice of these must have been made on grounds of economy. The larger number are, he says, "derived from the older works of Huxley, and the remainder from the well-known handbook of Owen (aus dem bekannten Owen'schen Handbuche), and other sources." We find some difficulty in understanding the translator's preface at this point. We presume that by "the handbook of Owen" he refers to Owen's "Lectures on the Comparative Anatomy of Invertebrates." We should very much like to know what illustrations are referred to, since, as far as the editions of Owen's lectures obtainable in this country are concerned, none of the figures of that work have been borrowed for Prof. Huxley's Invertebrata.

The translator informs us that he has thought fit to set aside many of Huxley's figures and to add new ones from well-known sources. He has, moreover, had a considerable number of the figures redone. In some of these cases we admit that some improvement has been effected by the alteration of the figures. The two figures copied from Ludwig to illustrate the anatomy of Comatula are excellent, and the substitution of Butschli's figures of Pilidium, for the somewhat erroneous ones of Leuckart and Pagenstecker, effects a decided improvement. In other instances the translator, in his zeal to make the figures clear, appears to have forgotten that it is also desirable to make them true to nature. Thus Fig. 77 does not appear to us to be so true a representation of the appendages of Astacus as the original figure of Huxley, which the translator has set aside; and in Fig. 80 the heart and vessels of Astacus are very far from being as true to nature as they should be. We think also the translator, in adding new figures, should be careful about the references. In the first two figures he has substituted for those of Huxley—Fig. 9 and 35-37—we find wrong references. On the whole the improvement is not so great as might have been expected. Every one is aware that for years past the illustrations of German scientific works have been far superior to those of English ones.

Such a superiority is less obvious than usual in Dr. Spengel's production. Either Dr. Spengel was generously unwilling that the difference should be too striking, or Prof. Huxley's malign influence has extended to the German engraver and printer.

Considering the view which the translator appears to take of Huxley's "Manual," we were rather surprised that he should jeopardise his great reputation by undertaking the translation of so inferior a work. Our astonishment may easily be imagined on finding on the back of the work that the *authorship is attributed to Spengel as well as to Huxley.* The outside of the book, as seen on the book-shelf, reads thus:—

HUXLEY-SPENGEL
ANATOMIE
DER
WIRBELLOSEN THIERE.

The only explanation which occurs to us of this unusual blending of the names of author and translator is that Dr. Spengel felt that the prominence of his name was necessary in order to ensure, for the production of so feeble an anatomist and so imperfect a writer as Prof. Huxley, a circulation large enough to bring about the pecuniary result for which the translation was made. Men have been known to make translations for the sake of a sort of parasitic, or rather "commensal" reputation; but in this case, since Dr. Spengel seems to be the superior of Prof. Huxley, some other object must have been foremost in view.

Seriously speaking, we hardly think Dr. Spengel can have fully realised the effect which such a preface would have upon the ordinary reader. Had he done so his behaviour towards Prof. Huxley would have been of a kind for which we should hesitate to use adjectives adequately descriptive. F. M. B.

MERRIMAN'S "METHOD OF LEAST SQUARES"

Elements of the Method of Least Squares. By Mansfield Merriman, Ph.D., Instructor in Civil Engineering in the Sheffield Scientific School of Yale College. (London: Macmillan.)

THE method of least squares has an extensive literature of its own. Our author, in a sketch appended to his work, gives the titles of forty-seven of the most important memoirs and books which treat of this subject and of the law of errors of observation. He further "takes the wind out of the sails" of his reviewers by saying: "It would be easy to greatly extend the limits of this list. The titles have, in fact, been selected from a list of about four hundred, which I hope some time to publish, accompanied by historical and critical notes." Though this is an unkind cut, inasmuch as a reviewer will hardly care to bring forward any references of his own, we yet trust Dr. Merriman will be sufficiently encouraged to bring out this promised contribution to the history of a particular branch of mathematics. The writer's objects are "to present the fundamental principles and processes of the method in so plain a manner and to illustrate their application by such simple and practical examples as to render it accessible to civil engineers who have not had the benefit of extended mathematical training; and secondly, to give an elementary exposition of the theory which should be adapted to the needs of a large and constantly-increasing class of students." Hence the book is both a practical and a theoretical one. The first part is concerned with the adjustment and comparison of engineering observations in which, after giving an introduction on the principles of probability and the method of least squares, he treats of direct observations upon a single quantity and independent observations upon several quantities, conditioned observations, and the discussions of physical observations.

The second part is devoted to the theory of least squares and probable errors; in this, after a deduction of the fundamental principles, he proceeds to the development of practical methods and formulæ.

In an Appendix he gives Gauss's method of solving normal equations, a list of literature (referred to above), remarks on the theory of least squares, and a few other short notes. A full index is given at the end. There is frequent evidence that the writer has carefully consulted the memoirs he cites in his list, so that while there is nothing of novelty in his treatment that treatment is founded upon the best authorities.

"As I have not written for mathematical experts, they will doubtless find considerable (*sic*) in the book at which to grumble." He points out what may be considered blots in his book. One is that he has adopted Gauss's development of the law of probability of error as the best adapted to an elementary presentation; "If this be objected to as defective, I claim at least the credit of knowing and of pointing out just what and where those defects are."

A consequence, perhaps, of having the work printed in this country is the list of errata. We would suggest in the event of the publication of the historical list, that the dates of reading of the memoirs should be given rather than (or at any rate in addition to) the dates of their publication.

We welcome this work as an evidence of the increasing attention that is being given to mathematics by the author's fellow-countrymen, and hope he will be encouraged by its reception here to follow up its publication with a promised work containing extended applications of the method to higher geodetic surveying and the other problems to which it can be and has been applied.

OUR BOOK SHELF

Holmes' Botanical Note-Book, or Practical Guide to a Knowledge of Botany. By E. M. Holmes, F.L.S., Curator of the Museum of the Pharmaceutical Society of Great Britain, late Lecturer on Botany at Westminster Hospital. (London: Christy and Co., 1878.)

FROM the author's experience at the Pharmaceutical Society, together with that gained during the time he held the lectureship at Westminster Hospital, he is likely to know pretty well the requirements of the students at the pharmaceutical and medical schools. It is not always, however, that a teacher, well acquainted though he may be with what is wanted by the students, is capable of providing the best material to supply those wants. In this note-book we think Mr. Holmes has succeeded in smoothing the path of the botanical course, often so uninteresting and consequently amounting to drudgery to many a student. The plan adopted of arranging one part so as to work in with another, or rather to lead up to it, is a good one. The aim has been, not to simplify terms, which has often been attempted with varying success, but to reduce as far as possible the difficulty always attending a clear understanding of the meaning of the terms, and indeed to simplify the whole system of teaching. "To this end," the author says in his preface, "two charts of the natural orders are given, in which the diagnostic characters are reduced to a minimum, those which are most easily observed having been chosen as far as possible in preference to the more minute, while all the exceptions have been indicated in an appendix. It is hoped that in this way, the student being familiarised with all the exceptions likely to be met with in this country, some of the difficulties attending a practical study of botany will be removed." The three diagrams of scarlet geranium, daisy and dandelion, and narcissus will be found very useful, as each part of the plant is very distinctly named on the plate itself and is furthermore minutely described in two and a half pages of letterpress. The glossary with the Latin terms accented will be a great help to a young beginner and the interleaving of this part is a good point. Altogether we think the book is very satisfactory. We should, however, have preferred to see the sixty schedules placed at the end of the book rather than in the middle. Placed where they are, one is led to suppose there is no further matter beyond them, which is not the case, the charts and a very useful "Floral Calendar" being placed at the end.

Grundzüge der Electricitätslehre. Zehn Vorlesungen von Dr. W. v. Beetz. (Stuttgart: Meyer and Zeller.)

DR. VON BEETZ has published a series of lectures delivered to the members of the medical association in Munich. These lectures do not pretend to contain an exhaustive treatment of the subject. They are meant to illustrate the fundamental principles of the science by a series of well-devised experiments, and they amply fulfil the object for which they have been written. The little book contains much matter in a small space, and is throughout clear and to the point. It will be useful to a wide class of readers especially as an introduction to more detailed treatises. Objections might be raised against some incidental and more speculative remarks; but these are very few in number, and do not affect the chief aim of the book. A. S.

LETTERS TO THE EDITOR

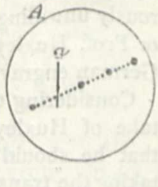
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

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

Measuring Scales for Pocket Spectroscopes

IN using small spectroscopes, such as miniature pocket instruments, to examine coloured flames, and to discover to what particular substances they owe the characters of their radiation, the power of such discrimination which these instruments possess is for many reasons very limited and circumscribed if they are unprovided with some description of dark-field illuminated scale of regular divisions. I have found the following description of measuring scale, when adapted to such small spectroscopes, answer ordinary purposes of recording bright-line positions with them very well, although it was for viewing faint lines in auroral spectra that it was originally devised, for which I have not yet had an opportunity to test its suitability with the same success.

The circular disc A is a piece of copper foil in which a fine slit *a* is punched, and oblique to it a row of twenty holes is punctured, five on the left and fifteen on the right of the slit, the highest and lowest holes of the row being level with its top and bottom points. The actual size of the disc is just half the size of this figure, and to puncture the holes at equal distances apart of about $\frac{1}{50}$th of an inch, either a dividing engine must be used and a needle-point drawn along the sloping face of a straight edge is pressed down with the equal pressure of a weight upon the disc laid on zinc or ivory, to puncture it; or a rack of fifteen or twenty of the finest sewing needles, side by side, may be so fixed in fusible metal as to produce the whole row of punctures by a single pressure. But the first method, even with a roughly made dividing engine for the purpose, I have found the easiest and the most successful plan. The disc takes the place of the jaws of a pocket spectroscope, being dropped into a recess where it is covered by a glass plate and held in its place by a brass ring or perforated cap screwed upon the end of the spectroscope. When viewed through the prisms by sodium light it is seen magnified by the eye-lens, and the punctures form a scale of bright yellow points to the right and left of the yellow sodium line produced by the slit.



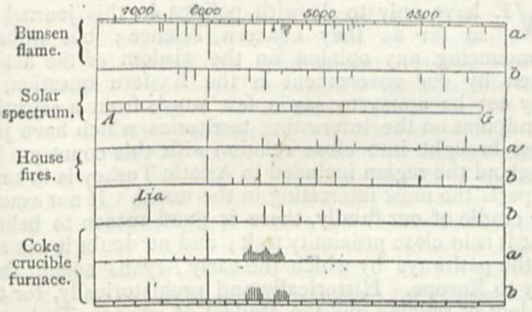
With sufficiently large punctures it is probable that the monochromatic yellow-green auroral ray would render the punctured scale visible in the same way that the sodium light does, so as to supply a measuring scale on which other spectral rays of the aurora's light besides the greenish one produced by the slit may be observed and recorded in their actual positions of distance from that leading line. Even the chief green ray of the solar corona in a total eclipse would not improbably illuminate the oblique scale sufficiently to allow the positions of other rays occurring in its spectrum to be recognised and mapped with ease and with considerable accuracy with a pocket spectroscope.

The object of inclining the row of punctures obliquely from a horizontal line is that other coloured images of it besides the principal or brightest one chosen for reference may not mix with and confuse its divisions. There is no means of varying the width of the slit in the arrangement, and I have not succeeded in obtaining microscopic scale photographs on glass sufficiently dense and opaque to replace the metallic punctured scales, and the focus of the eye lens for the yellow sodium points is not exactly the same as for very refrangible blue lines that coincide with them in position in the field of view; but an assortment of discs can be used and may be placed at pleasure in the cell, and the objection of the unequal focus is at least removable by using an achromatic lens. With these drawbacks to its use, however, the punctured scale has one essential advantage over laterally reflected ones, that its relation to the spectrum which it is used to measure always preserves an invariably fixed adjustment.

The presence of sodium light is so easily supplied where it is wanting that there are very few conditions (even if another bright spectral line cannot be chosen) in which the punctured scale is not available. The wave-length curve for each spectroscope is then easily constructed from observations of known elementary metallic lines in flame spectra in which the sodium line is always available for a line of reference. I have obtained this curve for both a punctured scale spectroscope and also for a Browning's miniature spectroscope with a reflected scale, and have examined several commonly occurring flames in furnace and other fires with the result of detecting in them some metallic spectra. Lithium is thus very often found, sometimes almost as bright as the sodium line, in coke furnace fires; and I have frequently observed in ordinary house fires a flame of rich blue colour with a very characteristic spectrum, which I now recognise by measurements as agreeing with that of copper chloride obtained by moistening copper foil with hydrochloric acid in a Bunsen-flame.

The accompanying figure (projected as nearly as the small size of the drawing permits, in tenth-metre wave-lengths) shows the appearance of the natural and artificial spectra, and their close resemblance, showing very clearly that some compound of copper is the cause of the very brilliant blue colour of the natural flame. Its finest exhibition in house-fires (where it quite filled a grate) arose from blazing wood-logs, which were described to me as broken-up ship-timber, in which traces of copper chloride might reasonably be expected to occur, and it is in the wood of fires that its hyacinth-blue flame has usually attracted my attention; but the same spectrum with three neat pairs of lines, green, blue, and indigo, was noticed also in jets of flame projecting from above the lid of a coke crucible furnace in which copper and brass were being melted (the first of the three furnace spectra in the figure), where the presence of a chloride would not be so readily suspected. The same furnace was revisited, and fired for experiment in different ways, but it only showed the copper-flame spectra drawn in the last two lines of the figure, whose total colour is olive, or tawny green, quite different in aspect from the rich blue of the flame first seen and identified with that occurring in ordinary fires. As refuse brass and copper articles are consigned for melting to these crucibles, it is, however, not improbable that copper chloride may in this instance have been introduced among them.

Attempting to discover the cause of the blue fire-flame by examinations of artificial spectra led me to try that of the blue flame found by Prof. Barrett (NATURE, vol. v. p. 483) to be produced when a burning jet of hydrogen is allowed to play upon



Spectra of the blue flame of copper-chloride, naturally and artificially produced; observed, *a*, with Browning's miniature spectroscope with reflected micrometer scale; *b*, with punctured-scale pocket-spectroscope.

the surface of sulphuric acid, or upon the surface of any object, indeed, which has contracted dust by exposure to the air. It is very abundant, and readily produced everywhere, and not less intensely blue than the copper flame; but no distinct measurements or notable appearances of its spectral bands could be obtained. I could, however, corroborate Prof. Barrett's observations of the extension of the blue colour only on the surfaces touched, and its want of penetration into the body of the flame; and I noticed that metal surfaces rubbed with sulphur which remain cool exhibit it more brightly than wood or other sulphurised surfaces which are quickly heated in the flame. A paste of coke-dust and sulphur wetted with water ceases to tinge the flame (as does also sulphuric acid) when it grows warm, and it fails to colour it when dry. The brightest blue flame was obtained by directing the burning jet upon a mixture of snow with coke dust and sulphur, pounded together in a mortar, the reason apparently being that great attenuation of the sulphur-vapour, and therefore a low temperature of the sulphur, is required to enable the sulphur compound formed to exhibit its characteristic blue-coloured spectrum in the flame.

A. S. HERSCHEL

Zoological Geography—Didus and Didunculus

MY use of the expression "a near congener" seems, from Prof. Newton's letter in your number of July 4, to have diverted attention from the point to which I desired to direct it.

If the bird of the Navigator group had presented such near congenerity to the Dodo as does the other of the ground birds (*Pezophaps*) known from the Mascarine Archipelago, this would have been startling, but as it is the degree of relationship (I avoid the word "congener" which gave rise to Mr. Newton's correction) seems to me to bear out the argument as to former geographical connections which I so long ago advanced.

Both birds belong to the *Columbæ* and to that all but extinct branch of the family to which the term "ground dove" has been applied; and the wingless condition of the Dodo has been by one great living authority accounted for on the hypothesis that by being confined to islands and so secured against enemies, and finding food on the ground, this queer pigeon gradually lost the necessity for, and with this the use of its wings, and thus acquired its bulky form and ground habits. Instead of this, however, I believe that both the *Dididæ* and *Didunculus* are survivors from mezozoic times, of a great family in which the characters that connect these ground birds with the winged *Columbæ* were those common to a large order of wingless birds that, like other orders of mezozoic life, have since perished. From this ancient order of life, or from some yet more ancient stem combining their common characters, the winged *Columbæ* may have been evolved; but of the order itself *Didunculus* has, I believe, survived at the eastern side (longitude 170° W.) of the ancient continent to which I in my first letter alluded, and the Dodo and its kindred at the western (long. 58° E.), in both cases by the protection afforded by insulation.

The application which I sought to make of this to the case of the tortoises was that the presence of those reptiles in the Mascarine and Galapagos archipelagos is due to the same geographical change. The osteological differences between the tortoises of the two regions may, perhaps, be less than those between *Didus* and *Didunculus;* but if so, this, in a lower and cold-blooded grade of vertebrate life, would not weigh much; and my contention is that the tortoises of the Galapagos are insulated there by survival from the eastern extremity of this ancient continent, and those of Aldabra, in the Mascarine region, by survival from the western, instead of from land extending across Africa and the Atlantic to South America, as supposed by Dr. Günther. The fossils of the Himalayan and Mediterranean regions prove that the great tortoises lived on the Europeo-Asiatic continent in miocene and older pliocene times (becoming extinct during the latter), but this does not appear to me to negative the conclusion drawn above.

To prevent misconception, I should, perhaps, add that the land tract from the submergence of which the Mascarine archipelago and the differentiation of the *immediate* kindred of the Dodo originated (as suggested by Prof. Newton in the memoir in the *Phil. Trans.* of 1869, to which he refers), was in my view but a fragment of the more ancient and far more extensive continent which (in 1860) I attempted to show occupied the southern hemisphere in mesozoic times; and that such fragment, again, was but a remnant of a still larger portion of this great southern continent, which, as far back as the triassic period, had become separated from the Australian portion, and, so late as the earlier part of the tertiary, occupied much of the Indian Ocean, where, during the eocene or miocene periods, it formed the cradle of the human race.

SEARLES V. WOOD, JUN.

July 13

P.S.—Dr. Forbes speaks of *Didunculus* being somewhat plentiful still in Upolu.

Smell and Hearing in Insects

IN NATURE (vol. xvii. pp. 45, 62, 82, 102, 162–3), which has just reached me, I see a discussion as to the senses of smelling and hearing in moths, to which I add my mite as an old observer.

I do not see how any one can doubt the first. What but the sense of smell directs nocturnal insects to their food? At this moment I have in my verandah a parrot, which is daily regaled with a portion of a banana. Every evening I see a dozen, or more, of the large *Sphingidæ* and *Noctuæ* trying to effect an entrance into the cage to get at the rotting fruit, *which is generally invisible* from the outside, being behind the flap of wood that serves for a door; the cage is only a rough box. I have always found bananas the best bait to attract the night-flyers, *but only when they began to rot.*

Again, how about "sembling"? Here the odour must be very subtle. A virgin female is instantly detected, while not one "gay Lothario" will visit a captive matron.

It is harder to say whether insects *hear* sounds, or *feel* them, as the same effect would be produced on them by either faculty. I have seen both moths and butterflies turn towards sound, and direct their antennæ to it, moving them to and fro. I have noticed larvæ—as remarked by one of your correspondents—assume certain attitudes on being affected by sound; these attitudes are, I think you will find, generally those assumed for protection or concealment; the creatures are, in fact, alarmed at the unusual—noise? or vibration?—which?

I will adduce one remarkable case in support of the smelling power. Years ago I had (while residing in the North of Ceylon) a lot of living *Achatina panthera* sent to me by the late Mr. Blyth. I placed them in a breeding-cage, and, to secure them from rats, suspended it to the ceiling of my drawing-room. We soon noticed that every night the floor of the room was covered with glow-worms, at which, never having seen them in that part of the island before, and they being of unusual size and brilliancy, we were much pleased.

At last it occurred to me why they came, and on placing the cage on the floor the onslaught on the contents was a convincing proof that *A. panthera* would never be naturalised at St. Pedro.

I could adduce many other instances of the smelling and the "perception of sound" (to phrase it), but will not intrude on your space. E. L. LAYARD

British Consulate, Noumea, New Caledonia, April 26

P.S. Since writing the above I named the subject to Père Montrousier, the celebrated French naturalist so long resident in this colony. He detailed the following experiment that he had made. He immersed a long-snouted weevil (*Octhorinus cruciatus*) so as to cover it, all but the tip of the antennæ, with a coating of wax. On presenting to it oil of turpentine it became violently excited and endeavoured to escape. Another now had the tips of its antennæ only coated with the wax, and neither turpentine nor any other strong smelling substance at all affected it. He places the faculty of the "perception of sound" equally in the antennæ. Since the discovery of the telephone who shall say to what extent these delicate organs can recognise the vibrations of the air? And after all, what is our own "perception of sound" but the appreciation of a vibration? E. L. L.

On the Lichen Gonidia Question

THE morphological side of Schwendener's theory may be now regarded as fully proved. The opponents have confined themselves on the whole to *à priori* arguments, and of those who have applied themselves to carefully working out afresh the relations of hypha and gonidium, several, if not all, have been converted to the new views. No one can have much faith in the haphazard style of preparation and examination known, *par excellence*, as the "lichenological." However, one or two points remain which have not as yet received much attention. These are the beautiful symmetry of the lichen as a whole, the rareness of the application of the hypha to the gonidium, and the generally healthy look of the gonidia themselves. All this contrasts greatly with what we find, as a rule, in the relations of parasitical fungus and host.

