THURSDAY, DECEMBER 7, 1882

RECENT RESEARCHES IN THE METAMORPHISM OF ROCKS

IN the heart of many mountain-ranges, and likewise spreading over wide hilly areas of the northern part of our hemisphere, lies the strikingly distinct series of rocks to which the name of The Crystalline Schists has been given. The passing traveller who knows nothing of geology cannot fail to be struck with their strange, crumpled and gnarled beds, through which streaks of white quartz wind and twist in a network of interlacing veins. Sheets of the naked rock often present a silvery sheen as sunlight falls across them, and this glistening aspect may be traced down in the minutest flakes of silvery mica that lie packed in parallel leaves throughout the mass.

No group of rocks has given rise to more discussion than the Schists. An account of the oscillations of opinion regarding their origin would form a curious and interesting chapter in the history of geological speculation. They have been looked upon as parts of the aboriginal crust of the planet—traces of the first solid film that formed upon its fiery surface. By one school of writers they are believed to be original chemical precipitates from the waters of the primeval ocean. By another they are treated as masses of sedimentary or other material which have been crystallised and altered into their present condition by a process to which the name Metamorphism has been given. Between these two doctrines, with their various modifications, the pendulum of geological opinion has vibrated for somewhere about a century, and vibrates still. In England and America indeed, owing mainly to the commanding influence of Lyell, the metamorphic theory has so entirely prevailed that most English-speaking geologists have come to accept it as a demonstrated truth, and to look back upon the Wernerian doctrine of chemical precipitates as a singular and happily obsolete vagary of the geological imagination. They have written text-books in which that doctrine is not even so much as honoured with an allusion to its ever having existed, though here and there a solitary protest has now and then been raised among us in favour of the other view, like that uttered by De la Beche as far back as 1834, and those of Dr. Sterry Hunt in later years. In Germany, on the other hand, the old Wernerian dogma has always had its staunch adherents, but in gradually diminishing numbers, the theory of the metamorphic origin of the crystalline schists having been warmly espoused there also by an ever-increasing body of observers.

For some years past what has been called the orthodox metamorphic doctrine has been called in question by various writers who have cast doubts on the observations which were believed to prove the fact that wide areas of rock, originally of fragmentary or detrital composition, had undergone a conversion into crystalline schists. The time-honoured doctrine of chemical precipitates, tricked out in the finery of modern chemical analysis, has been resuscitated and defended with the warmth of the most devoted partisanship. Within the present year, however, several memoirs have appeared which powerfully support the doctrine of metamorphism, and as effectively oppose the rival hypothesis. The aid of the microscope, as well as of chemical analysis, has been invoked: new facts and arguments have been adduced, and the nature of the changes involved in metamorphism have been more clearly made known. Whether or not there may be any crystalline schists in the earliest or Archæan rocks of the earth's crust, which had their origin in the chemical precipitates of a primeval ocean, may remain a question for future discussion. But recent researches with all the manifold appliances of modern petrography demonstrate beyond the possibility of all further cavil, that ancient sedimentary strata have undergone such an alteration as to have assumed a more or less completely crystalline condition, that numerous silicates have been developed in them, often also with foliation, that these changes are seen round bosses of granite and other eruptive masses (contact metamorphism), but also far more strikingly over wide regions where eruptive rocks cannot have induced them (regional metamorphism), and that in the latter case the alteration is always connected with evidence of enormous mechanical pressure of the strata. To one or two of the more important recent papers, brief reference may here be made.

The Silurian schists, with their fossils and remarkably compressed conglomerates in the Bergen district, have been made the subject of a remarkable memoir by Mr. Hans Reusch.[1] In this essay the author traces the passage from ordinary shales into fine phyllite-schists and mica-schists, in which crystalline aggregates of mica have been porphyritically developed. In some of the altered fossiliferous beds microscopic crystals of rutile and tourmaline have appeared. The fossiliferous limestones have been converted into marble, wherein, however, the organic forms can still be detected. The fossils which occur in certain mica-schists, and have been specifically determined, leave no doubt that the whole series of rocks belongs to the lower part of the upper Silurian system. Yet they include intercalated bands of gneiss, hornblende-schist, talc-schist, and other foliated rocks. The author connects the crystalline condition of these masses with the effects of the enormous mechanical pressure which they have undergone, as shown, for example, by the extreme flattening of the pebbles in some of the associated conglomerates.

The Silurian rocks of the Christiania district have long been famous for the illustrations they afford of the phenomena of contact-metamorphism. They have been subjected to a detailed investigation by Mr. W. C. Brögger, lately of the Geological Survey of Norway, and now Professor of Geology in the University of Stockholm. He has lately published what we hope is only an earnest of the valuable work we have yet to expect from him.[2] His monograph embraces the stratigraphy, palæontology, structure, eruptive rocks, and contact-metamorphism of the district. This last-named feature is more minutely traced out than has yet been attempted for that region, though only a beginning in the study has been made, Mr. Brögger deeming it

[1] "Silurfossiler og Pressede Konglomerater i Bergensskifrene." (Christiania: *Universitets programm*, 1882). This memoir was recently noticed in these columns (NATURE, vol. xxvi. p. 567).