With regard to the first objection I may call attention to the equally beautiful and symmetrical forms we find in galls, such as the spangles of the oak, the rose bedeguar, and the exquisite rosettes of certain *Dipterocarpeæ*.

It is, however, well known that many of the lower fungi can build up their protoplasm and live perfectly, if in addition to the salts needed for the growth of all plants (including nitrates or ammonium salts), there be present a tartrate or sugar. Now the gonidia, like the algæ with which they correspond, excrete as a cell-wall a thick layer of gelatinous consistency but giving reactions which show it a form of cellulose. It is in contact with, or through this that the hypha ramifies, and from this it can take up the necessary complement of the mineral food supplied by the substratum and medium. It can grow freely; and the gonidium, with its protoplasm intact, can go on growing as comfortably as the oyster infested by *Clione*. Perhaps like the oyster it may be stimulated to a more active secretion of envelope, but its health is unimpaired. Hence, too, there is no physiological need for the hypha to come in contact with the gonidia, and the last argument of the old school becomes untenable

Owens College, Manchester MARCUS M. HARTOG

The Phonograph

IN experimenting lately with the phonograph it occurred to me to try whether, after a series of musical or articulate sounds have been recorded, other series could successively be superimposed on the same tinfoil and reproduced. I found that if the instrument be simply reset to the starting-point, and sung or spoken to a second time, it will afterwards faithfully reproduce both series of sounds as though two persons were singing or speaking simultaneously, and by repeating the same process, a third and fourth voice may be added, or one or more instrumental parts, all of which will be reproduced. This experiment forms a striking commentary on Helmholtz's theory of the mode in which the ear recognises different tones in a chaos of sound, by analysing the compound wave, which it receives, into its component simple vibrations. Here the aggregate impressions on the tin-foil produce, so to speak, a compound indentation capable of reproducing a wave of sound which the ear can resolve into the original constituents.

Temple GEORGE P. BIDDER

Remarkable Form of Lightning

DURING a thunderstorm on Sunday afternoon, August 24, 1873, I saw a flash of lightning here exactly answering to Mr. Joule's description of "punctuation." The note of the storm in my diary says:—"Lightning and thunder very frequent but not violent. *One flash, very near, had the appearance of a chain of alternate links*, and remained visible, I should think, for half a second, gradually fading out." This persistence was, no doubt, mainly an optical illusion, but it shows the definiteness of the form. The flash was from cloud to cloud, and followed a very sinuous line, as described by Mr. Lawrence. Is not this what old books describe as "chain lightning?"

B. WOODD SMITH

Branch Hill Lodge, Hampstead Heath, July 12

OUR NEW PROTECTORATE

WE have only to do with politics in this journal in so far as they concern science; but without pronouncing any opinion on the wisdom of the action taken by our government in the Eastern question, it may not be amiss to say a few words from a scientific standpoint on the interesting territories which have just been brought into close relation with this country. To England the region included in Asiatic Turkey is in some respects the most interesting in the world. If not exactly the cradle of our family, there is good reason to believe that it is in close proximity to it; and no doubt it was one of the pathways by which the early Aryans sought their way to Europe. Historically and prehistorically, for the student of religion and the student of science, Turkey in Asia possesses features of the highest interest, and we may hope that one result of our new connection will be that our very imperfect knowledge of it in its various aspects will be rapidly filled up. Its shores—the Black Sea on the North, the Ægean on the west, the Mediterranean on the south, and, may we say, the Euphrates and Tigris rivers on the east—teem with historical associations. A careful investigation of its mountains and valleys, its rivers and numerous salt lakes, would doubtless yield the geologist a rich harvest of results, bearing everywhere as they do unmistakable evidence of former powerful volcanic action.

Asiatic Turkey, in its five great divisions of Anatolia or Asia Minor, Armenia, Kurdistan, Mesopotamia, and Syria, may be regarded as a western extension of the great central Asian plateau, with its surface much broken up by mountain chains and isolated ranges. This great plateau narrows very considerably as it approaches the Turkish territory in Asia, but increases in elevation. Here begins the Alpine region of Persia with Kurdistan; here are the lakes Urumiyeh and Van, and the sources of the rivers Zab, Tigris, Aras, and Euphrates. The table-land is broken up into and replaced by mountains, which rise to a great height, and by elevated valleys between them. On the north-east of Turkey-in-Asia both the mountain-ranges and the table-lands are united in the compact mountain-region and high table-land of Armenia, the country to the west resembling Europe in structure rather than Eastern Asia. Physically there are four divisions of this region, corresponding nearly to the divisions referred to above. The first is the elevated and mountainous table-land of Armenia, which extends in the form of a triangle between the angles of the three seas—the Caspian, the Black Sea, and the Gulf of Alexandretta on the south. Its central plain, on which stands Erzeroum, about which so much has recently been heard, rises to 7,000 feet above sea-level, and the highest peak of Ararat rises to above 17,000 feet.

The second great division is formed by the Caucasus, which is beyond the range of our present subject. The third separate mass is formed by the peninsula of Anatolia, or Asia-Minor, in the interior, a table-land of an average height of 3,000 feet, and joined to Persia by the mountain-chain of the Taurus. The Syrian mountains form the fourth division, culminating in Mount Libanus and terminating in the isolated mountain-mass of Sinai. The whole extent of Turkey-in-Asia is estimated at 660,000 square miles, and its population variously estimated at from ten to twenty millions.

The most extensive and altogether most remarkable mountain-chain of Turkey-in-Asia is the Taurus, with its offshoot the Anti-Taurus, belonging mainly to the division of Anatolia. The Taurus begins on the east, by the Euphrates, where one of its peaks rises to nearly 10,000 feet, and runs irregularly westwards not far from the Mediterranean coast, through Caramenia and Lycia, ending in the islands of the Greek Archipelago. Both to the north and south it sends out shoots, the island of Cyprus itself being really a spur of the great mountain-mass. The northern arm, the Anti-Taurus, runs north-east; and at the Chain may be said to turn in a westerly direction along and at no great distance from the Black Sea to the Bosphorus, sending out a south-west spur culminating in Mount Olympus, near Broussa, and further south, on the Gulf of Adramyti, in Trojan Ida.

The separate portions of the Taurus inclose many plains and valleys, which lie terraced above each other in the line of the meridian. On the south side of the mountain lies the plain, formed from augitic rocks, of Diarbekr in Kurdistan, 1,800 feet above sea-level; in the middle of the Taurus is the cultivated valley of Alendah, and Lake Gorjik Gol, 4,000 feet high; on the north side is the plain of Liwas, 4,000 feet, and that of Baulus, 3,000 feet, above sea-level, from which the land sinks rapidly to the Black Sea. In the south-east part of the peninsula rises the isolated peak, having little connection with the main range, the Erdjas Dag—the Mons Argæus of the ancients. It stands on the plain of Kassarieh (Cæsarea), its foot being 3,300 feet above sea-level, and its summit, the culminating point of Anatolia, close on 13,000 feet above the sea. It consists entirely of volcanic products, and its summit contains two craters, long ago extinct. The whole inner plateau, west to near Kutaya and thence to the plain of Sardis and even to the west coast at Smyrna, bears evident traces of volcanic activity. Extinct volcanic cones, often of considerable height, lava-streams and other unmistakable signs of subterranean activity, extend over a considerable space. Earthquakes are of frequent occurrence, and warm sulphur springs are numerous in Anatolia.

In the Anatolian peninsula the rivers flow mostly north-westwards into the Black Sea, though the courses of not a few of them remain to be explored. The most considerable of these is the Kisil-Irmik (the ancient Halys), though one of the most interesting is the Mendereh (ancient Meander), celebrated for its luxurious valley and winding corners, and for the fact that since Homer sang of it, the action of its current, combined with the action of the sea, has altered the whole aspect of the coast about Besika Bay.

The climate of Asiatic Turkey presents so many variations on account of the great inequalities of its surface, that any general view of it is impossible. In one day the traveller may go from the cold of winter to a heat almost tropical, and *vice versâ*. In the Mesopotamian and Bagdad regions, at the head of the Persian Gulf, and along the banks of the Tigris and Euphrates the heat in summer is quite tropical. Sir Frederic Goldsmid in his "Telegraph and Travel," a work which contains many valuable notes on the features and condition of the country in 1864, found it average 96° in the shade near Mosul in the beginning of June.

The Anatolian peninsula gradually blends eastwards into the highlands of Armenia, which unite the mountains of Asia Minor with the great system of Central Asia, and give rise to the two great rivers of Asiatic Turkey, the Euphrates and the Tigris. Armenia is a land of terraces. Between the rivers rise dividing mountain-ranges; within and between these ranges are wide, mostly level, steppe-like plateaux of various heights, which lie like terraces over each other; deep-cut valleys, gloomy, towering mountain masses; extreme climate, with severe winter and dry hot summer; in the valleys and on the mountain-slopes luxurious vegetation, but scanty on the plateaux; on the eastern border the landscape is Alpine, and forms the immediate connection between Armenia and the great table-land of Iran. The Armenian mountains are continued southwards into Kurdistan, gradually shading off into the great plain of Mesopotamia. In the north of Kurdistan lies the romantic salt lake Van, 1,200 square miles in area, at a height of 4,000 feet above sea-level. The two streams which water Mesopotamia, the Euphrates and Tigris, have a generally parallel course, sometimes approaching and sometimes receding from each other. At Bagdad they approach most closely before uniting, not far above the outlet in the Persian Gulf, giving the included land the shape of an hour-glass. It was this included land which the ancients appropriately named Mesopotamia, the northern half being now known as El Jesireh, or the island, and the southern Irak Arabi, or the Arab Irak, to distinguish it from the neighbouring Persia, or Irak Ajemi. The delta of the united stream begins about forty miles above its outlet, and there is evidence that since the time of Alexander the Great, the land must have encroached considerably on the Gulf. Lying between Mesopotamia and the coast region of Syria, and its southern part, Palestine, is the great Syrian desert, a chalk plateau of about 1,800 feet above the sea, bound on the west side by a great depression.

The flora of Asiatic Turkey, as might be expected, is very varied, partaking of a combined temperate and sub-tropical character. As to its fauna, the lion has disappeared from the countries west of the Euphrates, while in Mesopotamia are found the hyæna, panther, buffalo, and wild boar; jackals, bears, wolves, and wild hogs are met with in Asia Minor. The leopard is still found in the interior of Palestine, the Syrian bear in Lebanon, while European animals are found nearly everywhere. The whole territory is included in the Mediterranean sub-region of the Palæarctic Zoological region. (See Wallace's "Distribution of Animals.")

With regard to Cyprus a volume might be written on its history, from the time of the Phœnicians (it is supposed to be the Chittim of the Old Testament) till now, and we quite recently noticed Gen. Cesnola's remarkable work on the antiquities of the island. The ancients appropriately compared the shape of the island to that of a deer's skin or a fleece spread out. In length it is about 140 miles, and about 45 in breadth, much about the size of Skye and the Long Island from Barra Head to the Butt of Lewis together. The centre of the island is a plain or table land, while mountain-ranges occupy the west and south-west, and the northern coast is mountainous along its whole extent. In the northern range the highest summit does not exceed 3,340 feet, while among the southern masses, Mount Olympus (Trodos or Troödos) reaches a height of 6,590 feet. Other summits range from 2,000 to 5,000 feet. In the time of Titus a volcanic outburst from the northern range did great damage, and destructive earthquakes seem to have been at one time frequent. The streams are few and small; rain is almost unknown from May to October; the heat of summer is excessive on the plains, though the winter is mild, and the climate on the whole may be regarded as healthy. At one time the island appears to have been thickly wooded and to have yielded valuable mineral and vegetable products. The island is said to have then sustained a population of a million, but now the inhabitants do not exceed 180,000. Speaking of the flora of the island Drs. Unger and Kotschy in their work "Die Insel Cypern," say:—

"In Cyprus prairie or meadow land does not exist; the

'Ackerland' takes the place of it. After the rains, but only for a short time, cereals give a satin-like green to the landscape; and among them grow a profusion of flowers; but these artificial rather than natural fields fade more quickly than the flowers, and scarcely last a few weeks beyond the last spring rain. There is only one small corner of the island where the vegetation resembles ours. The great heat of the summer destroys all the tender plants; only those plants survive which through their anatomical construction, or hard substance, or in consequence of growing near water, can resist the effects of the heat.

"There is great resemblance in the vegetation throughout the island to the Mediterranean. In February and March there is on all the river edges a profusion of lilies; in April and May on the land side is one carpet of flowers. During the heat, however, the land assumes a yellow tint. Pine forests abound, olives, myrtles, and laurel trees. As far as the island has as yet been explored we know that there are 1,000 different sorts of plants. No eastern island can show such a rich forest growth as Cyprus.

"The *Pinus maritima* in Cyprus covers the hills and mountain regions to the height of 4,000 feet as one of the commonest trees. The *Pinus laricio*, which covers all the heights to 4,000 feet above the sea, rises on the western mountains of the island to 6,000 feet, and gives it a dark appearance from the sea. The wild cypress (*Cupressus horizontalis*) is the third tree which grows commonly in the eastern part of the island and in some places forms by itself whole woods. On the whole of the northern chain of mountains this wild cypress grows often to the height of from 2,000 to 3,000 feet above the sea. Great forests of wild cypresses must also have covered the whole of the south of the island, as also a shrub, the *Juniperus phœnicea*. In the north several varieties of oak are found, and throughout the island the arbutus abounds; the carob-tree and olive flourish on the banks of all the rivers and up to an elevation of 1,000 feet above the sea."

Dr. Unger's work gives a catalogue of the fauna of the island, which includes a considerable number of troublesome insects. Copper, gold, silver, and precious stones were at one time found in considerable quantities, and the mineral resources of the island are probably capable of great development. Doubtless one of the first cares of the new proprietors will be to obtain an accurate survey and estimate of its resources.

No less important than the physical are the ethnical conditions of the vast region to which we have just undertaken the responsibility of introducing the blessings of good government. Indeed, from the administrative point of view, a correct knowledge of the inhabitants of any country is almost more necessary than is that of their outward surroundings. Yet the most profound ignorance too often prevails regarding the affinities and characteristics of the peoples, the direction of whose destinies has been either assumed or thrust upon "the Mother of Empires." How few of our Indian administrators have yet succeeded in grasping the difference between *Aryan* and *Dravidian*, not to speak of *Kolarian*, and how many still affect to speak collectively of all the natives as "Niggers"! If it is so with a country which has been under British rule for upwards of three generations, no very general or accurate knowledge can be expected of the ethnography of Asiatic Turkey, with which our relations have hitherto been of a purely commercial character. Hence no apology will be needed for here submitting a few notes on the subject, for which we are indebted to Mr. A. H. Keane, B.A.

Apart from the question of the Autochthones, if any still survive, three distinct stocks are at present in possession of Turkey-in-Asia, taking the term in its widest sense, so as to include parts of the Arabian peninsula, as well as Syria, Mesopotamia, Armenia, and Asia Minor proper. These stocks or racial families are the Ural-Altaic, Aryan, and Semitic, each of which, omitting such minor distinctions as Juruks, Gipsies, Samaritans, Nestorians, Chaldæans, may be said to be represented by three separate offshoots, as clearly shown in the subjoined scheme. Here the various nationalities are grouped in the first, second, and third columns, according to their ethnical, linguistic, and religious connections respectively, while in the fourth an approximate estimate is given of their numbers, say twenty millions altogether.

		Language.	Religion.	Population.
I. Ural-Altaic Stock.	Turks	Turkish	Muhammedan	12,000,000
	Turkomans ...	Tatar dialect...	Muhammedan	300,000
	Kysyl-Bashes	Turkish	Pagan	?
II. Aryan Stock.	Hellenes ...	Greek	Orthodox and United Greek	2,000,000
	Armenians ...	Armenian ...	Orthodox and United Armenian ...	3,000,000
	Kurds	Kurdish; Zaza	Muhammedan mainly... ...	1,000,000
III. Semitic Stock.	Arabs	Arabic	Muhammedan	1,500,000
	Maronites ...	Arabic	United Syrian	30,000
	Druses	Arabic	Pagan	40,000

Mention should also be made of the few Circassians still surviving of those who, some years ago, fled from the sword of the Russians, and of the few thousand Lazes still left to Turkey by the Berlin Congress. Both belong to the southern branch of the CAUCASIAN STOCK, which is entirely distinct from any of the foregoing. Nor should the Jews be overlooked, who, though still numerous in some of the larger cities (10,000 in Jerusalem alone), have almost disappeared from their original homes.

But of the really representative peoples in these regions the Turks are undoubtedly entitled in every respect to our first consideration. Anatolia, that is to say, all the country between the Upper Euphrates and the Ægean Sea, and from about the 36th parallel northwards to the Euxine has for centuries been the true home of this race. Although even here intermingled in the west with the Greeks, in the east with the Armenians, Kurds, and Arabs, they form, on the whole, the great bulk of the population of Asia-Minor within the specified limits, presenting a compact and homogeneous mass—homogenous in every sense of the word, in race, speech, and religion. They are unquestionably of pure Tataric descent, their Muhammedan prejudices having enabled them to keep aloof from the surrounding populations ever since they entered the country as conquerors in the eleventh century. Hence it is that Anatolia has long been the true backbone of the Turkish rule, a backbone reaching even across the Bosphorus, and that in Anatolia alone is it possible profitably to study the true character of the Osmanlis.

Doubtless the word "Turk" itself is now eschewed in Asia-Minor, where it has become almost a term of reproach corresponding to our "clod-hopper" or "yokel." But this simply means that the Anatolian Turks have become essentially a rough peasant people, as contrasted with their more refined kinsmen of Roumelia and Constantinople. It would be difficult to imagine a greater contrast than is presented by the Asiatic and European branches of this race, though it is of the last importance that the difference should be thoroughly realised before a just estimate can be formed of the Turks as a factor in the calculations of statesmen. They have, unfortunately, been too often judged from the polished and somewhat effeminate Effendis of the Capital, as many superficial observers are apt to confound the gay, frivolous *jeunesse dorée* of the Paris boulevards with the plodding and really thrifty agricultural people of France.

The Anatolian Turks are a lusty, stalwart race, of rude manners and harsh utterance, still speaking nearly in its purity the primitive agglutinating Turkish tongue, which in Stambûl has become a sort of Arabo-Perso-Tatar medley. They are not, perhaps, over-industrious, cultivating little more than is needed to supply their modest wants, and showing a preference for the fig, the vine, and the olive, plants yielding bounteous returns for the little care bestowed on them. Though by constitution extremely frugal, with few and simple belongings, and living in the humblest of dwellings, they are still generally oppressed with debts, and at the mercy of the usurer and the tax-gatherer, the former relentlessly exacting his pound of flesh, the latter often farming the public revenues, forestalling the tithes before harvest-tide and basing his estimates on calculations not always realised even in more favoured climes. Hence many yearly give up their holdings, sinking to the position of proletariates, the day-labourer's life being in many respects preferable to that of the small tenant farmer left unprotected by the authorities and an easy prey to the unscrupulous in a country where the administration of justice leaves much to be desired.

Fortunately for their rulers, past and to come, the Anatolian Turks are a patient, much-enduring race, kindly, hospitable, and tolerant in religious matters. Of an earnest, taciturn temperament, with much sound understanding and shrewd observation, they are yet devoid of foresight and business habits. Hence they make, as a rule, indifferent merchants, so that most of the wholesale trade has fallen into the hands of the rival races. In the country districts they are simply tillers of the land and stock-breeders, in the towns dealers in small wares mostly of home production, or else craftsmen employed in such industries as are needed to supply the few wants of Turkish life. Their seafaring qualities, however, have been unjustly decried, for in the hands of efficient officers they make excellent sailors, while as organisers and conductors of caravans they are unsurpassed. Their greatest shortcomings are perhaps a certain apathy due mainly to the universal belief in *Kismet*, or "the Inevitable," combined with the absence of progressive ideas and indifference to the future. Heedless of the morrow they will often pay exorbitant interest to escape from present pressure. Hence where mingled with other peoples they have fallen somewhat behind in the race, though never sinking to abject want, so modest are their needs, so rich their lands in varied resources. Military service, also, as is well known, weighs heavily on them, and on them alone, helping with polygamy, and all its accompanying evils, to account for the steady decrease of the Turkish element for some years past, especially on the coast.

Here the somewhat indolent Osmanli has had to confront the more versatile Greek, still clinging to his old Ionian homes along the eastern shores of the island-studded Ægean, and it is not, perhaps, surprising that under such circumstances his quick-witted rival has largely succeeded to his inheritance. For the second time in the history of the Hellenic race, *Græcia capta feros victores cepit*. An industrious trader, a shrewd calculating merchant, an excellent seaman, an intelligent agriculturist, the Greek outstrips the Osmanli in his own special province, while monopolising the learned professions. Smyrna has thus again become a Greek city, and the Greek race has in modern times everywhere displayed a praiseworthy zeal for the spread of education, while fostering among the people a healthy national sentiment. A well-directed and widely-ramifying association, radiating from Athens, encourages a movement which has tended more than anything else to maintain the influence of the Hellenic race in western Anatolia, despite their numerical inferiority.

Next to them in importance are the Armenians, sparsely diffused throughout the east from Constantinople to Calcutta, and still existing as a distinct nationality in the north-eastern highlands of Anatolia. Intellectually almost on a level with the Greeks, out-rivalling them in commercial enterprise, the Armenians present certain distinctive physical, social, and moral characteristics by which they are readily recognised wherever met. Conspicuous amongst these traits, besides their speech, belonging to the Eranian branch of the Aryan family, are their national dress, their bushy close-set eyebrows, and a decidedly unlovable disposition, which has earned for them the dislike and contempt of their neighbours. Their trickery and avarice have become proverbial throughout the East, and after making all due allowance for exaggeration, they cannot be altogether acquitted of a certain moral obliquity. Deprived for generations of all political rights, they have taken eagerly to trade like the Jews in Europe, like them in many places monopolising it, ruling the money market, and notwithstanding mutual family jealousies ever ready to band together and make any sacrifices for the common good. As traders they certainly display an amount of keenness and cunning, though of a somewhat low order, dealing by preference in "the cheap and nasty," and retailing their "shoddy" and "Brummagem" wares at exorbitant prices to an ignorant *clientèle*.

Constitutionally timid and reserved they may on the whole be regarded as a feeble race, rarely appealing to arms in self-defence, in all cases ever ready to yield submission to the strongest. Of all Christian peoples the Armenians harmonise best with their Turkish rulers; they habitually speak Turkish like a second mother-tongue, and come nearest to the Osmanli in their quiet, earnest disposition.

Of far different temperament are their southern neighbours, the fierce, freedom-loving Kurdish highlanders. Long recognised as belonging also to the Eranian branch of the Aryan stock, in which they seem linguistically to approach nearer to the Persian than to the Armenian sub-division, the Kurds have been variously depicted, according to the sympathies of the writer, as brave, chivalrous mountaineers or else treacherous, lawless, and blood-thirsty marauders. All, however, agree in describing them as of a restless and unruly disposition, some attributing this quality to the effects of Turkish misrule, others to inherent national temperament, the latter appealing with some plausibility to the sentiment of antiquity, according to which the fierce *Carduchi* of Xenophon evidently bear a strong family likeness to their modern descendants.

What may be called the disturbing element in Asiatic Turkey is continued from Kurdistan southwards to Arabia by the Bedouins of the Syrian desert. Half savage Kurdish tribes in the uplands about the head streams of the Tigris and the Euphrates, almost equally restless nomad Arab tribes in the plains watered by those rivers will for a long time tax all the watchfulness of a strong and wise administration. Nominally subjects of the Porte, the Shamara, Beni-Lam, and other powerful Arab tribes have long maintained an ill-disguised standing feud with the authorities, often making their presence unpleasantly felt, especially along the right bank of the Euphrates from about the parallel of Aleppo all the way to the Persian Gulf. If united they might easily bring from 10,000 to 20,000 formidable mounted warriors into the field. But here as elsewhere tribal dissensions neutralise their power, enabling the Turks still to keep the upper hand in the Mesopotamian plains, and show a fair front towards the Persian frontier.

A glance at the population column in the above scheme will show at once that the peoples hitherto touched upon —Turks, Greeks, Armenians, Kurds, Arabs—can alone possess any real importance for the future administrators of these regions. The Kysyl-Bashes, Juruks, Druses, and Maronites, doubtless present many curious problems to the ethnologist and philologist. But they are numerically too insignificant to claim further notice here.

The Island of Cyprus presents no fresh ethnical elements beyond those specified in our scheme. The bulk of the population are Greek, or, at all events, a mixed Phœnician, Carian, and Greek people that have long been Hellenised. The rest are mainly Turks, and both have hitherto been permitted to live harmoniously together. They are not likely to prove a source of trouble to their new rulers.

As to the future of this varied and interesting region, it is not for us to speak. Everywhere there are evidences that at one time it must have been thickly populated and its resources highly developed. What the country is capable of may be learned from the classical reports of Palgrave, Scherzer, and other British and foreign consuls, as well as from the various special reports on the much-talked-of trans-Asiatic railway. In this connection books worth referring to are Palgrave's "Essays on Eastern Questions," Goldsmid's "Telegraph and Travel," and Goldsmid and Blanford's "Eastern Persia." Good authorities to consult on the geography and science of the region are the various articles in the "English Cyclopædia," recent volumes of Petermann's *Mittheilungen*, Hellwald's "Die Erde und ihre Völker," the *Bulletin* of the French Geographical Society, Chihacheff's "Asie Mineure," Schliemann's and Cesnola's works, Thielmann's "Caucasus, Persia, and Turkey," Unger's "Die Insel Cypern," besides older well-known works.

TYCHO BRAHE'S CORRESPONDENCE[1]

WE have received the first three *fasciculi* of this work, projected by M. Friis in 1876. Its purpose is to place in the hands of the astronomer, in a collective form, the letters of Tycho and his correspondence, preserved in the Royal Library at Copenhagen, and in the libraries of Vienna, Pulkowa, and Basle, and others which may be found elsewhere, and it is expected that the work will be complete in about sixteen parts. The earliest letter is one from Tycho to Joannes Aalborg, afterwards librarian at Copenhagen, dated January 14, 1568. There are letters to or from Steno Bille, or Bilde (an uncle of Tycho's, at whose house, it may be remembered, he detected the celebrated star of 1572 which is associated with his name), Thaddæus Hagecius, physician to the Emperor Rudolph II., Paulus Haintzel, Hieronymus Wolfius, and others, whose names occur in the well-known treatise, "De Nova Stella Anni 1572." In a letter, No. 47, written in 1584, to Henricus Brucæus, Tycho enters into some discussion of the "Hypothesis Copernici," in another to Hagecius (we follow the Latin names in use at the time) he refers at length to the parallax of the comet of 1577, observed by him with much care; from his observations of this body, as Pingré says, "on en concluait que le lieu des comètes était au-delà du ciel de la Lune."

The third part contains a finely-executed portrait of Tycho (Woodburytype) from the oil painting in the possession of Dr. Crompton, of Manchester, for information respecting which M. Friis refers his readers to NATURE, vol. xv. p. 406, and vol. xvi. p. 501; an account of it also appeared in the *Proceedings* of the Manchester Literary and Philosophical Society, October 31, 1876.

We may express the hope that the success attending the publication of the first three numbers of this work may be sufficiently encouraging to induce a more rapid issue of the remaining parts.

[1] "Tychonis Brahei, et ad eum doctorum virorum Epistolæ nunc primum collectæ et editæ," a F. R. Friis. (D. Nutt: London.)

OUR ASTRONOMICAL COLUMN

PERIODICAL COMETS IN 1879.—Of the known comets of short period, two will pass through perihelion in the spring of the ensuing year. The comet discovered by Brorsen at Kiel in February, 1846, and since observed in 1857, 1868, and 1873, according to the elements deduced at the last appearance by Dr. Schulze, will arrive at perihelion again on April 1, perturbations, which must be light in the actual revolution, being neglected. This comet still approaches very near to the orbit of the planet Jupiter, though perhaps not quite so close as in 1842, when the present form of orbit was impressed upon it by the action of the planet, the point of nearest approach being at a true anomaly of 167° 48′, or in heliocentric longitude 283° 30′ (Eq. 1870); when last passing this point of its orbit, early in October, 1875, Jupiter was distant from the comet, 5·58, whence the effect of his attraction upon the length of the present revolution will be comparatively trifling. At the ascending node the comet may approach pretty near to Venus, as was the case in October, 1873, a few days previous to the last perihelion passage. To obtain an idea of the track in the heavens in the spring of next year, we may assume that the comet will arrive at its least distance from the sun at midnight on April 1 (guided by Schulze's elements) and will have the following positions:—

12h.	R.A.	N.P.D.	Distance from Earth.	Distance from Sun.	Intensity of Light.
March 12	23°·6	89°·7	1·35	0·71	1·08
,, 22	32·4	80·5	1·20	0·63	1·77
April 1	41·6	69·7	1·05	0·59	2·58
,, 11	51·7	57·5	0·91	0·63	3·06
,, 21	63·3	45·9	0·81	0·71	3·00
May 1	85·0	33·3	0·74	0·83	2·66
,, 11	118·6	27·2	0·71	0·96	2·12
,, 21	154·2	30·8	0·74	1·09	1·53
,, 31	176·3	40·1	0·81	1·23	1·02
June 10	189·0	50·2	0·91	1·36	0·65

Whence it may be expected that the comet will be observed in the latter half of March, attaining its greatest brightness as it traverses the constellation Perseus, about the middle of April.

The second comet due in 1879 is that discovered by M. Tempel at Marseilles in April, 1867, and re-observed in 1873, after undergoing great perturbation from a close approach to the planet Jupiter, early in 1870. The best elements for 1873 are those of Sandberg, according to which the next perihelion passage would fall on April 26, without taking into account the effect of planetary action, which, as in the case of Brorsen's comet, is not likely to be material in the present revolution; indeed, when the comet was last in aphelion, and nearest to the orbit of Jupiter, the planet was on the opposite side of the sun.

Assuming, then, that the next perihelion passage will take place at midnight on April 26, the following positions and distances will result:—

	R.A.	N.P.D.	Distance from Earth.	Distance from Sun.	Intensity of Light.
April 26	261°·8	106°·5	0·916	1·770	0·38
May 16	262·9	109·3	0·819	1·778	0·47
,, 26	262·1	111·0	0·796	1·789	0·49
June 5	260·7	112·6	0·791	1·804	0·49
June 15	259·1	114·5	0·808	1·823	0·46

The comet under the above condition, will therefore be situate during the whole period in the southern part of the constellation Ophiuchus, and it may be hoped that it will be well observed, as, during the ensuing revolution, material perturbations of the elements may be again occasioned by the action of Jupiter, from which body the comet at the beginning of October, 1881, may not be distant more than 0·55, a degree of approximation that, although not sufficient to lead to such heavy disturbance of the comet's motion as in 1870, will yet render a precise determination of the orbit in 1879 very essential for an accurate prediction of the apparent track in 1885.

In September, 1879, another return of Biela's comet will be due with the elements of 1866, but we reserve a few remarks upon this subject for another note.

A New Comet.—By telegram to the Vienna Academy of Sciences, with which body rests the award of the medal for cometary discoveries, it is announced that a telescopic comet was detected on July 7 by Mr. Swift, of Rochester, N.Y. The place at 14h. was in R.A. 265° and N.P.D. 72°, if the telegram is to be read according to the suggestion of the late Prof. Littröw; the comet was a faint diffused object, and had a slow motion towards the south-west.

It would be an advantage if arrangements could be made for the communication of telegraphic notices of these discoveries to the Royal Astronomical Society, which is the proper centre for such information in this country.

Minor Planets.—On June 26 Prof. Peters detected No. 188 in R.A. 15h. 37m., N.P.D. 106° 18′, shining as a star of the twelfth magnitude. No. 173, discovered by Borrelly on August 2, 1877, has been named *Ino*, and No. 180, which was found by Cottenot on February 2, 1878, it is proposed to call *Eucharis*.

Saturn's Satellites.—Mr. Marth has again prepared, evidently at great trouble, ephemerides of the five inner satellites of Saturn, which will be found in Nos. 2,205-6 of the *Astronomische Nachrichten*, as far as October 23, the conclusion to follow. With such elaborate prediction, the regular observation of these faint objects should be assured; indeed Mr. Marth's exertions in this direction have already led to excellent results.

BIOLOGICAL NOTES

The Male of Salpa.—The development of the spermatozoa in the Salpæ has hitherto not been satisfactorily studied. Only two years ago Mr. Brooks, of Boston, stated that the testis developed from the elæoblast, and moreover maintained that of the two generations which alternate in these pelagic Tunicates—the one set, the "chain" Salpæ, are exclusively males, whilst the other set, the "solitary" Salpæ, are exclusively females. This view involved the theoretical assumption that the single egg which is found in every individual of a chain of Salpæ does not *really* belong to that individual which is only a male, and has the egg laid into it by the solitary Salpa from which the chain is derived by budding. Accordingly, the elæoblast in the solitary Salpa which, according to Brooks, is female, represents the testis and points to a primitive hermaphroditism; whilst in the chain Salpæ (actual males, according to Brooks), the elæoblast becomes testis. The more usual view is that the solitary Salpæ are not sexually differentiated at all, and that the chain Salpæ are hermaphrodites. Prof. Salensky, of Kasan, has recently published (*Zeitsch. wiss. Zoologie*, 1878, Supplement 2) some observations on this matter, having previously given a very careful account of the development of these organisms, and at the same time he enters into a discussion of the relationships of various Tunicata which has much interest. He shows that the eggs found in the chain Salpæ cannot be regarded as given off from the solitary mother into the budded chain because there is no specialised ovarian cord or rudiment in the proliferous mother. She differs in this respect from the adult proliferous persons in Pyrosoma—which really, as shown by Huxley and by Kowalewsky, give to their buds a part of their own ovarian rudiment. The solitary Salpa has nothing of the kind to give. Further, Salensky shows that the elæoblast has nothing to do with the testis. It exists in the solitary Salpa, and in the chain Salpa appears only for a brief period, and then disappears; but is certainly *not* developed into a testis. Accordingly the solitary Salpa is devoid of all trace of either ovary or testis. The elæoblast appears very probably, according to Salensky, to represent the notochord. The tailed larvæ of the true Ascidians possess a well-developed notochord, and present to us the ancestral form of the Tunicata, which only persists to the adult condition in the Appendiculariæ. In the Ascidiæ the tail and notochord atrophy as development advances. In Doliolum the young form which develops from the egg has a short tail with an axis apparently intermediate in character between the notochord of the Ascidian tadpole and the elæoblast of the Salpæ. The sexual form of Doliolum developed by budding from a second sexless generation, is devoid of tail. Salensky holds that we must distinguish in the Tunicata such simple budding from the adult as is presented in the Pyrosoma colonies and others, and that kind of budding which definitely characterises the alternation of generations morphologically distinguishable from one another. The sexless nurse, constituting the one generation, appears to retain the characteristics of the ancestral Tunicate form with tail and notochord. It corresponds to the Ascidian tadpole, and is represented in more or less completely modified condition by the tailed sexless nurses of Doliolum, by the solitary Salpæ, and by the Cyathozooid or primary person of the Pyrosoma colony, which gives rise to the colony by a process of budding which it is necessary to distinguish very widely from that which the persons of the colony exhibit at a later stage themselves. Just as the Ascidian tadpole becomes itself atrophied and metamorphosed so as to form the sexually mature Ascidian, so do the "nurses" above mentioned give rise by budding to a generation not possessing their own archaic characters, but bearing sexual organs and corresponding to the adult Ascidian, and thus we have an alternation of form in the successive gamic and agamic generations. Should multiplication by budding or fission be confined to the later sexual phase, then there is no morphological alternation of generations. Salensky thinks that a hopeful way of gaining a deeper insight into the phenomenon of true metagenesis lies in the further study of the cases presented by Tunicata. E. R. L.

The Structure and Development of Sponges.—The sponges are at present attracting a very large amount of attention from zoologists and are undergoing investigation in the fresh condition, so that their living soft tissues are subjected to the refined methods of modern histology. Prof. Franz Eilhard Schulze, of Gratz, is foremost in this study, the way in which was led by Ernst Haeckel in his monograph of the Calcispongiæ. Dr. Keller, of Zürich, who has previously published on the development of certain calcareous sponges, has now (*Zeitsch. wiss. Zoologie*, 1878, part 4) given attention to *Reniera semitubulosa*, O. Schm., a representative of the commoner marine fibrous sponges. Schulze, by the use of silver nitrate, discovered a differentiated epithelial covering to the body surface, which was previously denied by Keller, who now admits Schulze's observation to be correct, and adds a similar observation of his own on Reniera. Keller describes the syncytium of Reniera, denies the existence of muscular cells, and recognises certain "nutritive wander-cells" in the body-wall of the sponge. His observations on "starch-containing cells" are of special importance. He was led to attach a high functional importance to the nutritive wander-cells which pass inwards from the flagellate endoderm-cells, carrying with them assimilated matter necessary for the nutrition of the syncytium, which forms a thick wall beyond. His conception of their importance was confirmed by the discovery that many of them contain starch. Keller has made an extensive search for starch in the cell-elements of sponges, and has found it, or rather we should say has obtained the blue reaction with iodine, in cells from the following sponges:—(1) *Spongilla lacustris*, (2) *Reniera litoralis*, nov. spec., (3) *Myxilla fasciculata*, (4) *Geodia gigas*, (5) *Tethya lyncurium*, (6) *Suberites massa*, (7) *Suberites flavus*. The substance, whatever it may be, which gives the blue reaction, is not in a granular condition, but fluid, and in those cells in which it occurs occupies a large vacuole comparable to a fat vacuole. Neither ordinary nor absolute alcohol, nor cold water, dissolve the contents of this vacuole. Keller could not find this starch-like substance in Halisarca nor Chondrosia, nor in any Calcispongiæ. It seems desirable in this connection to refer to the strictly granular condition in which chlorophyll appears in the case of Spongilla, the granules having the form of concavo-convex discs. In colourless (etiolated) specimens of Spongilla, the same granules are present of a little different form, and as in Neottia and other similar plants, these granules turn green (develop into chlorophyll?) on the addition of strong sulphuric acid (see *Quarterly Journal of Micros. Science*, 1874, vol. xiv. page 400, where I have recorded these facts, and also that of the occurrence of starch in Spongilla, though I have not yet been able to find the authority for the latter observation, which was made many years previously to Keller's investigation). With regard to the question of the formation of a gastrula in Sponges, and as to the development of the endoderm of that gastrula into the endoderm of the adult sponge, and therefore the continuity of the archenteric cavity of the gastrula with the digestive cavity and canals of the sponge, Keller has some remarks to offer which do not, in point of fact, amount to very much. Like Franz Eilhard Schulze, Keller fell into a complete error in his earlier publication on the development of Calcareous Sponges. Haeckel, in his monograph, stated that the sponge embryo was at first a hollow one-cell-layered sac, on the inner wall of which a second cell layer formed, by delamination, whilst subsequently a mouth broke through. This was vehemenently denied and ridiculed by Metchnikoff; it was also denied by Oscar Schmidt, and by F. E Schulze, who published a beautiful set of drawings showing that after the embryo sponge had acquired some thirty or forty cells, one hemisphere of cells became granular and enlarged, and then invaginated—sunk into the other hemisphere—thus forming a gastrula with endoderm and archenteron by invagination. This account was at first accepted as the true one, but it was strongly insisted upon by Keller in his former memoir, that the orifice of invagination closes up, as in fact the blastopore so usually does throughout the animal kingdom, and that the young sponge is then a mouthless closed sac with two layers of cells. It was in this condition that Haeckel saw it and described the further stage in which the true mouth breaks through. There is, however, still a great difficulty about the development of the gastrula of sponges; for no one can doubt, who will examine a common calcareous sponge, or who looks at Barrois' valuable memoir on the subject, that F. E. Schulze was—as he himself has admitted—so far misled in his account of the development of *Sycandra ræphanus* as to transpose two very important stages of the development. In fact, the concavo-convex stage of the embryo sponge, with one set of cells (endodermic) tucked into the narrower, clearer, longer, ciliate cells, actually *precedes* that in which the same cells form respectively a hemisphere of clear ciliate cells and a hemisphere of large swollen cells, not tucked into the former at all, but so arranged that a small central cavity is closed in by the two groups. How we pass from this stage to the young sponge, or even to the two-cell-layered sac, is still a complete mystery. One thing, however, is obvious. Haeckel could hardly have been led to the generalisation known as the gastræa theory, which, on the whole, is a truthful and productive generalisation, by erroneous observation. We must, therefore, respect his positive statements of fact. E. R. L.

GEOGRAPHICAL NOTES

THE Swedish North-East Passage Expedition, under Prof. Nordenskjöld, was arranged to start from Tromsoe about the 15th inst. in the *Vega*, which sailed from Gothenburg about the beginning of the month. The *Vega* is commanded by Lieut. Palander, who was second in command of the *Sofia* in the polar expedition of 1868. Nordenskjöld's scientific staff consists of F. Kjellman, docent in the University of Upsala, who took part in the expeditions of 1872-3 and 1875; Dr. A. Stuxberg, who took part in the expeditions of 1875 and 1876; Dr. E. Almquist, medical officer; Andreas Hovgaard, lieutenant in the Danish navy, physicist; and Giacomo Bove, lieutenant in the Italian navy, hydrographer, the last-named officially sent by his Government. The *Vega* is provisioned for two years, but if the state of the ice be favourable, Nordenskjöld hopes to reach Behring's Straits by the end of September. The *Vega* will be accompanied as far as the mouth of the Lena by a new steamer, the *Lena*, which will ascend the river of the same name, on which it is intended to ply, as far as the town of Yakoutsk.

AFTER an absence of several months Dr. Georg Schweinfurth returned to Cairo on June 13 from his exploring journey through the Arabian desert. He reports having crossed some fifty valleys in the desert mountains, which he entered near Atfieh; eventually he reached Mount Gharib, and later on the Nile near Siut. Dr. Schweinfurth intends returning to Europe for some time to recruit his health, which has considerably suffered.

PROF. BASTIAN, of Berlin, who has explored more or less in nearly every region of the globe, is setting out again for four years' work in Asia, and especially in Further India, from whence he hopes to bring home many additions to his already large ethnological collection.

THE long-talked-of voyage round the world, under the auspices of the Société des Voyages d'Etude, is at last coming off under the leadership of Lieut. Biard. The *Junon*, the vessel in which the expedition sails, leaves Marseilles this week. We have on several occasions alluded to this and other similar projects, very tempting but much too expensive to attract many passengers. In the present case only twenty-five student-passengers of various nationalities have been obtained. The *Junon* has on board three professors who will lecture on natural history, geography, physics, and meteorology. The expedition has been well planned, and if the programme is carried out to even a moderate extent, the young voyagers ought not only to enjoy themselves, but return with much more knowledge, and perhaps wisdom, than when they set out. The *Junon* proceeds westwards to North and South America, the archipelagos of the Pacific, Australia, and New Zealand, China and Japan, India and Egypt, returning to the Mediterranean by the Suez Canal. A considerable part of the elevên months or so the expedition is expected to be away will be passed in the various countries at which the expedition will touch.

IN No. 3 of the *Deutsche geographische Blätter* of the Bremen Geographical Society Herr Camill Russ has a long and valuable paper on the present position ot Abyssinia; the author has an intimate personal acquaintance with the country. Dr. Sandeberg gives a graphic and instructive account of a pilgrimage in Russia, in the summer of 1876, to Solowjetsk, lying between Lake Onega and the White Sea, and for centuries one of the most celebrated places of pilgrimage in Russia. Dr. Bretschneider, physician to the Russian Embassy in Pekin, sends a long letter, giving detailed instructions as to the best methods and seasons for travelling through Siberia and Mongolia to China, which will be found of great service to any enterprising tourist who may have time and money enough to spare for such an out-of-the-way journey. The letter conveys indirectly a good deal of information concerning Siberia and Mongolia.

IT is stated that the Lisbon Geographical Society reports favourably on a project for an exploring expedition in Portuguese Guinea.

THE GENESIS OF LIMBS[1]

II.

In those huge marine reptiles of the secondary period, the *Ichthyosaurus* and the *Plesiosaurus*, we meet with the most complete serial symmetry between the fore and the hind limbs. In the *Plesiosaurus*, not only are the bones of the hand and foot completely alike, but the same is the case with those of the upper arm and thigh and those of the fore-arm and leg.

In the *Ichthyosaurus* there is a similar resemblance between the fore and hind limbs, with the further curious similarity that in both hand and foot the very numerous digital bones are so disposed as to indicate that the number of the digits exceeded five.

When we descend from reptiles to batrachians we again find in the tailed forms a remarkable and exceptional serial homology in the bones and cartilages of the limbs. Thus, through the great descending series of forms from man down to reptiles and efts, we find that there is one fundamental type of limb. In all such creatures the limbs are never more than four, they are divisible into two pairs, which always possess complete *bilateral* and more or less clearly marked *serial* symmetry. This serial symmetry is generally more or less disguised owing to the different uses to which the two pairs of limbs are respectively put. Yet whatever such uses and needs may be, whether the limbs be formed simply for locomotion, as in the horse; for grasping, as in the ape; for flying, as in the bat and bird; or for swimming, as in the seal and the large extinct reptiles before referred to, we find the same limb segmentation running through all in both limbs.

1. An upper limb segment (upper arm and thigh).
2. A lower limb segment (fore-arm and leg).
3. A root part of the extremity (wrist and ankle).
4. A middle part of the extremity (mid-hand and mid-foot).
5. A terminal part of the extremity (the fingers and toes, *i.e.*, the digits).

In the great class of fishes an altogether different set of conditions obtains. The parts in fishes which answer to the fore limbs of the creatures hitherto considered, are the pectoral and the ventral fins. In them we find a number of delicate structures, "fin-rays," supported by bones or cartilages which have no obvious, even remote resemblance to the bones or cartilages of the limbs of batrachians, reptiles, birds, or beasts. The pectoral limbs are indeed attached to a shoulder girdle, but the ventral fins are appended only to bones or cartilages which lie amongst the muscles of the ventral surface of

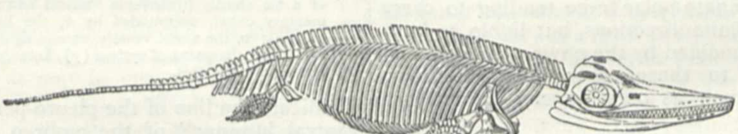


Fig. 12.—Skeleton of an Ichthyosaurus.

the body and hardly ever even approach the superincumbent vertebral column. In *Lophius*, indeed, amongst bony fishes, these supporting structures do ascend somewhat, and the same is the case in *Callorhynchus* and *Chimæra* amongst the cartilaginous fishes. Yet even here these pelvic structures are far from reaching the vertebral column.

In the fishes, which are in many respects most like the

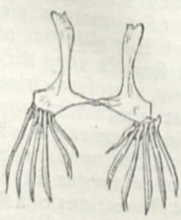


Fig. 14.

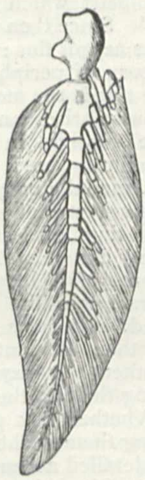


Fig. 15.

Fig. 14.—The two ossa innominata of the Angler-fish (*Lophius*), showing the ascending processes which simulate ilia. The fin-rays are attached to the outer-ventral margin of each os innominatum.

Fig. 15.—Cartilaginous skeleton of a limb of *Ceratodus*. (After Günther.) The large upper piece articulates with the limb root.

higher animals, *i.e.*, in the sharks and rays, the pectoral and ventral fins are not both formed in the same manner, but their structure differs considerably in different species. The pectoral fin is supported by a number of cartilaginous rays which rest upon three basal cartilages lying nearest to the slender girdle and called respectively the *Propterygium*, the *Mesopterygium*, and the *Metapterygium* (see Fig. 17). The ventral fin is smaller, and consists of cartilaginous rays appended to a basal cartilage, which is suspended from the pelvic cartilage, to which latter some rays may also be directly attached.

In one very exceptional form, the ancient triassic fish still surviving in Queensland, *Ceratodus*, the limb-skeleton is *sui generis*. It consists of a median longitudinal series of cartilages, whence other smaller cartilages diverge on each side, the whole structure tapering to its distal end.

We see then, now, the answer to one of our initial questions, "What do our limbs stand for as compared with the bodies of other animals," and may proceed to another of those questions, namely, "Why are our limbs so much alike and yet so different?" We form one of a series of creatures with digit-bearing limbs (all vertebrates above fishes), all presenting similar resemblances and differences in varying degrees. The differences between our limbs are manifestly due to difference of function, but the resemblance may be due to one of two causes:—(1) The conservation of a complete serial symmetry present in the earliest vertebrate types, or (2) The action of internal polar force, tending to educe serial symmetry when such symmetry does not interfere with function. In other words, it may be due either (1) to genetic homogeny, or (2) to intra-organic homoplasy.

It appears to me impossible that it can be due to the former cause, for even if the first pairs of limbs ever formed were completely similar, which I by no means regard as certain, still the detailed resemblances found in animals high up in the scale cannot have continued uninterruptedly from such primitive forms. Even if we consider that the complete serial homology in the limbs of the tortoise, *Chelydra*, might be primitive, the limb of *Hyrax*, *Perodicticus*, and *Nycticebus* cannot owe their peculiar serial resemblances[1] to the survival of primeval conditions.

[1] Continued from p. 284.

[1] See "Genesis of Species," second edition, p. 201.

But the action of an internal polar force is evidenced by other phenomena of pathology and teratology, which come to the aid of comparative anatomy in demonstrating its existence. Thus we very often see that parts which are serially or bilaterally symmetrical, are abnormally affected in a similar manner,[1] as recorded by Sir James Paget, Dr. William Budd, Prof. Burt Wilder, and others, and the same is the case with congenital deformities.[2]

Perhaps, however, the most curious and instructive are those presented by some of our domestic birds. In birds we have found the serial symmetry of the limbs reduced almost to its minimum—the leg and foot being so widely different from the wing. In trumpeter pigeons and some bantams, however, the feet, which usually are naked, become abnormally furnished with feathers (technically called "boots"), which may be even longer than the wing feathers, and are developed from that side of the foot which corresponds with the feather-bearing side of the hand. Moreover, in ordinary pigeons, though the digits of the hand are completely united together, while the toes of the foot are free, but in "booted" pigeons the outer toes become more or less united together by skin like the fingers.

With facts such as these it seems to me unreasonable to deny the existence in each animal (which as a whole is a visible unity) of an innate polar force tending to carry out development in definite directions, but liable to have its action and effects modified by the environment.

We may now turn to those other initial questions, Whence have limbs such as ours arisen? What is a limb?

As to the first question: The digit-bearing limbs of man, beasts, birds, reptiles, and batrachians are usually supposed to have been derived from structures having more or less resemblance to the paired fins of fishes, but the path which the genetic process has followed is differently represented by different evolutionists.

As to the second question, *i.e.*, as to the essential nature of vertebrates' limbs, of whatsoever kind, different views have also been maintained. By some anatomists they have been regarded as parts which have in one way or another been derived from the axial skeleton, by others they have been represented as skeletal structures appended to, but not derived from the axial skeleton.

In 1843 Oken taught the extremely fanciful doctrine that arms and legs are so many liberated ribs, and Carus followed him to a certain extent, teaching that they are essentially elements radiating from the exterior of a rib-like arch.

In 1848 Owen propounded the view that they are diverging appendages attached to ribs like the uncinate processes of birds, and he compared them to the branchiostegal rays of fishes. He also taught that the shoulder and pelvic girdles are modified rib arches.

In 1852 Maclise represented the limbs as modified ribs, the parts beyond the elbow and the knee, however, corresponding with the interspinus bones and fin rays of fishes' azygos fins.

In 1857 Goodsir described them as radiating actinophyses.[3]

In 1871 Humphrey represented the limbs as modified portions of a primitively continuous inferior azygos fins.

In 1872 Gegenbaur threw out the suggestions which he has since (1874 and 1876) more definitely adopted, that the shoulder girdle is a modified arch of similar nature to the branchial arches, the limbs having been formed from rays diverging outwards from such an arch. He also considers the skeleton of the azygos fins as the separated ends of the neural and hœmal spines of the vertebral column.[4]

Owen and Gegenbaur consider the paired and azygos limbs to be two fundamentally different structures, and Huxley[1] calls their sustaining bones or cartilages "elements of the exoskeleton."

The fundamental distinctness between the paired limbs and the axial system appears to have been held by Cuvier and by Huxley. I advocated the same view in 1870,[2] and I have since expressed[3] my conviction "that the appendicular skeleton is no mere portion of the axial skeleton, but a distinct system of parts appended to, and more or less closely and variously connected with, the axial system." To this conviction I now adhere more firmly than ever. I have also been long convinced that the shoulder-girdle could not be (as Gegenbaur thinks) a branchial arch, or be formed of coalesced branchial arches, as also that the branchial arches could not be (as some have supposed) serially homologous with rib-arches. For the branchial arches are within the aortic vessels, which vessels I took[4] to

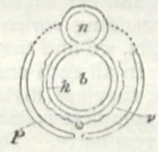


FIG. 16.—Diagram of the condition of the skeleton in the branchial region of some sharks (transverse vertical section).—*n*, neural canal; *b*, alimentary canal, surrounded by *h*, the branchial arches (splanchnapophyses); *v*, the aortic vessels, extending up outside the branchial arches and inside the paraxial system (*p*), here represented by certain external branchial cartilages.

"indicate the line of the pleuro-peritoneal division of the ventral laminæ" of the embryo. This conviction has been remarkably justified by Mr. Balfour's recent discovery of the continuation (in embryo elasmobranchs) of the pleuro-peritoneal cavity into the head, and externally to their aortic vessels.[5]

Prof. Parker has recently suggested[6] that the "extrabranchials" of the dogfish may be homologous with the scapulo-coracoid, but I am persuaded this is not the case.

In 1876 Mr. Balfour described[7] the development of the limbs of elasmobranchs as "special developments of a continuous ridge on each side, precisely like the ridges of epiblast which form the rudiments of the unpaired fins." Since then the paired fins arise in the same way as the azygos fins; they all probably belong to the same category of peripheral, non-axial structures. Moreover, since this is the mode of origin in the individual, there of course arises an *à priori* probability that it was the mode of origin in the race, and that the primeval vertebrate limbs were a pair of continuous lateral folds, serving to balance the body in swimming.

Now I conceive it will hardly be disputed that when supporting hard structures were first developed in the azygos fins they had the form they so generally still present, of a longitudinal series of numerous similar, separate, rod-like structures. But the skeleton of the paired, especially of the pectoral fins, is very different from this. The interesting questions, therefore, arise: (1) Whether any azygos fins present characters approximating them to the normally developed paired fins? and (2) Whether any paired fins present characters approximating them to the normally developed azygos fins?

A detailed account of some recent dissections of fish-fins made with a view to answer these questions—dissections effected through the kindness and liberality of Dr. Günther, at the British Museum—have been lately[8] communicated to the Zoological Society. The result of those dissections

[1] See "Genesis of Species," second edition, p. 205.
[2] *Loc. cit.*, p. 202.
[3] *Edinburgh New Phil. Journal*, vol. v. (new series), 1857, p. 178.
[4] "Grundriss d. Vergl. Anat.," 1874, p. 488.

[1] "Anat. of Vertebrates," p. 43.
[2] *Linn. Trans.*, vol. xxvii. p. 388.
[3] "Lessons in Elementary Anatomy," 1873, p. 230.
[4] *Linn. Trans.*, *l.c.*
[5] *Cambridge Journal*, vol. xi. part 3, April, 1877, p. 474. The author's words are:—"It occupies a position on the outer side of the aortic trunk of its arch."
[6] "Morphology of the Skull," p. 343.
[7] *Cambridge Journal*, vol. xi. part 1, p. 132.
[8] Vol. v., 1878.

is that I have found such varying degrees of coalescence between the cartilaginous rays of the dorsal fins as may go far to bridge over the differences between the two orders of fins, while the close resemblance sometimes presented by paired fins to azygos fins (some of the ventrals being so nearly like certain dorsal and anal fins), is such that I think a conclusion in favour of their essential similarity of nature cannot be successfully contested.

As to the dorsal fin, I have found incipient coalescence between the rays, in *Scyllian canicula*, *Ginglymostoma cirratum*, and others, but in *Notidanus cinereus* I have found this process carried to such a degree, that there comes to be one continuous basal cartilage to the dorsal margin of which the cartilaginous rays are appended.

In *Pristis* and *Pristiophorus* I found a very interesting condition which I am not aware has been described. The rays in these genera repose upon solid cartilages which are absolutely continuous with the subjacent axial skeleton. I would suggest that the lateral pressure of the saw-like rostrum must be aided in these fishes by such a firm attachment of the dorsal fin cartilages to the vertebral column. ST. GEORGE MIVART

(*To be continued*)

A HUNTING WASP

THE following interesting account of a chase between a wasp and a spider has been forwarded to us by Mr. Henry Cecil, who, it may be remembered, wrote to NATURE on the subject (vol. xvii. p. 381):—

The Piræus, Athens, June 19

DEAR SIR,—Your letter of April 5, and the two numbers of NATURE, reached this during my absence in Thessaly, which must be my apology for not having sooner replied to your letter.

Though more than thirty years have elapsed since the circumstance alluded to, I perfectly remember the curious chase I witnessed of a very large and powerful hunting-spider by a species of wasp.

I was sitting one summer's afternoon at an open window (my bed-room) looking into a garden, when I was surprised to observe a large and rare species of spider run across the window-sill in a crouching attitude. It struck me the spider was evidently alarmed or it would not have so fearlessly approached me. It hastened to conceal itself under the projecting edge of the window-sill inside the room, and had hardly done so when a very fine large hunting-wasp buzzed in at the open window and flew about the room evidently in search of something. Finding nothing the wasp returned to the open window and settled on the window-sill, running backwards and forwards as a dog does when looking or searching for a lost scent. It soon alighted on the track of the poor spider, and in a moment it discovered its hiding-place, darted down on it, and no doubt inflicted a wound with its sting. The spider rushed off again and this time took refuge under the bed, trying to conceal itself under the framework or planks which supported the mattress. The same scene occurred here, the wasp never appeared to follow the spider by sight, but ran backwards and forward in large circles like a hound. The moment the trail of the spider was found the wasp followed all the turns it had made till it came on it again. The poor spider was chased from hiding-place to hiding-place—out of the bedroom across a passage and into the middle of another large room, where it finally succumbed to the repeated stings inflicted by the wasp. Rolling itself up into a ball the wasp then took possession of its prey, and after ascertaining it could make no resistance, tucked it up under its *very long hind legs* just as a hawk or eagle carry off their quarry, and was flying off to its nest, when I interposed and secured both for my collection.

Both insects were rare ones, and during the ten years I collected as a field naturalist in Greece, I don't remember ever seeing more than three or four specimens of either that species of wasp or spider.

The wasp was a hunting one (a female) about an inch and-a-half long, a very finely formed insect, which for gracefulness of form and beauty of colouring is entitled to be placed at the head of its species. The legs of this kind of wasp are very long and of a dark chocolate brown. It runs very quickly. The wings are a light-brown with dark-brown tips and long and powerful, and the body beautifully mottled with pale yellow and brown. It has very long fine antennæ. It is not an English species, but probably exists in Spain, the south of France, and Italy.

The spider, too, was a rare one. One of the largest Greek hunting-spiders, nearly as large in the spread of its legs as the flesh-coloured tarantula though without his powerful crab-like pincers. The one I allude to must have covered at least three inches in circumference when its legs were fully extended. It was of a dull mottled brown colour on the upper surface of the body. Very difficult to distinguish from the ground. The lower part of its body was, however, brilliantly coloured, the long legs, or arms, being marked underneath with velvet-like looking black and white rings. The head, thorax, and abdomen were of a velvety black, the lower portion of the latter surrounded with a bright orange ring.

There is only one error in the account given by you in NATURE, that is, that you were under the impression I told you, that kind of spider was the common prey of that species of wasp. You must have misunderstood me.

1. I do not think that particular kind of spider is sufficiently common for this to be the case.

2. I never saw a similar conflict of the kind before or after, which as it was in a room, and not in the grass, where I presume such encounters usually take place, I observed under exceptionally favourable circumstances.

I am certain the spider left no web or thread behind it. I cannot be sure, however, that, as it had evidently been attacked by the wasp before entering my room, a small quantity of liquid may not have exuded from its wounds, which may have helped the wasp in tracking it. I have no doubt myself that insects have the sense of smell, and probably much more developed than our own. No one, as you remark, who has sugared for moths, or seen the large sphingidæ hovering over the strongest scented flower at night, or employed a caged female moth as a lure to her male admirers, can, I think, doubt this. If so, let them put a saucerful of honey in a corner of a room opening into a garden, throw open the window, and see how soon the bees, wasps, &c., will be attracted to the honey.

There is a tradition in the east that one of the tests by which the Queen of Sheba tried to prove the wisdom of Solomon, was placing on a table before him two bouquets, one of artificial, and the other of natural flowers, and requiring that he should say which were the real and which the artificial, without moving from his throne. Solomon ordered the windows to be thrown open, and in flew the bees, &c., which went at once to the real flowers.

Whether the senses of insects, birds, and what we call the lower creation, are similar to ours in every respect, it is very difficult to say. No doubt a dog, if he could speak, would say a man had not the sense of smell, and would prove that his nose was worse than useless to him. An eagle or hawk would say that men and moles, &c., have only the rudiments of eyes, and so on.

Man, with five very imperfectly developed senses (who can say that there are not twenty senses), is the only animal that is dogmatical, and denies all he cannot understand. The oracle of Delphi said "Socrates was the wisest man in Greece, *because he was the only man who knew he knew nothing*." Yours faithfully,

C. L. W. MERLIN

To Henry Cecil, Esq., Bournemouth.

A NEW CAMERA LUCIDA

THE various kinds of camera lucida hitherto used have always possessed many inconveniences, none of them allowing to be seen upon the paper with sufficient precision, and simultaneously, the image of the object and the point of the pencil. For the purpose

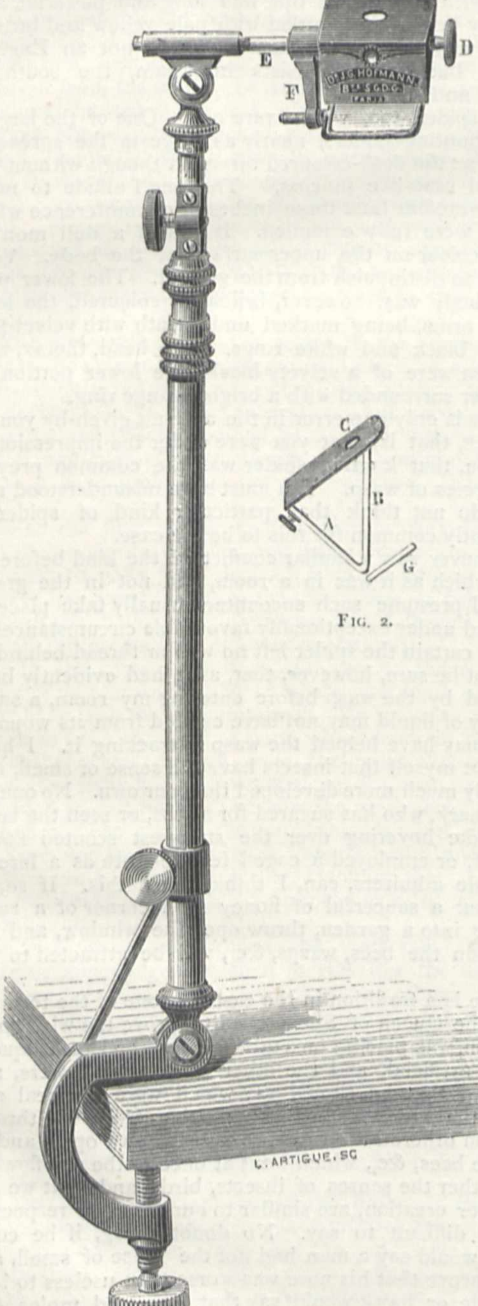


FIG. 2.

FIG. 1.

of remedying this inconvenience, Dr. J. G. Hofmann, of the Rue Bertrand, Paris, has had recourse to an arrangement by which he believes he has obtained the most satisfactory results. The illustration will give some idea of this arrangement.

Fig. 1 represents the general elevation, in half size, of Hofmann's camera lucida. Fig. 2 is a transverse section of the optical part, composed, at A, of a metallised mirror, or other metallic surface, polished and rigorously plane; at B, of a small plane mirror of parallel glass, forming, with the metallised mirror, a fixed angle. The function of the latter is to let pass a part of the luminous rays coming from the object to be drawn, and to show at the same time the point of the pencil alongside the image upon the paper. At G may be placed, in a movable frame, either a plate with parallel surfaces, or lenses of neutral glass of various foci, the principal object of which is to enable a satisfactory drawing to be made of the objects placed inside, when using white paper; for the outside, this glass serves to temper the brightness of the sun.

At C is the eye-hole or opening before which the eye is placed. The knob D serves to place the chamber in a convenient position, which sometimes depends on that of the artist with respect to the object; but generally it is convenient to place the mirror D vertically. With the same pieces of the optical part, with the addition of a concentrating lens, Dr. Hofmann has been able to construct a second model applicable to microscopes, for which, as well as for telescopes, all previous forms of camera have given only very mediocre results.

ANATOMICAL PREPARATIONS FOR MUSEUM AND CLASS PURPOSES

IN a former number of NATURE (vol. xvi. p. 360) I offered some suggestions on museum preparations and arrangement. These I can now supplement by a new method which I have tried with encouraging success.

No museum-curator needs to be reminded of the many defects of the ordinary fluid-preservatives. Evaporation, blanching, spilling, optical distortion, the cost and inconvenient shape of glass vessels—these are among the serious and apparently inevitable advantages of dilute spirit. I have found it possible to get rid of all these difficulties together by mounting dissections and entire animals in glycerine jelly.

The following directions may be followed until experience shall suggest better. Soak gelatine (best quality) in water until it has absorbed as much as it can, melt and add an equal bulk of best German glycerine. Clarify with white of egg, one egg to a pint of mixture, taking care to boil very steadily, without burning. Filter hot through flannel. The jelly should be transparent, and of a pale straw-colour. It should melt at 39° C., and have a specific gravity of 1·186 at 8° C., compared with water at the same temperature.

The jelly may be diluted with water, with glycerine, or with a mixture of the two. I find one part of jelly to one of glycerine and one of water a convenient proportion. The dilute jelly is apt to run fluid on exposure to the air, owing to the growth of moulds. This may be prevented by using a solution of salicylic acid or thymol in water for dilution. These substances cause opalescence in the medium, but a very minute quantity of acetic acid clears it again.

Lay out the dissection on wax, as recommended in my previous letter, but without pins, and fill up with jelly rendered fluid by gentle heat. When the vessel is full, allow the jelly to cool and set, then pour a little more on the top. After this also has set, lay the glass cover (warmed by immersion in hot water) in its place. As the superficial layer of jelly melts, press the cover down. When cold, cement the edges with strips of cloth smeared with coaguline.

The vessel for mounting may be of almost any size and shape. I have tried glass jars, built-up glass cells, ebonite, gutta percha, earthenware, and wood soaked in paraffin. The vessel should be strong and quite air-tight.

It is early as yet to speak of the final result. Some preparations have lasted five months without alteration.

The inert character of glycerine jelly, so well-known to microscopic mounters, justifies confidence in its stability. A large proportion of glycerine may render certain objects too transparent. This tendency may be corrected by changing the proportions as required, or by adding alum. I have found even delicate colours, such as those of squids, readily preserved by the jelly. No effusion of mucus or colouring matter takes place, and an animal may be mounted fresh if care be taken that the jelly penetrates sufficiently into cavities of the body. Previous immersion in alcohol, or other preservatives, does not prevent re-mounting in glycerine jelly. Many of the ordinary reagents used by the histologist may be added to obtain special results. I have not as yet succeeded with large objects, but mountings with as much as a pint of jelly have done well.

The cost of the jelly is not prohibitive, and when the freedom from loss by evaporation, or spoiling by turbidity and discoloration is considered, this mode of preparation will be found cheapest in the end. Harvey and Reynolds, of Leeds, undertake to supply the undilute jelly at a moderate price.

Until experience suggests improvements I have nothing to add. The preparations ought to be kept for years before the new process can be recommended in unqualified terms. I think, nevertheless, that I have already seen enough to warrant the anticipation that mounting in jelly will for certain purposes displace all the fluid methods in use. L. C. MIALL

Leeds Museum

BEES

AN American correspondent writes asking Mr. A. R. Wallace, through NATURE, his opinion as to the genus *Apis*. Are *dorsata*, *zonata*, *indica*, *adansoni*, *nigrocincta*, and *florea*, each or all distinct species? or, our correspondent asks, are some of these like *ligustica* and *fasciata*, simply varieties of *mellifica?* Also as to structure and habits of *A. dorsata* and others, which Mr. Wallace has personally seen and handled.

The following reply has been sent us to these queries:—

Mr. Alfred R. Wallace having suggested that I should answer the queries of your American correspondent, I do so at once, having in the year 1865 published in the *Annals and Magazine of Natural History*, a somewhat elaborate paper on the subject on which information is sought for. The species that in my opinion are distinct are *Apis mellifica*, *A. adansoni*, *A. dorsata*, *A. zonata*, *A. unicolor*, *A. indica*, and *A. florea*. I do not consider the examination of worker bees only sufficient material to enable any one to form a decisive opinion as to species; the examination of drones, also, I consider indispensable; it is advantageous to see queens, but those which I have seen do not present any very marked peculiarities indicative of specific distinction. I possess males and workers of *A. dorsata*, *A. indica*, and *A. florea*. That *A. ligustica* and *A. fasciata* are climatal varieties of *A. mellifica* has been apparently proved by the fact of their having in England reverted to the original stock, *A. mellifica;* there is, however, a remarkable fact to be noticed that, notwithstanding the change referred to, they still possess a much greater degree of irascibility than *A. mellifica; A. fasciata* undoubtedly in the greatest degree. I consider *A. zonata* distinct from *A. dorsata*, its nearest ally; it is a larger bee, jet-black, with snow-white bands on the abdomen; I have not seen *A. dorsata* from Celebes, where *A. zonata* was discovered by Mr. Wallace, but he found that species in Sumatra, Flores, Timor, and Gilolo. *A. adansoni*, and *A. nigro-cincta*, will probably prove to be climatal varieties of one species, the latter being a pale form with dark bands. There is no doubt of *A. indica* being a distinct species, all the sexes are known, and there is no other species found in India with which it could be assimilated. Of the specific distinction of *A. florea*, the remarkable structural formation found in the drone, that of a lobe on the metatarsus, is conclusive; it is also much the smallest species known of the genus Apis. *A. unicolor* inhabits Madagascar, Mauritius, and the Island of Rodriguez; a considerable portion of a swarm was obtained from the latter island, an examination of which inclines me to consider the insect much more than a climatal variety of any other species; it remains that the drones and queens should be obtained in order to decide the question; until this can be effected I shall consider *A. unicolor* a good species.

Of the habits of the species of the genus Apis, Mr. Wallace, Sir John Hearsey, Dr. Jerdon, and Mr. Chas. Horne have given some interesting particulars. *A. dorsata* suspends its mass of combs on the branches of trees, quite exposed, having no covering whatever; Sir John Hearsey succeeded in obtaining a swarm which he secured in a box-hive, thus domesticating the species, and obtaining from time to time quantities of delicious honey. Dr. Jerdon gave me combs of *A. indica*, which had taken up its abode in the rafters of an outhouse. Mr. Horne gave me the comb of *A. florea;* it is attached to a twig of some bushy plant. Dr. Welwitsch brought combs of *A. adansoni* from Angola; they were found inside a hollow tree; the cells are considerably smaller than those of any of the honey-bees of Europe. FREDERICK SMITH

British Museum

THE ORION NEBULA

A SHORT time ago we gave an abstract of d'Arrest's "spectroscopical researches." The Danish paper contains also the conclusions at which he arrived after many years contemplation of the nebula in the sword-handle of Orion. The spectrum is now easily visible, with open slit, even without a telescope. Then we see three images of the nebula corresponding to the three lines, whose relative intensity d'Arrest found to be 100, 24, and 71. To see the fourth line is of course very difficult. If the spectrum of the stars is looked at together with that of the nebula, we find the nebular lines continue absolutely unimpaired through the inner trapeze. Consequently it cannot be considered as proved that the stars are in connection with the nebula. It has not, of course, yet been possible to ascertain spectroscopically whether the stars are nearer to us than the nebula, or farther away in space. The question of resolvability has lost a good deal in interest since Huggins showed its gaseous nature. However, d'Arrest would not believe that it had ever been resolved into stars in any of the large telescopes of his day. All the more startling was the Rev. Dr. Robinson's letter (NATURE, vol. xv. p. 292), that he as early as 1848 had resolved this nebula with the Earl of Rosse's telescopes. It would be worth while for Mr. Ellery, who, according to our astronomical column, is investigating the southern nebulæ, to ascertain whether actual resolvability is referred to here, or the circumstance that, as might be expected in so enormous a reflector, a good many small stars become visible by glimpses. Liapounov describes the appearance of Regio Hugeniana as follows: "Ces masses m'avaient présenté à plusieurs occasions des ressemblances frappantes avec des amas d'étoiles. Le caractère stellaire s'est prononcé d'abord dans la masse la plus lumineuse, dont l'apparence me conduisait depuis constamment à l'idée d'une agglomération de petites étoiles condensées." We are hardly right in concluding that the nebula could be resolved in the nine-inch refractor of the Cazan observatory.

The Orion nebula was first pictured together with the four stars of the trapeze by Huyghens, who discovered it in 1656, though Cysat referred to it already in 1618. It was afterwards examined by Derham, Godin, Fouchy, Mairan and Picard. Legentil compared its outline to that of the open mouth of an animal. Messier was the first who gave a catalogue of the stars seen in the nebula. Schröter, in Lilienthal observed it, 1794-1799. It was this eminent astronomer who discovered that this chaotic mass is not in perfect equilibrium, and several of the changes he pointed out have been verified by modern observers. Sir W. Herschel watched the nebula during thirty-seven years. He believed that changes were taking place in Nebula Mairani. The most important fact connected with the discovery of changes was, that the three conspicuous stars ϵ, ζ, and η (J. Herschel, 1825), in most of these old maps, are represented as inside the bright nebulosity, while they are now seen far from it. D'Arrest showed that no changes have occurred here by aid of a drawing, which Lefebvre published, 1783, in Roziers, "Observations de la Physique." He also remarked the characteristic circumstance that in this figure Sinus Magnus is represented as running right across the trapeze, which, in consequence, is lying altogether outside the nebula. Lefebvre's drawing is, however, executed in the style of those that preceded Messier. It is of uniform brightness and sharp outlines.

Sir J. Herschel appears to have been the first who understood that in order to ascertain changes, it was required to give faithful drawings of all the minute parts of the nebula. His first drawing was executed in 1824, and that was, in 1847, followed by the beautiful figure founded on micrometric measurements made at the Cape, 1834-1837. He attributes hardly any weight to the first drawing, which had been made with freehand, compared with the last one.

Lamont published, 1837, an image of the brightest part of the nebula which Herschel criticised. He found, for instance, Regio Hugeniana more uniform, and marked with certain channels, while Lamont represented it as consisting of rounded masses running into each other. Later authorities agree with Herschel, but it deserves to be remarked that he had not himself, 1824, remarked these channels, nor are they laid down on Cooper's map. It so happens that the refractor in Copenhagen is exactly similar to that in Munich, and in consequence a comparison of the respective drawings made at an interval of thirty-five years could not but be of importance. There is no trace of the sharp outline in the north-west corner, which the Danish drawing shows, and it is so much more likely that here great alterations in brightness have taken place, as all the old drawings, for instance Cooper's, support Lamont, while the later ones in this respect agree among themselves. Amongst the most remarkable differences d'Arrest classed Pons Schröteri in Sinus Magnus. Lamont has of this bridge only the small piece, which, like a promontory, is attached to the north side, while d'Arrest saw the brightest patches about midway. On the above-mentioned old drawing by Cooper, Pons Schröteri is only represented as three small pieces emanating from the north side, while the same is now in the large refractor of the Markree Observatory only noticed as a little spot in the middle of the bay. Such changes were already alluded to by Schröter, and modern diagrams support this hypothesis.

Liapounov's diagram, drawn after most careful micrometric measures,[1] represents the object as seen about 1850. He agrees with Lamont about Regio Hugeniana, and also about the east point, which he found well defined against the far fainter Proboscis Major. He observed Sinus Lamontii, which he surrounded by the bright nebulosity, since called Hemicyclium Liapounovii. The darkness of this Sinus varied considerably, and thus it was explained why it was not noted by Herschel, though indicated on Cooper's map. Liapounov represented Pons Schröteri as emanating from the north side of Sinus Magnus, but he made it end with a bright spot, and his representation is, therefore, the midway between older and later drawings. Few astronomers have conducted similar researches so earnestly and faithfully as the Russian professor, and his merits have not been so highly appreciated as they deserve. It appears to me that this is even the case from the side of his Danish colleague.

Lassell published in 1854 a steel engraving, which was badly executed, the regions round Sinus Magnus in particular. Nebula Mairani was made brightest of all the nebulæ, while it only holds the third or fourth place. All these drawbacks have, however, been removed from the second drawing made in Malta, 1862 and 1863, which is one of the best extant.

The drawing Secchi published in 1868 is not to be trusted, and even the central region is wrongly drawn. D'Arrest had made a similar remark about an earlier figure by Secchi, to which the Papal astronomer answered: "Che la figura litografica pubblicata, benchè esatta in generale, ha alcune inesattezze non trascurabili." The possibility of a similar explanation in the present case was excluded by the remark: "Cosi siamo sicuri che l'incisione rappresenta la nebulosa come vedesi da noi nel nostro strumento."

George Bond's drawing, of about 1860, is in d'Arrest's opinion, more like the nebula than any that has been drawn from a refractor, and the characteristic calmness over the whole has been successfully imitated. He only saw the northern boundary, and the parts about Palus Bondii somewhat different from Bond. The divisions in the south-east corner of the nebula, so prominent in the drawings made of late with gigantic telescopes, do not appear so distinct in d'Arrest's refractor as in Bond's. In Markree it is not possible to trace them at all. On this point Rosse's drawing contains more particulars than any that I have seen.

The most complicated drawing of the nebula was published in 1868, by the present Earl of Rosse. D'Arrest found this drawing to be very accurate. The dark channels in Regio Hugeniana are, however, rather broad, and two large spots north of the bright mass too prominent, the boundaries are generally considered too sharp, and the contrast between the stronger and feebler parties rather strong by those accustomed to other telescopes; but it does not appear that the limits to which nebulosity was traced are much farther than in the refractors of Cambridge, United States, and Copenhagen. The feeble streams of nebulosity which connect the θ with the southern ι nebula have been well studied at Birr Castle, while the faint northern branches were more attended to in Cambridge, United States, where Bond first traced the connection with the c nebula. The connection between θ and ι was known to d'Arrest since autumn, 1865.

On Rosse's drawing the east point of the main part is bent somewhat and does not go smoothly over in Proboscis Major. Thus far this agrees with d'Arrest, but the image at present seen in the Markree refractor is more like Bond's figure. D'Arrest evidently gives the almost straight south-eastern outline of Regio Hugeniana too great concavity. Rosse, d'Arrest, and Holden agree well about the part west of Sinus Gentilii. Hereabout the Roman drawing does not correspond to nature at all. Nor are the diagrams of Liapounov and Cooper in accordance with d'Arrest. Now this might arise from the different quality of their telescopes, but it is not unlikely that some change has taken place here, though d'Arrest does not offer this explanation. But he declares Sinus Lamontii and Hemicyclium Liapounovii to be very changeable. The agreement of the different diagrams of Lacus Lassellii is striking; it was remarked already in 1795, by Schröter, and notwithstanding possible fluctuations in brightness, no alteration in the form has taken

[1] From a discussion of his own and W. Struve's observations, Liapounov concluded that three stars of the trapeze were moving with respect to the fourth, the most southern star. An investigation, on the whole confirmative of this, was read by Prof. Nobile, last year, before the Reale Accademia of Naples.

place during the last eighty years. On the whole this constancy in the form d'Arrest considers the principal result of all our studies of this object. The changes, which have been remarked, seem all reduced to mere variations in intensity, but such small alterations may greatly change the impression we get on looking at certain parts of the nebula.

The nebula has of late been well watched at the United States Naval Observatory. Prof. Holden has been hitherto engaged in making micrometric measurements of prominent parts of the nebula and noting the order of brightness of the various masses. He will even attempt a little photometry with the 26-in. refractor. The stars suspected to be variable by O. Struve, are nightly observed. From a provisory discussion of the observations, Holden alludes to changes of short period, and a preliminary sketch of the central part shows that his discoveries in nebular astronomy are likely to rank with those of Newcomb and Hall in other parts of the science. W. D.

AMERICAN GEOLOGICAL SURVEYS

NORTH-WESTERN WYOMING AND YELLOWSTONE NATIONAL PARK [1]

IN a former number of NATURE (vol. xii. p. 265) some account was given of the various independent surveys in progress among the western territories of the United States. Allusion was then made to the unfortunate want of concert among them which had led to a reduplication of the work, and consequently to a struggle at Washington between the different surveying staffs, one fighting for a continuance of power, another for very existence. By the decision adopted by Congress the Engineer Department retained control only of those surveys which might be required for military purposes, while the geographical, geological, and other surveys, carried on for the purpose of exploring new ground and making its features and productions known were to be taken charge of by the Department of the Interior. Such a limitation ought to be sufficient to prevent any future risk of the same tract of country being surveyed twice by different and independent officers. That it was needed became abundantly evident during the time of the contest which was finally settled by Congress. And the present volume furnishes fresh proof of its necessity.

Early in the year 1873 the Engineer Department organised a surveying party to make a military reconnaissance of the north-west of Wyoming territory lying between the Union Pacific Railroad and the line of the Northern Pacific Railroad in Montana. As this department had all along been in the habit of employing civilian geologists, naturalists, botanists, and other scientific observers, Captain Jones, who took command of the expedition, collected a party of nineteen persons, exclusive of a military escort under four officers. This military character which the engineers have given to their reconnaissances, though, perhaps, hardly avoidable, seems with good reason to have been regarded as irritating to the Indians. During the investigation into the question of reduplication of surveys, it was stated by the geologists of the Department of the Interior that they did not wish any escort of soldiers as they were never molested by the Indians, who would have been suspicious of their movements had soldiers accompanied them. Captain Jones, indeed, refers to a large war-party of Sioux Indians which came into Big Horn Valley shortly after he and his expedition had passed out of it, and he seems to think that he made a lucky escape. But the appearance of so large a body of armed men as he commanded within the lands reserved by treaty to the Indians could hardly fail to awaken their distrust and set them in motion.

[1] Report upon the Reconnaissance of North-Western Wyoming, including Yellowstone National Park, made in the summer of 1873, by W. A. Jones, Capt. U.S. Engineers, with Geological Report by Prof. T. B. Comstock. (Washington: Government Printing Office.)

The country passed over in the route lay across the formidable range of rugged snow-capped mountains which rise round the head-waters of the Yellowstone. By some travellers this lofty barrier had been pronounced to be inaccessible, one picturesque observer declaring that "a bird cannot fly over that without taking a supply of grub along." Once across the watershed the expedition descended upon the basin of the Yellowstone, which had already become famous for its wonderful hot springs, and had been pretty fully described and carefully mapped. Indeed when one remembers how much had already been done in the scientific exploration of North-western Wyoming, one is tempted to ask whether the elaborate preparations made by Capt. Jones were really needed. Nearly a half of the geological part of the Report is occupied with a description and discussion of the geyser phenomena of the National Park—a very interesting and important subject, but one which had already been largely treated of, and which does not appear to be quite in its proper place in the midst of a military reconnaissance. Dr. Hayden, who had done so much to make known the structure and the wonders of that region, is cited in the report, but not in such a way as to suggest any adequate notion of the relative importance of his labours and those of Capt. Jones's expedition. The most important geographical point established by the latter traveller was the existence of an easily traversible pass through the mountains between the head of Wind River and the sources of the Yellowstone. He named it Togwotee Pass, and found that though it reaches an elevation of 9,621 feet above the sea, the slopes leading to it are so gentle that a railway might be led through it at a reasonable cost.

Prof. Comstock, who was attached as geologist to the expedition, contributes a series of geological chapters to the Report. They are well written, and show him to be not only a good observer, but one who endeavours to group what he sees round some leading principles in science. In particular he adopts a systematic method of treatment in preference to the order of observation usually followed in such reports. This plan saves his readers at a distance much time and trouble, besides enabling them to grasp the main outlines of his work far more clearly than would be otherwise possible. He begins by giving a general outline of the physical geography of the region, connecting the area examined by the party with the rest of the Rocky Mountain tracts as far as explored by other observers. Availing himself of the previous labours of Hayden, Clarence King, Whitney, and others, he arranges his narrative of the geological history of the region in stratigraphical order, beginning with the most ancient metamorphic or archæan rocks, and leading his readers through the Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, Tertiary, and Post-tertiary systems. In seven interesting chapters Prof. Comstock discusses the questions in dynamical geology suggested by the work of the expedition. In pointing out the evidences for glacial action in North-western Wyoming, he admits that even the hardest rocks fail to show traces of glacier-striation; that in all his journey he had only seen two or three faint scratches approaching the nature of a glacial mark, but which might have been made quite recently. He found, however, on the Wind River plateau long and high ridges composed of huge granite boulders and immense blocks of Silurian and other rocks, with intervening lakes or ponds, and he no doubt correctly regards these features as glacier-moraines. He finds evidence of enormous erosion in recent geological times, and points out the causes now at work in producing rapid disintegration and removal of rock. Among these he mentions the great altitude of the region allowing of the accumulation of large masses of snow, and of the alternate freezing and thawing of the snow by night and day; the steepness of the slopes favouring rapid erosion, and the character of the rocks powerfully influencing alike the amount of waste and the nature of the resultant forms of surface. The wind plays a not unimportant part in modifying the scenery partly by transporting vast clouds of sand away from the mountains and forming sand-hills in the plains, partly by felling large quantities of timber which obstruct the flow of surface-water, dam up streams, and render the country for wide distances all but impenetrable. The action of vegetation in preserving the surface of loose soil from disintegration, and in giving rise to mould, turf, and other accumulations is illustrated by examples met with on the journey. The author enters with considerable minuteness into the dynamics of the Yellowstone geyser region. He carefully describes eighteen groups of thermal springs, and distinguishes these somewhat arbitrarily, as he admits, from the geysers or eruptive springs, of which he enumerates twenty-five. In two concluding chapters he gives some account of the archæology of the region and of the manners and customs of the Eastern Shoshone Indians, from jottings made by him in intervals of leisure during the march. The Report is illustrated by forty-nine small sketch-maps of each day's march, two large general maps of the region traversed (one coloured geologically), and numerous sketches and sections. As a record of three months of daily toil in a wild little-known region the volume is creditable to its authors, and as a source of information regarding one of the most interesting regions of North America it will be useful to geological and general readers. ARCH. GEIKIE

NOTES

THE programme of the fifty-first meeting of the German Naturalists and Physicians (the German equivalent of the British Association) will be held this year at Cassel, from September 18 to 24. This, probably the most thoroughly scientific and efficient of all the Associations, consists of twenty-five sections, ranging from Mathematics and Astronomy to Veterinary Surgery. This year a number of addresses on leading topics by eminent men of science are promised. Among these are the following :—"On the Relation of Darwinism to Social Democracy," by Prof. Oscar Schmidt, of Strassburg; "On Symbiosis, Parasitism, and Allied Phenomena of Life," by Prof. De Bary, of Strassburg; "On the Education of the Physician," by Prof. Fick, of Würzburg; "On the Physician in his Relation to Research and Natural Science," by Prof. Hüter, of Greifswald; "On Harvey's Life and Work," by Dr. Baas, of Worms; "On the Colour-sense and Colour-blindness," by Dr. J. Stilling, of Cassel. Many other attractions are promised, including excursions, social gatherings, and the inevitable winding-up "Abschieds-Commers." The various German railways will afford great privileges to those attending the meeting.

WE have received a circular issued by the local committee of the American Association, which meets at St. Louis on August 21, giving detailed directions as to how to reach the place of meeting from different points. From this circular we learn that the railway companies, proprietors of Pullman and other luxurious cars, various express companies, and the local hotel-keepers, afford unusual facilities to members at greatly reduced rates. The concluding excursion of the meeting is to be to the Rocky Mountain region of Colorado, the details of which have not yet, however, been arranged.

THE thirty-fifth annual congress of the British Archæological Association will be held at Wisbeach, from August 19 to 27, under the presidency of Lord Hardwicke.

WE are sure that all our readers will be pleased to hear that a Civil List Pension of 200*l*. per annum has been granted to Dr. Prescott Joule.

THE Royal Society of Sciences at Upsala have shown their appreciation of Mr. Alex. Buchan's work as a meteorologist by electing him a foreign member of their body.

MR. P. S. ABRAHAM, M.A., B.Sc., of St. Bartholomew's Hospital, who recently catalogued the Nudibranchiate Mollusca at the British Museum, has been engaged to arrange scientifically, and to write a descriptive catalogue of the natural history collections at the Winchester Town Museum.

LAST week we spoke of the generosity of the United States Government in the distribution of the publication of their admirable surveys. We regret to see, from a speech in the House of Representatives by the Hon. O. R. Singleton, that the usefulness of Dr. Hayden's surveys threatens to be seriously crippled from want of funds. The appropriation for this survey in 1867 was only 5,000 dollars, which in 1873 had been raised to 95,000 dollars. In 1876, however, this was reduced by 30,000 dollars, and again, in 1877, by 20,000, leaving the appropriation at only 45,000 dollars. The largest sum is what is actually needed that the survey may be carried on with efficiency, and to reduce it is quite unworthy of a nation so advanced and liberal as the United States, and is really the worst possible economy. The additions which have been made to science by Dr. Hayden's survey have been immense and of the highest importance, and its economic value to the country can be no less great. The mere list of the many admirable publications of the survey is sufficient to prove that the money has been well spent; and we trust the United States Government and Congress will be able to rise above all party feeling, and prove to the world that they have the best interests of the country and the interests of scientific knowledge at heart by restoring the appropriation to at least its old amount. Mr. Singleton truly says not a small item in favour of these surveys is the check they place on mining and land swindles.

WE have received the first number of the *American Journal of Mathematics*, to which we have already referred on more than one occasion. It is a large quarto of 104 pages, the chief editor being Prof. Sylvester. Its contents will bear comparison with those of any similar publication on this side of the water. We can only give a list of the papers in this number: "Note on a Class of Transformations which Surfaces may undergo in Space of more than Three Dimensions," by Prof. Simon Newcomb; "Researches in the Lunar Theory," by G. W. Hill; "The Theorem of Three Moments," by Dr. H. T. Eddy; "Solution of the Irreducible Case," by Guido Weichold, of Zittau, Saxony; "Desiderata and Suggestions," by Prof. Cayley—"No. 1. The Theory of Groups;" "Note on the Theory of Electric Absorption," by H. A. Rowland; a review, by Mr. C. S. Peirce, of Lieut.-Col. Ferrero's "Espozione del Metodo dei Minimi Quadrati;" "On an Application of the New Atomic Theory to the Graphical Representation of the Invariants and Covariants of Binary Quantics," by Prof. Sylvester. The first announcement of Prof. Sylvester's remarkable application of the chemical theory was made in NATURE (vol. xvii. p. 284). The London publishers of the journal are Trübner and Co.

ON the 21st will be opened the new magnetic observatory at Pavlovsk in connection with the Central Physical Observatory of St. Petersburg. The new observatory covers about eight hectares of surface, and the situation is in all respects favourable. The establishment comprises three principal scientific buildings, the main building of stone and surmounted by a tower for meteorological observations; a double-arched structure in stone covered with earth for observations in magnetic variation; and a wooden pavilion, without a particle of iron, for absolute magnetic measurements and for determinations of time. Besides these three buildings devoted to the purely scientific work of the observatory, there are four wooden houses for lodging the staff, servants, and for other purposes. All these structures are roofed with bituminized paper, and we need scarcely say that the scientific buildings are at a sufficient distance from the other buildings to prevent the scientific observations being affected by their neighbourhood. The Pavlovsk Observatory is furnished with the most improved scientific instruments, and like the Central Physical Observatory of St. Petersburg, is a model establishment of its kind. Every precaution has been taken, both during the building and after its completion, to prevent a trace of iron getting near it. The instruments themselves have been put in their places under the personal superintendence of Dr. Wild, the head of the Central Observatory at St. Petersburg. Provisionally the work of the establishment at Pavlovsk will be specially directed to the observation of the meteorological elements and of terrestrial magnetism. As soon as trustworthy methods have been found for the constant measurements of other elements, such as atmospheric electricity, terrestrial currents, radiation of heat, the optics and chemistry of the sun and sky, these elements will also form the objects of normal observations.

MR. MURRAY has the following books in the press:—"Researches and Adventures among the Lakes and Mountains of Eastern Africa," from the journals of the late Capt. F. Elton, H.B.M.'s Consul in Mozambique; this work will include notes on the suppression of the slave trade, and will be edited, with additions, by the author's companion, H. B. Cotterill; "Sketches of the Natives of Burmah," an account of their manners, customs, and religion, by Capt. C. J. F. S. Forbes, the officiating Deputy Commissioner of British Burmah; the fifth division of Dr. Percy's "Metallurgy," which will treat of silver; and a third revised edition of Mr. E. B. Tylor's "Researches into the Early History of Mankind." Mr. Murray will also publish in autumn the life of another Scottish naturalist, by Dr. Smiles. This newly discovered prodigy, a baker, whose name was Dick, has been dead ten years, and is said to have been an even more remarkable man than Thomas Edward. The principal sphere of his geological and botanical labours was in the region of the Pentland Firth and Dunnet Bay, on the north-west of Scotland.

THE problem of technical education, of which so much has been said of late, has long occupied the attention of thoughtful men in France and Germany. In the former of these countries the question has received much more attention than in the years preceding the war of 1870. In a recent conference at the Trocadéro Palace, M. Corbon, who has laboured in this direction for forty years, urged the introduction of manual employments and of the practical teaching of the skilled industries into the higher schools. He spoke of the good results which had been found to follow the establishment of the municipal School of Apprenticeship in Paris. Although founded only a few years ago, their system of teaching has attained a high degree of development; the mechanical trades being particularly well taught and the pupils of the school being in great demand by masters. Examples of the work of pupils of this excellent institution are shown at the Paris Exhibition in the building known as the "Ville de Paris." Visitors to Paris interested in scientific and technical education should not fail to note the collection of objects there shown. They would also find the school well worthy of a visit. It is situated at No. 60, Boulevard de la Villette.

IT is stated that the Jablochkoff electric lights now so brilliantly employed in the Avenue de l'Opera of Paris are costing 20*l*. per night, but the four-and-thirty lamps that illuminate that street give much more light than is necessary for the purposes of street-lighting. The problem of electric lighting is evidently one in which the scientific workers across the channel are deeply interested. It is stated that no less than eighteen different kinds of regulators for the electric light are exhibited at the Paris exposition; not including the "candle" of M. Paul Jablochkoff.

M. MAUMENÉ recently communicated to the Société de Physique, of Paris, a discovery of some importance in thermochemistry. Concentrated sulphuric acid which has been left for some months undergoes a change of condition of a singular nature. On mixing a liquid such as olive oil, with, say, one-tenth of its weight of fresh concentrated acid, a certain constant rise of temperature is observed, but if acid three months old is used, the rise of temperature so obtained has a value of about 8° C. less. The same results occur even if the acid has been hermetically sealed in glass tubes. With water and other liquids analogous results are found. It is evident that some of the most important data of the thermal effects of chemical action may require revising in the light of this discovery.

THOUGH it is very difficult to obtain any details about their jealously-guarded country, a Japan contemporary gathers that the condition of the Coreans is just now miserable in the extreme. The spring crops of this year, it is said, will utterly fail, and the stock of food in the country is reported to be a mere nothing for the four or five millions of people, who must, if they can, struggle on in the hope of a possible autumnal harvest. The cause of the Corean famines is not known, but it is probable that the primary cause there, as in China, is disafforestation, for, although the forests of pines, oaks, &c., on the sea-board are carefully preserved, a great drain must have thinned the woods by the river-sides. Much or most of the wood used in Peking for building houses, temples, and palaces is said to come from Corea, and from the same source are obtained the vast supplies needed for Tientsin and the cities of the province of Chihli, which lie on the Pei-ho, Peitang-ho, and the Grand Canal. Corea produces various woods of the finest quality, and the cart shafts, dray poles, and axle-trees in Northern China are made out of the tough and strong Corean ash, elm, hornbeam, and other hard timber. We think, however, that our contemporary is in error in stating, without qualification, that "the great wooden masts which support the noble temples and gatehouses of the Imperial city of Peking (all enormous, beautiful, and enduring spars) come from Corea," for there is no doubt that most of the magnificent wooden pillars to be found in the halls of the Ming tombs and the Peking palaces and temples came from the Chaotung department and other parts of the Yünnan province. The timber in question is called by the Chinese *nan-mu*, and is to be seen in the places mentioned at the present day in perfect condition after the lapse of nearly three hundred years. It may not be uninteresting to add that it is not teak, as is often supposed by foreigners, and that the tree is tall, thin, straight-growing, having no bough or twigs on the stem, but suddenly shooting out branches at the top somewhat like a canopy over a maypole, and its bark is of a peculiar ashy grey colour. This is the account given of it by Mr. Consul Davenport in his Report on the trade capabilities of the country traversed by the Yünnan Mission in 1875-76, who also observed in the Manwyne valley, in the Kakhyen hills, and again in Lower Burmah, in places comparatively accessible, many trees bearing so striking a resemblance to the valuable *nan-mu* that the Indian Government have been recently instituting inquiries into the subject with a view to the development of the timber trade in British Burmah.

WE have received the first part of a new "Anatomisch-physiologischen Atlas der Botanik," by Dr. Arnold Dodel-Port, of Zurich, and his wife, published by Schreiber, of Esslingen. The atlas will be published in two forms containing forty-two and sixty plates respectively, to suit different classes of schools. It is the finest publication of the kind we have seen, and the plates are of such a size that they may be hung up on the wall. The plants and various parts of plants in the part sent us are magnified from 15 to 8,000 times, and are most beautifully and successfully coloured according to nature. Explanatory text accompanies each plate, and as an aid to botanical teaching it would be difficult to imagine anything more useful and attractive; it would be a boon to teachers and students of botany to have the Atlas published in this country.

THE Harvard Library *Bulletin* No. 8, the *Nation* states, announces that a sufficient subscription to Scudder's "Catalogue of Scientific Serials" has been secured, and that the work will be immediately put to press.

THE eleventh annual report of the Peabody Institute of Baltimore shows that the institution is efficiently serving the various scientific, literary, and artistic purposes for which it was established.

LAST Friday, at half-past 8 P.M., a magnificent meteor was seen at Privat, in the Ardèche Department. The meteor broke into several pieces and emitted a magnificent blue light.

THE state of the weather in the principal Algerian towns is posted regularly at the Meteorological Pavilion in the Trocadero, Paris. A special column is devoted to describing the state of the sea, but the writers having the care of translating the telegrams are so ignorant that they have posted a notice for several days telling the Parisians that "the sea was very smooth at Laghouat and Biskra," two Saharan cities!

THE French *Journal Officiel* has published a notice intimating that a school for telegraphy has been established, and that the course of instruction will be opened in October next. Pupils will be admitted after a competition. Preliminary examinations will take place in several cities of France, and the final examination will take place in Paris. A certain number of places is reserved to the pupils of the Polytechnic School, without competition, though it is expected that this privilege will be cancelled by the Chamber of Deputies when deliberating upon the matter next session.

THE inflation of the great Giffard balloon was completed on Sunday evening. Aeronauts are now busy arranging the manœuvres, and it is expected that the preliminary ascents will be made at the end of this week. Next week M. Tissandier will make a communication to the Academy of Sciences on behalf of M. Giffard, who has appointed him general manager. MM. Eugene and Jules Godard and Camille Dartois have been appointed aeronauts. Free ascents will be made twice a week from the Cour des Tuileries. The reappearance of a monster captive balloon will very likely revive an interest in aeronautics. We have heard of many contemplated experiments on a smaller scale. Some Americans have constructed, with light oiled silk, a cylinder six feet in height and twenty feet long, which has been filled with pure hydrogen. This elongated balloon supports an immense sheet in silk, on which advertisements are to be painted and exhibited at fixed rates per hour. The effect is said to be very graceful indeed.

IT is stated, on the authority of the *Agricultural Gazette* of Hanover, that a discovery has recently been made of a new remedy for the prevention of ravages to cabbages by the common caterpillar. A steward of an estate in Hanover having observed that one bed of cabbages was left untouched by caterpillars, whilst others were infested with them, found that the healthy bed had a quantity of dill growing on it, the smell of which, apparently, was obnoxious to the caterpillars. As dill will grow in almost any soil, it is suggested that the experiment might be tried by agriculturists. As indicative of the possibility of there being some truth in this, *The Colonies and India* says:—"We have heard of the common green ("gooseberry") caterpillar being kept off by planting broad beans close to the bushes—and the pyrethrum, a strong smelling weed which is cultivated as a garden border flower—is said to protect vines from the ravages of the *Phylloxera*.

THE phenomenon of supersaturated solutions of salts forms the subject of an elaborate study by M. D. Gernez (*Ann. de l'École normale*, 1878). He finds that besides water a number of other liquids, such as carbon-disulphide, the hydro-carbons, the phenols, and notably the alcohols, afford instances of this peculiarity. A substance which does not yield supersaturated solutions with one solvent never yields them with another, nor can the phenomenon be produced by the addition of substances such as dextrin, tending to increase the viscosity of the solvent. The salts yielding these solutions most easily are sodium carbonate, calcium nitrate, magnesium sulphate, plumbic acetate, and alum. In the case of all five crystallisation ensues only on the introduction of crystals of an isomorphous substance, and the latter lose this property if once heated above a certain temperature, for example, 98° for alum. The author gives a list of 120 substances which possess the property of yielding these solutions.

THE Ethnographic Congress in connection with the Paris Exhibition was opened on Monday. The President, M. Leon de Rosny, delivered a somewhat vague and apparently not over scientific address, in which he defined ethnography as the study of conscious humanity, the discovery of the law of the evolution of humanity in its relation with the general laws of the universe. While anthropology studied individuals or grouped them only according to physical affinities, ethnography recognised groups formed by collective consent and based on compatibilities of temperament and intelligence. It was the fashion, indeed, to decry half-breeds; but the majority, if not the whole, of nations prominent in history had been mixed races, and this mixture was the law of nature, though, under unfavourable conditions, it sometimes proved a failure.

THE report of the Miners' Association of Cornwall and Devon for the year 1877 is, we are glad to say, as satisfactory as usual.

MR. E. SCHÖNE, of Moscow, who is making extended researches on the presence of peroxide of hydrogen in the air, communicates recently the results of his investigations on its presence in the solid and liquid depositions from the atmosphere. He finds that in general the percentage of peroxide of hydrogen increases with the height above the earth's surface at which the condensation of the aqueous vapour takes place. Thus rain always contains more than snow—the rain-clouds moving, as is well known, at a higher elevation than those yielding snow—mists which take their origin near the earth's surface contain comparatively little, and dew and frost show no traces.

THE additions to the Zoological Society's Gardens during the past week include a Beatrix Antelope (*Oryx beatrix*) from Tyef Hedgar, presented by Commander Burke, s.s. *Arcot*, two Crested Porcupines (*Hystrix cristata*), a Banded Ichneumon (*Herpestes fasciatus*) from East Africa, presented by Dr. G. P. Badger; four Paradise Whydah Birds (*Vidua paradisea*), a pin-tailed Whydah Bird (*Vidua principalis*), three Grenadier Weaver Birds (*Euplectes oryx*) from East Africa, presented by Mr. Archibald Brown; a Barn Owl (*Strix flammea*) from Mesopotamia, presented by Commander Wyatt, s.s. *Deccan*; a Hawk's-billed Turtle (*Chelone imbricata*) from the East Indies, presented by Capt. Henderson; a Water Chevrotain (*Hyomoschus aquaticus*), an Electric Silurus (*Malapterurus beninensis*) from West Africa, a Plantain Squirrel (*Sciurus plantani*) from Java, purchased; a Chimpanzee (*Troglodytes niger*) from West Africa, four Vulturine Guinea Fowls (*Numida vulturina*) from East Africa, deposited; a Hairy Tree Porcupine (*Sphingurus villosus*) born in the Gardens.

THE EXPLANATION OF CERTAIN ACOUSTICAL PHENOMENA [1]

MUSICAL sounds have their origin in the vibrations of material systems. In many cases, *e.g.* the pianoforte, the vibrations are free, and are then necessarily of short duration. In other cases, *e.g.* organ pipes and instruments of the violin class, the vibrations are maintained, which can only happen when the vibrating body is in connection with a source of energy capable of compensating the loss caused by friction and generation of aërial waves. The theory of free vibrations is tolerably complete, but the explanations hitherto given of maintained vibrations are generally inadequate, and in most cases altogether illusory.

In consequence of its connection with a source of energy, a vibrating body is subject to certain forces, whose nature and effects are to be estimated. These forces are divisible into two groups. The first group operate upon the periodic time of the vibration, *i.e.* upon the pitch of the resulting note, and their effect may be in either direction. The second group of forces do not alter the pitch, but either encourage or discourage the vibration. In the first case only can the vibration be maintained; so that for the explanation of any maintained vibration, it is necessary to examine the character of the second group of forces sufficiently to discover whether their effect is favourable or unfavourable. In illustration of these remarks, the simple case of a common pendulum was considered. The effect of a small periodic horizontal impulse is in general both to alter the periodic time and the amplitude of vibration. If the impulse (supposed to be always in the same direction) acts when the pendulum passes through its lowest position, the force belongs to the second group. It leaves the periodic time unaltered, and encourages or discourages the vibration according as the direction of the pendulum's motion is the same or the opposite of that of the impulse. If, on the other hand, the impulse acts when the pendulum is at one or other of the limits of its swing, the effect is solely on the periodic time, and the vibration is neither encouraged nor discouraged. In order to encourage, *i.e.* practically in order to maintain a vibration, it is necessary that the forces should not depend solely upon the position of the vibrating body. Thus, in the case of the pendulum, if a small impulse in a given direction acts upon it every time that it passes through its lowest position, the vibration is not maintained, the advantage gained as the pendulum makes a passage in the same direction as that in which the impulse acts being exactly neutralised on the return passage, when the motion is in the opposite direction.

As an example of the application of these principles, the maintenance of an electric tuning-fork was discussed. If the magnetic forces depended only upon the position of the fork, the vibration could not be maintained. It appears, therefore, that the explanations usually given do not touch the real point at all. The fact that the vibrations are maintained is a proof that the forces do not depend solely upon the position of the fork. The causes of deviation are two: the self-induction of the electric currents, and the adhesion of the mercury to the wire whose motion makes and breaks the contact. On both accounts the magnetic forces are more powerful in the latter than in the earlier part of the contact, although the position of the fork is the same; and it is on this *difference* that the possibility of maintenance depends. Of course the arrangement must be such that the retardation of force *encourages* the vibration, and the arrangement which in fact encourages the vibration would have had the opposite effect, if the nature of electric currents had been such that they were more powerful during the earlier than during the later stages of a contact.

In order to bring the subject within the limits of a lecture, one class of maintained vibrations was selected for discussion, that, namely, of which *heat* is the motive power. The best understood example of this kind of maintenance is that afforded by Trevelyan's bars, or rockers. A heated brass or copper bar, so shaped as to rock readily from one point of support to another, is laid upon a cold block of lead. The communication of heat through the point of support expands the lead lying immediately below in such a manner that the rocker receives a small impulse. During the interruption of the contact the communicated heat has time to disperse itself in some degree into the mass of lead, and it is not difficult to see that the impulse is of a kind to encourage the motion. But the most interesting vibrations of this class are those in which the vibrating body consists of a mass of air more or less completely confined.

If heat be periodically communicated to, and abstracted from, a mass of air vibrating (for example) in a cylinder bounded by a piston, the effect produced will depend upon the phase of the vibration at which the transfer of heat takes place. If heat be given to the air at the moment of greatest condensation, or taken from it at the moment of greatest rarefaction, the vibration is encouraged. On the other hand, if heat be given at the moment of greatest rarefaction, or abstracted at the moment of greatest condensation, the vibration is discouraged. The latter effect takes place of itself, when the rapidity of alternation is neither very great nor very small, in consequence of radiation; for when air is condensed it becomes hotter, and communicates heat to surrounding bodies. The two extreme cases are exceptional, though for different reasons. In the first, which corresponds to the suppositions of Laplace's theory of the propagation of sound, there is not sufficient time for a sensible transfer to be effected. In the second the temperature remains nearly constant, and the loss of heat occurs during the *process* of condensation, and not when the condensation is effected. This case corresponds to Newton's theory of the velocity of sound. When the transfer of heat takes place at the moments of greatest condensation or of greatest rarefaction, the pitch is not affected.

If the air be at its normal density at the moment when the transfer of heat takes place, the vibration is neither encouraged nor discouraged, but the pitch is altered. Thus the pitch is *raised*, if heat be communicated a quarter period *before* the phase of greatest condensation, and the pitch is *lowered* if the heat be communicated a quarter period *after* the phase of greatest condensation.

In general both kinds of effects are produced by a periodic transfer of heat. The pitch is altered, and the vibrations are either encouraged or discouraged. But there is no effect of the second kind if the air concerned be at a loop, *i.e.*, a place where the density does not vary, nor if the communication of heat be the same at any stage of rarefaction, as in the corresponding stage of condensation.

The first example of aërial vibrations maintained by heat was found in a phenomenon which has often been observed by glass-blowers, and was made the subject of a systematic investigation by Dr. Sondhauss. When a bulb about three quarters of an inch in diameter is blown at the end of a somewhat narrow tube, 5 or 6 inches in length, a sound is sometimes heard proceeding from the heated glass. It was proved by Sondhauss that a vibration of the glass itself is no essential part of the phenomenon, and the same observer was very successful in discovering the connection between the *pitch* of the note and the dimensions of the apparatus. But no explanation (worthy of the name) of the production of sound has been given.

For the sake of simplicity, a simple tube, hot at the closed end and getting gradually cooler towards the open end, was first considered. At a quarter of a period *before* the phase of greatest condensation (which occurs almost simultaneously at all parts of the column) the air is moving inwards, *i.e.* towards the closed end, and therefore is passing from colder to hotter parts of the tube; but the heat received at this moment (of normal density) has no effect either in encouraging or discouraging the vibration. The same would be true of the entire operation of the heat, if the adjustment of temperature were instantaneous, so that there was never any sensible difference between the temperatures of the air and of the neighbouring parts of the tube. But in fact the adjustment of temperature takes *time*, and thus the temperature of the air deviates from that of the neighbouring parts of the tube, inclining towards the temperature of that part of the tube *from* which the air has just come. From this it follows that at the phase of greatest condensation heat is received by the air, and at the phase of greatest rarefaction is given up from it, and thus there is a tendency to maintain the vibrations. It must not be forgotten, however, that apart from transfer of heat altogether, the condensed air is hotter than the rarefied air, and that in order that the whole effect of heat may be on the side of encouragement, it is necessary that, previous to condensation, the air should pass not merely towards a hotter part of the tube, but towards a part of the tube which is hotter than the air will be when it arrives there. On this account a great range of temperature is necessary for the maintenance of vibration, and even with a great range the influence of the transfer of heat is necessarily unfavourable at the closed end, where the motion is very small. This is probably the reason

[1] Friday Evening Lecture, by Lord Rayleigh, M.A., F.R.S., March 15, at the Royal Institution of Great Britain.

of the advantage of a bulb. It is obvious that if the *open* end of the tube were heated, the effect of the transfer of heat would be even more unfavourable than in the case of a temperature uniform throughout.

The sounds emitted by a jet of hydrogen, burning in an open tube, were noticed soon after the discovery of the gas, and have been the subject of several elaborate inquiries. The fact that the notes are substantially the same as those which may be elicited from the tube in other ways, *e.g.*, by blowing, was announced by Chladni. Faraday proved that other gases were competent to take the place of hydrogen, though not without disadvantage. But it is to Sondhauss that we owe the most detailed examination of the circumstances under which the sound is produced. His experiments prove the importance of the part taken by the column of gas in the tube which supplies the jet. For example, sound cannot be obtained with a supply tube which is plugged with cotton in the neighbourhood of the jet, although no difference can be detected by the eye between the flame thus obtained and others which are competent to excite sound. When the supply tube is unobstructed, the sounds obtainable are limited as to pitch, often dividing themselves into detached groups. In the intervals between the groups no coaxing will induce a maintained sound, and it may be added that, for a part of the interval at any rate, the influence of the flame is inimical, so that a vibration started by a blow is damped more rapidly than if the jet were not ignited.

Partly in consequence of the peculiar behaviour of flames, and partly for other reasons, the thorough explanation of these phenomena is a matter of some difficulty; but there can be no doubt that they fall under the head of vibrations maintained by heat, the heat being communicated periodically to the mass of air confined in the sounding tube at a place where, in the course of a vibration, the pressure varies. Although some authors have shown an inclination to lay stress upon the effects of the current of air passing through the tube, the sounds can readily be produced, not only when there is no through draught, but even when the flame is so situated that there is no sensible periodic motion of the air in its neighbourhood. In the course of the lecture a globe intended for burning phosphorus in oxygen gas was used as a resonator, and, when excited by a hydrogen flame well removed from the neck, gave a pure tone of about ninety-five vibrations per second.

In consequence of the variable pressure within the resonator, the issue of gas, and therefore the equivalent of heat, varies during the vibration. The question is under what circumstances the variation is of the kind necessary for the maintenance of the vibration. If we were to suppose, as we might at first be inclined to do, that the issue of gas is greatest when the pressure in the resonator is least, and that the phase of greatest development of heat coincides with that of the greatest issue of gas, we should have the condition of things the most unfavourable of all to the persistence of the vibration. It is not difficult, however, to see that both suppositions are incorrect. In the supply tube (supposed to be unplugged, and of not too small bore) stationary, or approximately stationary, vibrations are excited, whose phase is either the same or the opposite of that of the vibration in the resonator. If the length of the supply tube from the burner to the open end in the gas-generating flask be less than a quarter of the wave length in hydrogen of the actual vibration, the greatest issue of gas *precedes* by a quarter period the phase of greatest condensation; so that if the development of heat is *retarded* somewhat in comparison with the issue of gas, a state of things exists *favourable* to the maintenance of the sound. Some such retardation is inevitable, because a jet of inflammable gas can burn only at the outside, but in many cases a still more potent cause may be found in the fact that during the retreat of the gas in the supply tube small quantities of air may enter from the interior of the resonator, whose expulsion must be effected before the inflammable gas can again begin to escape.

If the length of the supply tube amounts to exactly one quarter of the wave length, the stationary vibration within it will be of such a character that a node is formed at the burner, the variable part of the pressure just inside the burner being the same as in the interior of the resonator. Under these circumstances there is nothing to make the flow of gas, or the development of heat, variable, and therefore the vibration cannot be maintained. This particular case is free from some of the difficulties which attach themselves to the general problem, and the conclusion is in accordance with Sondhauss' observations.

When the supply tube is somewhat longer than a quarter of the wave, the motion of the gas is materially different from that first described. Instead of preceding, the greatest outward flow of gas *follows* at a quarter period interval the phase of greatest condensation, and therefore if the development of heat be somewhat retarded, the whole effect is unfavourable. This state of things continues to prevail, as the supply tube is lengthened, until the length of half a wave is reached, after which the motion again changes sign, so as to restore the possibility of maintenance. Although the size of the flame and its position in the tube (or neck of resonator) are not without influence, this sketch of the theory is sufficient to explain the fact, formulated by Dr. Sondhauss, that the principal element in the question is the length of the supply tube.

The next example of the production of sound by heat, shown in the lecture, was a very interesting phenomenon discovered by Rijke. When a piece of fine metallic gauze, stretching across the lower part of a tube, open at both ends and held vertically, is heated by a gas flame placed under it, a sound of considerable power, and lasting for several seconds, is observed almost immediately *after* the removal of the flame. Differing in this respect from the case of sonorous flames, the generation of sound was found by Rijke to be closely connected with the formation of a through draught, which impinges upon the heated gauze. In this form of the experiment the heat is soon abstracted, and then the sound ceases; but by keeping the gauze hot by the current from a powerful galvanic battery, Rijke was able to obtain the prolongation of the sound for an indefinite period. In any case from the point of view of the lecture the sound is to be regarded as a *maintained* sound.

In accordance with the general views already explained, we have to examine the character of the variable communication of heat from the gauze to the air. So far as the communication is affected directly by variations of pressure or density the influence is unfavourable, inasmuch as the air will receive less heat from the gauze when its own temperature is raised by condensation. The maintenance depends upon the variable transfer of heat due to the varying *motions* of the air through the gauze, this motion being compounded of a uniform motion upwards with a motion, alternately upwards and downwards, due to the vibration. In the lower half of the tube these motions conspire a quarter period *before* the phase of greatest condensation, and oppose one another a quarter period after that phase. The rate of transfer of heat will depend mainly upon the temperature of the air in contact with the gauze being greatest when that temperature is lowest. Perhaps the easiest way to trace the mode of action is to begin with the case of a simple vibration without a steady current. Under these circumstances the whole of the air which comes in contact with the metal, in the course of a complete period, becomes heated; and after this state of things is established there is comparatively little further transfer of heat. The effect of superposing a small steady upwards current is now easily recognised. At the limit of the inwards motion, *i.e.* at the phase of greatest condensation, a small quantity of air comes into contact with the metal, which has not done so before, and is accordingly cool; and the heat communicated to this quantity of air acts in the most favourable manner for the maintenance of the vibration.

A quite different result ensues if the gauze be placed in the *upper* half of the tube. In this case the fresh air will come into the field at the moment of greatest rarefaction, when the communication of heat has an unfavourable instead of a favourable effect. The principal note of the tube therefore cannot be sounded.

A complementary phenomenon discovered by Bosscha and Riess may be explained upon the same principles. If a current of *hot* air impinge upon *cold* gauze, sound is produced; but in order to obtain the principal note of the tube the gauze must be in the upper, and not as before in the lower, half of the tube. An experiment due to Riess was shown in which the sound is maintained indefinitely. The upper part of a brass tube is kept cool by water contained in a tin vessel, through the bottom of which the tube passes. In this way the gauze remains comparatively cool, although exposed to the heat of a gas flame situated an inch or two below it. The experiment sometimes succeeds better when the draught is checked by a plate of wood placed somewhat closely over the top of the tube.

Both in Rijke's and Riess' experiments the variable transfer of heat depends upon the motion of vibration, while the effect of the transfer depends upon the variation of pressure. The gauze must therefore be placed where both effects are sensible, *i.e.* neither near a node nor near a loop. About a quarter of the length of the tube, from the lower or upper end, as the case may be, appears to be the most favourable position.

RAYLEIGH

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

AMONG the bequests of the late Mr. Henry Brown, J.P., formerly of Bradford, is a sum of 5,000*l.* to the Yorkshire College, Leeds, for the purpose of founding and maintaining scholarships.

THE New York *Nation* states that Dr. A. S. Packard, jun., has been appointed Professor of Natural History at Brown University. His departure from Salem, Mass., the *Nation* states, following on Prof. Morse's and Prof. Putnam's is a serious loss to that scientific centre, and implies an inadequate endowment of the Peabody Academy of Sciences.

THE first conferment of degrees by the Johns Hopkins University took place on June 13. Four candidates were admitted to the degrees of Ph.D. and M.A.

THE following figures, which have been published quite recently at Algiers, will give an idea of the state of public instruction in that colony. Superior instruction is represented only by a preparatory school of medicine in Algiers. It is contemplated to establish in that city a university of letters, science, law, and medicine; but no step has yet been taken to realise the scheme. There are colleges, or lycées at Algiers, Oran, Constantine, Bone, Philippeville, Blidah, Mostaganem, and one or two other places, and two clerical institutions, one at Blidah, and the other at Algiers. The number of pupils of these establishments is 3,142 in a population of 344,849 of European extraction. Primary instruction is given in 803 schools, frequented by 66,343. A few natives follow the course of instruction in European or secondary schools. Most of them are pupils in the Algiers lycée, which has no less than 980 pupils, and is considered one of the best under the authority of the French government, even in France. Great efforts have been made to organise French-Arab schools for natives, but with not much success. Within the last few years thirteen French-Arab schools have been opened in the Sahara and Kabylè, which have now 1,481 pupils. The aggregate number of young Arabs, receiving education from the French government, is only 1,573 boys, and 173 girls out of a population of 2,500,000. A normal school has been established at Mustapha, near Algiers, and numbers from thirty to forty pupils.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 4, 1878.—This number commences with a paper by M. Schering on friction currents as exemplified in the rubber of a (cylinder) electrical machine. For production of such currents it is unimportant whether the cylinder be connected to earth or not; and the occurrence of *opposite* electricities at the two ends of the rubber is also not essential. The electricity on the hinder margin of the rubber is derived from the insulator (cylinder); for it agrees in sign with that of the latter, and nearly always disappears when the insulator is connected to earth. The friction causes a less quantity of negative electricity to exist on the hinder margin of the rubber than on the forward margin; the quantity of electricity steadily varies from the hinder to the forward margin.—M. Fröhlich investigates the intensity of diffracted light in relation to that of the incident light. His experimental results closely correspond to those of theory. With small angles the entire incident energy of motion appears again after diffraction as light-motion.—Fresnel's theory of diffraction phenomena is treated at some length by M. Voigt.—Studying certain hydrodynamic problems in relation to the theory of ocean currents, M. Zöppritz concludes, *inter alia*, that the influence of friction has, in one direction, been underrated, in another overrated; the former, because it has not been supposed to extend deep enough, the latter, because in regard to propagation of variable current-motions too much has been ascribed to it. He calculates that with a mean ocean depth of 4,000 m. the trade winds in their present extent and strength would have to blow 100,000 years ere the present state of motion of the equatorial current could be supposed approximately stationary. The damping influence of continents and islands would somewhat diminish the number.—M. Antolik communicates further observations on the gliding of electric sparks, obtaining new evidence for the fact that a greater tension is required for discharge of positive than for that of negative electricity, and that the one kind passes more rapidly and further than the other.—A formula determining the rotation of the plane of polarisation in quartz for all colours as function of the temperature, is given by M. Sohncke, who also finds that the rotation in chlorate of soda increases with rising temperature in a greater degree than in quartz.—An improved tangent galvanometer for lecture purposes (based on the principle of the Gauss-Weber mirror-magnetometer), a modification of the mercury air-pump, and a method of more accurate measurement of thickness by means of the spherometer, are among the remaining subjects here dealt with.

No. 5.—M. Kohlrausch here describes a "total reflectometer," or instrument by means of which the total reflection in solid bodies is utilised for determination of refraction. (The instrument can also be adapted for liquids.) A liquid is employed which refracts more strongly than the body examined (generally sulphide of carbon). The author gives his numerical results in a table.—A paper on the theory of double refraction, by M. Lommel, furnishes, with two previous papers, the outlines of a new theory of light (he says it might be called the "friction theory"), in which the phenomena in their connection are explained by the reciprocal action of the ether and the particles of bodies.—M. von Waha calls attention to some interesting movements obtained in badly-conducting liquids (as olive oil or petroleum), when *placed, e.g.*, on a horizontal metallic plate, connected electrically with one pole of a Holtz machine, while a point connected with the other pole is held above the liquid.—The phenomena of resonance in hollow spaces are investigated mathematically and experimentally by M. Wand, and an improved anemometer, capable of measuring the mean velocity of air-currents of constant direction between wide limits, forms the subject of a paper by M. Recknagel.

Actes de la Société Helvétique des Sciences Naturelles (C. R. 1876–77) contain an account of the sixtieth meeting of the Society, held at Bex on August 20–22, 1877, together with notes of the sectional meetings, and the following more elaborate memoirs:—On the adaptation of copepod crustaceans to parasitism, by Prof. K. Vogt.—On the fecundation and first development of the ovum, by H. Fol.—On the railway over the Simplon, by Herr Lommel.—Historical account of the mines and salt-works of Bex, by Ch. Grenier.—On the retrogradation of the shadow on the sun dial, by E. Guillemin.—Note on the study of thunderstorms accompanied by hailstorms and electric phenomena, by D. Colladon.—On the geology of the neighbourhood of Bex, by E. Renevier.—On some geological formations in the Bernese Alps, by S. Chavannes.—On the nummulites of the Western Alps, by Ph. de la Harpe.—On the origin and the repartition of the Turbellaria of the deep fauna of the Lake of Geneva, by G. du Plessis.—On the formation of feathers in the gold-hair penguin and *Megapodius*, by Th. Studer.—On the blood corpuscles of *Mermis aquatilis*, Duj., by E. Bugnion.—On a new Amphipode (*Gammarus rhipidiophorus*), by O. I. Catta.—On the doubtful species in the flora of Switzerland, by L. Leresche.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 19.—"On the Reversal of the Lines of Metallic Vapours," by G. D. Liveing, M.A., Professor of Chemistry, and J. Dewar, M.A., F.R.S., Jacksonian Professor, University of Cambridge. No. III.

In our last communication to the Royal Society we described certain absorption lines, which we had observed to be produced by the vapour of magnesium in the presence of hydrogen, and certain other lines which were observed when potassium, and others when sodium, was present, in addition to magnesium and hydrogen. These lines correspond to no known emission lines of those elements; but, inasmuch as they appeared to be regularly produced by the mixtures described, and not otherwise, we could only ascribe their origin to the mixtures as distinct from the separate elements. It became a question of interest, then, whether we could find the conditions under which the same mixtures would give luminous spectra, consisting of the lines which we had seen reversed. On observing sparks from an induction coil taken between magnesium points in an atmosphere of hydrogen, we soon found that a bright line regularly appeared, with a wave-length about 5,210, in the same position as one of the most conspicuous of the dark lines we had observed to be produced by vapour of magnesium with hydrogen in our iron tubes. This line is best seen, *i.e.*, is most steady, when no Leyden jar is used, and the rheotome (the coil we used has an ordinary self-acting one) is screwed back, so that it will but just work. It may, however, be seen when the coil is in its ordinary state, and when a small Leyden jar is interposed; but it disappears (except in flashes) when a larger Leyden jar is used, if the hydrogen be at the atmospheric pressure. This line does not usually extend across the whole interval between the electrodes, and is sometimes only seen near the negative electrode. Its presence seems to depend on the temperature, as it is not seen continuously when a large Leyden jar is employed, until the pressure of the hydrogen and its resistance is very much reduced. When well-dried nitrogen or carbonic oxide is substituted for hydrogen, this line disappears entirely; but if any hydrogen or traces of moisture be present it comes out when the pressure is much reduced. In such cases the hydrogen lines C and F are always visible as well. Sometimes several fine lines appear on the more refrangible side of this line, between it and the *b* group, which give it the appearance of being a narrow band, shaded on that side. We have used various samples of magnesium as electrodes, and they all give the same results. We have also used hydrogen, prepared and purified in different ways: hydrogen prepared by the action of zinc on dilute sulphuric acid, purified by an acid solution of bichromate or permanganate, and by potash, and dried by sulphuric acid; electrolytic hydrogen; hydrogen from dry formiate of soda and soda lime; hydrogen occluded by sodium and expelled by heat; and hydrogen occluded by palladium and expelled by heat. In the last two cases the whole apparatus was connected by fusion, and a Sprengel pump, also connected by fusion, employed to remove the air. In all cases the phenomena were the same.

In addition to the above-mentioned line, we observed that there is also produced a series of fine lines, commencing close to the most refrangible line of the *b* group, and extending with gradually diminishing intensity towards the blue. These lines are so fine and close to one another, that in a small spectroscope they appear like a broad shaded band. We have little doubt that the dark absorption line, with wave-length about 5,140, shading towards the blue, which we previously observed in our iron tubes, and described in our last communication, was a reversal of part of these lines, though the latter extend much further towards the blue than we had observed the absorption to extend. In fact, the bright lines extend somewhat more than half the distance between *b* and F, from forty-five to fifty being visible, and placed at nearly equal distances from each other. They also commence close to the *b* group, *i.e.*, with a wave-length nearly 5,164, but the first two or three lines at that end are not so bright as those which immediately succeed them. The light giving these lines does not extend to more than a short distance from the electrodes, and is generally most conspicuous at the negative electrode. There is a difficulty in consequence of the flickering character of the discharge in getting any accurate measures of them, though they are bright enough, especially at the less refrangible end, to be easily seen. The comparative faintness of the light from the iron tubes appears to us almost sufficient to account for our not having seen the reversed lines so completely as the bright ones; nevertheless, it is quite in accordance with what we in other cases observed, to suppose that some of these lines may be more easily reversed at the temperature of the iron tubes than others.

Zoological Society, June 18.—Arthur Grote, vice-president, in the chair.—The Secretary read extracts from a letter addressed to him by Mr. E. L. Layard, containing remarks on two species of New Caledonian birds.—A second communication from Mr. Layard stated that there was an example of the recently-described woolly cheetah (*Felis lanea*) in the South African Museum at Cape Town.—Mr. Edward R. Alston read a paper on the squirrels of the Neotropical region, in which he recognised twelve out of fifty-nine described species, and re-described two, *Sciurus rufo-niger*, Pucheran, and *S. pusillus*, Geoffroy, which had been recently overlooked.—Mr. Sclater exhibited and made remarks on a third collection of birds from Duke of York Island, New Britain, and New Ireland, which he had received from the Rev. George Brown, C.M.Z.S. Amongst them was an example of a new fruit-pigeon, proposed to be called *Carpophaga melanochroa*.—A communication was read from Dr. M. Watson, containing a description of the male generative organs of *Chlamydophorus truncatus* and *Dasypus sexcinctus*.—A communication was read from Prof. Garrod on certain points in the anatomy of Levaillant's darter (*Plotus levaillanti*).—A communication was read from Messrs. Garrod and Turner on the gravid uterus and placenta of *Hyomoschus aquaticus*.—A communication was read from Mr. F. Moore containing the descriptions of New Asiatic butterflies of the family Hesperiidæ.—A second communication from Mr. Moore gave a list of the lepidopterous insects collected by the late Mr. R. Swinhoe, in the Island of Hainan.—A communication was read from the Marquis of Tweeddale, F.R.S., being the tenth of his contributions to the ornithology of the Philippines. The present paper gave an account of the collection made by Mr. A. H. Everett in the Island of Bohol. The collection contained representatives of forty-seven species. Although all of these were previously known, seven of them had not been before recorded as being inhabitants of the Philippines.—Dr. O. Finsch, C.M.Z.S., read the description of a new species of starling from Lake Marka-kul, in the Chinese High Altai, which he proposed to name *Sturnus poltaratzskyi*, after Gen. Poltaratzsky, Governor of Semipalatinsk.—A communication was read from Mr. H. W. Bates containing the description of new species of coleopterous insects (*Geodephaga* and *Longicornia*) taken by the late Dr. Stoliczka during the Forsyth Expedition to Kashgar in 1873–1874.—A communication was read from Dr. G. Hartlaub, in which he gave the description of a new species of *Notauges* (*N. hildebrandti*) of Cabanis, M., discovered by Mr. Hildebrandt at Ikanga in Ukamba, Eastern Africa.—A communication was read from Lieut.-Col. R. H. Beddome, C.M.Z.S., giving the description of a new batrachian from Southern India belonging to the family *Phryniscidæ*, which he proposed to call *Melanobatrachus indicus*.—Sir V. Brooke, Bart., exhibited and made remarks on a fine head of the male *Gazella granti*, originally described from sketches made by Capt. Speke during Speke and Grant's expedition. The present specimen had been shot by Mr. Arkwright about eighty miles from Ugogo in Eastern Africa.—A communication was read from Prof. v. V. Barboza du Bocage, F.M.Z.S., containing a list of the antelopes observed in Angola.—A communication was read from Mr. Carl Bock, in which he gave the description of two new species of shells from China and Japan.—A communication was read from Mr. Edgar A. Smith, containing the description of five new shells from the Island of Formosa and the Persian Gulf, with notes upon some known species.—Messrs. Godman and Salvin read the descriptions of some apparently new species of butterflies from New Ireland and New Britain, received from the Rev. G. Brown.—Mr. O. Salvin read the twelfth of a series of reports on the collection of birds made during the voyage of H.M.S. *Challenger*. The present paper contained an account of the Procellariidæ, collected during the expedition. Eighty specimens had been obtained belonging to twenty-two species.—Mr. Sclater read some supplementary notes on the curassows now or lately living in the Society's gardens.—Mr. J. Wood-Mason read a paper on the structure and development of the trachea in the Indian painted snipe (*Rhynchæa bengalensis*).

Physical Society, June 22.—Prof. G. C. Foster, vice-president, and afterwards Prof. W. G. Adams, president, in the chair.—The following candidate was elected a Member of the Society: Mr. F. W. Grierson.—Prof. W. G. Adams exhibited a new form of polariscope suitable for projecting on to a screen the figures formed by any crystal, and for measuring the angle between the optic axes. Parallel light from the electric lamp, after traversing a Nicol of about two-inch aperture, is rendered divergent by a set of lenses. The crystal under examination is placed in a recess formed by removing a slice from the middle of a spherical lens which is capable of motion in any direction about its centre, while any movement in the vertical plane passing through the axis of the instrument can be measured by a scale and Vernier; and if, by such a motion, the point on the screen representing the position of one axis, when the two are in the vertical plane, be transferred to that indicating the position initially occupied by the other axis, we have at once a measure of the optic angle of the crystal, for the rotation of two plano-spherical lenses forming an exact sphere has no effect on the direction of the beam.—Mr. Walter Baily read a paper on the effect of starch, salicene, unannealed glass, &c., on polarised light. In his experiments light was passed through a Nicol's prism, then through a quarter undulation plate, and then through a body having an optical structure symmetrical round an axis in the direction of the ray, such as any of the above-named substances. The axes of the quarter undulation plate being taken as axes of reference, ρ being the angle between the plane of polarisation and one of these axes, σ half the difference of retardation at a given point between the part of the light resolved in a plane through the axis of the body and the part resolved perpendicular to that plane, ϕ being the angle between an axis of the $\frac{1}{4}$-undulation plate and the perpendicular on the axis of the body from the given point (which perpendicular is taken as the initial line in the equation to the ellipse defining the light at such point) and r, θ, being the co-ordinates of this ellipse, the writer finds the equation to the ellipse to be

$$1 + A \cos \theta + B \sin 2\theta = r^{-2}\left\{1 - (A^2 + B^2)\right\}$$
$$\text{where } A = - \cos 2\rho \cos 2\phi$$
$$\text{and } B = \sin 2\rho \sin 2\sigma + \cos 2\rho \cos 2\sigma \sin 2\phi.$$

From this equation diagrams have been drawn to exhibit the condition of the light at every point for different positions of the polariser. For the simple case of salicene or starch, in which the difference of retardation is the same, or nearly so, for all distances from the axis of the body, the diagram consists of a ring of ellipses of various eccentricities and inclinations, each ellipse showing the condition of the light along the radius on which it lies. For the general case in which the difference of retardation is a function of the distance from the axis of the body the diagram consists of two series of curves, one series being "isomorphal" curves or curves along which the eccentricity of the ellipse is constant, and the other series being "isoclinal," or curves along which the inclination of the axis major of the ellipse to the perpendicular in the axis of the body is constant. The general equation to the isomorphal lines is $A^2 + B^2 = \text{constant}$; and to the isoclinal lines is $\frac{A}{B} = \text{constant}$. These two series of curves completely define the form and position of the ellipse of polarisation at every point and render it easy to determine what appearances will be presented on passing the light through an analysing prism in any given position. The results obtained were illustrated by some experiment.—Prof. W. C. Unwin made a communication on the flow from orifices at different temperatures. A paper recently appeared in *The Franklin Journal of Science*, by Mr. Isherwood, giving results of experiments on this subject, and according to him the volume discharged from a given orifice is increased by about 12 per cent. on raising the temperature from 60° to 212°. It is difficult to accept this result, because the friction is known to diminish the discharge by an amount much less than 12 per cent., and no other cause than a decrease of friction can be assigned to account for Mr. Isherwood's results. In the author's experiments the increase of discharge at 190° above that at 60° was only 4 per cent., with conoidal orifices in the form of the vena contracta; with thin edged orifices the variation of discharge was still less. He is disposed to think that the great increase of discharge in Mr. Isherwood's experiments was due to diminution of friction in a rather small pipe leading to the orifices, and would not occur with any other arrangement.—Mr. Graham then read a paper on complementary colours. He stated that the three primaries are green, red, and blue, and not yellow, red, and blue; that yellow is a binary compound of green and red; and that yellow and blue when mixed form white. He remarked that after looking at a green disc the eye evokes another colour, but this is not seen unless certain conditions are fulfilled; thus the undulations must be arrested by a gray surface: this was proved by an experiment in which a green disc carrying a concentric ring half white and half black was caused to rotate, when a medium gray was produced and this at once arrested and made visible pink the complement of the green. Several other complementaries were shown by the same means. Mr. Graham next showed how the grays can be formed by cancelling either reflected or transmitted rays of white light. The first of these cases is illustrated by white paper painted over with a wash of Indian ink, and the second by the well-known Berlin tiles, in which light and shade are obtained by giving varying thickness to the ware. He showed that this last effect may be imitated by piling strips of paper to varying heights, and he has succeeded in photographing geometrical figures so formed. Lastly the author explained a method of arresting and showing the complementaries more satisfactorily than he considers has hitherto been done. Six thicknesses of white paper are gummed together and cut into a ring, a ring of the same size and shape being also cut from a disc of coloured paper, and the white ring is let in to fill its place. On observing such a disc by white transmitted light the complement is seen through the ring.—Prof. S. P. Thompson exhibited a series of magnetic figures illustrating electro-dynamic relations. The lines of magnetic force around a wire carrying a magnetic current can be shown by passing a wire through a glass plate, strewing iron filings around, and tapping the plate gently. The filings may be fixed in their places, if the plate has previously been gummed and dried, by softening the gum with steam. Such a prepared plate may be used to project the figures of the magnetic curves in the lantern. Two parallel like currents attract, their curves forming a figure illustrative of the action; or they repel if travelling in opposite directions, the repulsion also being evident from the form of the curves. It was shown by a series of such lantern-slides that a very large number of electro-dynamic relations can be illustrated by curves produced in this manner. Figures were thrown upon the screen illustrating the law of oblique currents, the attraction of a magnet into or its repulsion out of a circuit, the deflection of a magnetic needle by a current, and the mutual tendency of a current and magnetic pole to rotate. A very curious figure was produced by a current running through a magnet longitudinally. A transverse section of the lines of force at a pole gave neither the radial lines of the magnet nor the circular lines of the current, but a series of spirals. It was argued that Faraday's conception of the lines of force tending to shorten themselves supplied the means of interpreting the physical effects indicated by the lines of force in the various figures.—The Secretary read a paper by Mr. C. H. Hinton, on the co-ordination of space. If a cubical space be divided into twenty-seven numbered cubes, and each of these be again subdivided in the same way, and so on, the position of any point within the initial cube can be expressed by a reference to the numbers of the several cubes in which it is placed, and the more this series of numbers is extended, the more accurately is its position defined; and, further, if we consider an expression of the form . . . . . *rqponm . lkjih* . . . . . where each letter stands for any number from 1 to 27, and if *m*, before the dot, indicates the unit space, it will be evident that by such an expression the position of any point in space can be indicated with any degree of accuracy; each letter representing a space twenty-seven times as great as that which immediately succeeds it; or, in place of 27, any other number offering special facilities for any given purpose may be employed. The author then gives some account of the manner in which the system can be utilised for classifying chemical phenomena and in arranging plants, &c.—An adaptation of the telephone and microphone for communicating vibrations to the phoneidoscope, by Mr. Tisley, was then shown. The metal disc carrying the soap film is fixed just above the telephone plate, and, this being in circuit with a microphone and battery, any vibration imparted to the microphone at once sets the soap film in action, the characteristic figures being at once obtained.—Mr. A. Haddon exhibited a modified form of microphone which he has arranged with a view to make the same instrument available for receiving sounds of any given intensity. Its main peculiarity consists in having a thin strip of elastic attached to the middle of the pointed graphite. By varying the tension of this elastic, the sensitiveness of the instrument can be accurately regulated.—The meeting of the Society was then adjourned to November.

Chemical Society, June 20.—Dr. Gladstone, president, in the chair.—The following papers were read:—Contributions to the history of the naphthalene series, No. 2, β naphthaquinone, by Dr. Stenhouse and Mr. Groves. By the action of nitric acid sp. gr. 1·2 on this substance, mononitroy-β-naphthaquinone was obtained in red crystals. By the action of dilute sulphuric acid a dark-coloured compound was obtained, which, on reduction, yielded white acicular crystals, and on oxidation orange-coloured prisms. The new quinone has the formula $C_{20}H_{10}O_4$; the authors purpose to call it dinaphthyldiquinone. It is very stable.—On pyrotritartaric and carbopyrotritaric acids, by Mr. G. Harrow. By saponifying diacetosuccinic ether with dilute sulphuric acid, the author succeeded in preparing these two acids; the author has obtained sodium and silver salts, and discusses their constitution.—Laboratory notes, by Dr. Armstrong.—On the action of alkaline hyprobromite on ammonium salts, urea, and oxamide, Prof. W. Foster. The author gives a *résumé* of the present state of our knowledge as to the action of hypobromite on ammonium salts and urea, with some results of his own; he then investigates the action of hypobromite on oxamide—74·87 per cent. of its total nitrogen is given off—and endeavours to ascertain the precise condition of the suppressed nitrogen.—Action of the halogens at high temperatures on metallic oxides, by Messrs. C. F. Cross and S. Suguira. With lead oxides oxyiodides are formed, and with the oxides and carbonates of the alkaline earth metals in the presence of oxygen periodates are produced.—On manganese tetrachloride, by Mr. W. W. Fisher. The author has studied the action of strong hydrochloric acid on the black and red oxides of manganese; brown liquids are formed containing a highly chlorinated manganese compound, probably the tetrachloride, which is readily resolved into manganous chloride and free chlorine.—On salts of nitrous oxide, by Mr. A. E. Menke. The sodium salt was obtained by fusing nitrate of soda with iron filings; its properties and reactions were studied. Diver's silver salt was prepared, and its composition confirmed.—Notes on madder colouring matters, by Messrs. E. Schunck and H. Roemer. The authors have prepared some quantity of munjistin and examined its properties, also its reactions with acetic anhydride, bromine, potash, and nitric acid. In all respects munjistin resembles purpuroxanthic acid.—On the occlusion of hydrogen by copper, by Mr. G. S. Johnson. The discrepancy between the results obtained by previous experimenters is explained (1) by the fact that hydrogenised copper retains nearly all its hydrogen in vacuo at a red heat. (2) That the same metal occludes varying quantities of hydrogen. The amount occluded is in most cases sufficient to introduce a serious error in organic analysis. At a red heat copper oxide occludes carbonic acid.—On the *rôle* played by carbon in reducing the sulphates of the alkalies, by Mr. J. Maclear. At a high temperature with excess of carbon, sodium sulphide and carbonic oxide are formed. At a dull red heat sodium carbonate and carbonic acid are produced in addition.—On the action of ethylchlorcarbonate on some oxygenated haloid compounds of the fatty series, by Mr. O'Neil F. Kelly. The compounds employed were allyl alcoholdibromide glycerindichlorhydrin and epichlorhydrin.—The Society adjourned over the recess.

PARIS

Academy of Sciences, July 8.—M. Fizeau in the chair.—The following among other papers were read:—Action of heat on aldol, by M. Wurtz. He obtains, beside crotonic aldehyde, a little ordinary aldehyde, and, in certain circumstances, a new polymer of the aldehyde, which he describes.—On malignant pustule in fowls, by MM. Pasteur, Joubert, and Chamberland. Fowls when cooled contract it easily, and they may then be completely cured by reheating.—Influence of atmospheric electricity on the nutrition of plants, by M. Grandeau. His mode of experiment was to place two plants of the same species (tobacco, maize, wheat) under the same conditions as to soil, aëration, isolation, &c., but the one withdrawn from the action of atmospheric electricity by means of a Faraday's cage. The plants thus withdrawn elaborated, in equal times, 50 to 60 per cent. less of living matters than the others. Plants of small elevation above the ground are also affected by atmospheric electricity. The centesimal amount of proteic matter formed appears not to depend sensibly on this action; it is proportional to the yield. The proportion of ash is higher in plants removed from the electricity; and the proportion of water is less.—On the curves of solubility of salicylic and benzoic acids, by M. Bourgoin. Taking the temperatures for abscissæ, and the quantities dissolved for ordinates, the solubility of salicylic acid in water is represented by a parabolic curve, whose convexity is towards the axis of temperatures.—On the diffusion of fire-damp in mines, by M. Coquillion. The experiments show that it diffuses very slowly from above, but rapidly upwards.—On a disease of malignant pustule form, caused by a new aerobic vibrion, by M. Toussaint. He found this vibrion in a rabbit inoculated from the blood of a horse which had died rapidly with symptoms of malignant pustule.—On *Avenardia Priei*, a giant Nemertian of the west coast of France, by M. Giard. In the state of rest it measures 1 m. to 1·20 m. in length (in extension twice or thrice as long), the width being 2 to 3 ctm. It is found in hundreds in an old canal from salt marshes at Pouliguen, now transformed into a reservoir, where the sea-water is renewed each tide.—Observations and experiments on the migrations of *Filaria rytipleurites*, a parasite of cockroaches and rats, by M. Galet. The eggs produced by the parasite in the alimentary canal of the rat are thrown out with fecal matters, and swallowed by the cockroach. The embryos, when hatched, penetrate the walls of the alimentary canal of the latter, and are encysted in fatty matter, where they await the cockroach being devoured by the rat. In the rat they now complete their cycle.—Experimental researches on the variations of volume of the cranium, and on the applications of the graphic method to solution of various anthropological problems, by M. Le Bon. A superior race contains more of voluminous crania than an inferior. Among 100 modern Parisian heads there are about eleven with a cranium of 1,700 to 1,900 cubic centimetres; in the same number of negro heads not one will be found of such size. The weight of 100 masculine Parisian brains of the present varies between 1,000 and 1,700 grammes, the volume between 1,300 and 1,900 cubic centimetres. The difference between the largest and smallest brains among modern Parisians is three times that observed in the negro, and it is greater than in the Parisians' ancestors of 600 years ago. Stature has only a very slight influence on the volume of the brain. With equal stature woman has a much less heavy brain than man. Rising in the scale of civilisation, the difference in weight of brain (and so volume of cranium) between man and woman is found constantly increasing; thus the average difference of crania of the present Parisian men and women is nearly double that between the crania of the ancient Egyptian men and women. Persons having the same circumference of crania may have differences in volume of over 200 cubic centimetres; but operating on series, 1 centimetre increase of circumference corresponds to an increase of about 100 cubic centimetres in volume. Certain relations are found to exist between circumference of cranium and head, and volume and weight of brain. The cranium is always unequally developed on the two sides, without apparent relation to race or intelligence.—Automatic imitation of mountain chains on a globe according to the theory of upheaval, by M. Chancourtois. This is by the method of a caoutchouc balloon covered with wax, then allowed to contract.—Determination of the orbit of the planet 103, Hera, by M. Leveau.—On the development of the cephalo-thoracic portion of the embryo of vertebrates, by M. Cadiat.

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ERRATA.—Vol. xviii. p. 294, 2nd column, line 22 from top, read for "insolvents" "resolvents;" line 31, for "2^m" read "2^{2^m}." In last week's "Paris," parenthesis near beginning, for "distillation (which discoloured the fatty acids)" read "distillation (which had been resorted to to purify the fatty acids)."