[2] "Die Silurischen Etagen 2 and 3 im Kristianiagebiet und auf Eker." (Christiania: *Universitätsprogramm*, 1882).

better to publish his first results now than to wait for leisure to extend and complete them. He points out, as had already been done by Kjerulf and others, that while there is a general alteration as the rocks approach the eruptive masses of granite and syenite, the special type of alteration depends in each case upon the original capacity of the rock for metamorphism. He has traced the Silurian zones from their ordinary unaltered condition until they assume their most metamorphosed character against the granite, and he compares the chemical composition and microscopic structure of the unaltered and altered strata. He points out that certain bands of rock appear to be endowed with a remarkable capacity for withstanding the effects of metamorphism. Thus the *Dictyograptus*-shales may be observed close to the granite and in the midst of the most intensely-metamorphosed beds, yet comparatively little changed. They become paler in colour and perhaps somewhat harder and more compact, but their graptolites are as well preserved, down even to the minutest details, as they are at a distance from the contact-zone. The dark alum-shales are converted into hard compact bluish "Knotenschiefer" and chiastolite-slates, still retaining their fossils. The chiastolite crystals may even be seen traversing the graptolite-stems, which are otherwise as well preserved in these as in the ordinary unaltered shales. The remarkable development of silicates in the Christiania limestones, where these rocks have been converted into marble near the granite, has long been a classical instance of contact-metamorphism. Mr. Brögger gives some interesting observations of his own among these rocks. He notes the occurrence of recognisable fossils even in those parts of the marble where the silicates have been abundantly developed, and he points to the suggestive fact that where a fourth or fifth part of the marble is made up of red garnet, the latter mineral, in well crystallised rhombic dodecahedra, may be found inclosing the valve of an *Orthis calligramma*.

The alternation of comparatively little-changed graptolite shales with fine crystalline schists and forms of hornfels, which Prof. Brögger reports from so many localities, is a fact of great significance in relation to the problem of the origin of the crystalline schists. That the crystalline character has been superinduced upon what were once ordinary marine mechanical sediments admits now of no doubt. The extent of the change appears on the whole to depend on the one hand upon the liability of the rock to metamorphism, and on the other upon relative proximity to the eruptive rock. The preservation of organic remains in the altered bands is exceptional, and depends, according to our author, 1st, upon the greater permanence of the substance of the organisms, the chitin of the graptolites, for example, being apparently undistinguishable in the altered beds from the same substance in the ordinary shales; 2nd, upon the replacement of the hard parts of the organisms by mineral matter, either before or during the process of metamorphism; and 3rd, upon the filling up of the original cavities of the fossils by some mineral, as graptolites by pyrites, and the interior of brachiopods by wollastonite, or upon the inclosing of the organisms in a crystalline matrix as in the case of the impressions of shells in garnet, just referred to. But, as a rule, fossils disappear even from the most richly fossiliferous bands as these are traced across the altered zone. Mr. Brögger modestly regards his observations as still too limited to warrant him in theorising on the phenomena of contact metamorphism. But the admirable methods he has followed, connecting in one broad microscopical and chemical research both the altered and unaltered condition of the same rock, mark a new starting-point for the further study of that great geological problem—metamorphism.

There is one further incidental but pregnant statement in this Memoir to which reference must here be made. So far back as the years 1875 and 1877 Prof. Brögger, in the course of his field-work in the Geological Survey of Norway, established the existence of graptolite-bearing beds among the crystalline schists of the Hardanger region. He now publishes some details of the section there visible, from which we learn that the graptolite band (*Dictyograptus*-schiefer) occurs among some black little altered alum-slates lying at the very base of the enormous series of crystalline schists forming the Norwegian highlands! The alum slates pass under some bluish quartzose sandstone, overlaid by a white impure marble (possibly the Orthoceratite limestone), which in turn is covered by greenish micaceous clay-slates (phyllites). Above these basement strata come more and more crystalline schists, comprising diorite-schists, hornblende-schists, garnetiferous mica-schists, foliated rocks of many varieties, and true gneisses—the two last mentioned rocks sometimes several thousand feet thick. We learn further that in 1877 the same observer, in harmony with Naumann's observations, established the fact that the enormous series of crystalline schists of the Norwegian mountains is younger than the second stage of the Silurian (or Cambrian) rocks of the Christiania district. He refers to his friend Mr. Reusch's discovery of Upper Silurian fossils from the crystalline schists of Bergen, as a confirmation of his former supposition that the whole of the vast succession of crystalline schists in the Norwegian mountains is a metamorphic series.

When we remember that on the opposite side of the peninsula similar primordial fossiliferous strata emerge from underneath the vast overlying schists and crystalline rocks of the Swedish uplands,[1] it is evident that an enormous area of regional metamorphism extends across Scandinavia. The close parallel between the structure of this region and that of the Scottish Highlands is one of the most striking facts in the geology of North-Western Europe. In both areas recognisable Silurian fossils occur at the very base of the vast metamorphic series, and the rocks become progressively more and more crystalline as they are traced from bottom to top.

A third remarkable paper by Père Renard, of the Royal Museum, Brussels, must be cordially welcomed as one of the most important contributions of modern petrography to the study of metamorphism.[2] It deals with a portion of the singular belt of crystalline schists which runs through the French and Belgian Ardennes. Dumont as, far back as the year 1848, published an account of these rocks, the significance of which that accurate observer fully perceived. He showed that they occur in his

[1] See A. E. Törnebohm, Bihang till Svensk. Akad. Handl., 1873.

[2] "Les Roches Grenatifères et Amphiboliques de la region de Bastogne," par A. Renard. *Bulletin du Musée Royal d'Histoire Naturel de Belgique*, tome i. 1882.

Coblentzian division of the Lower Devonian rocks of that region, that they pass insensibly into ordinary sedimentary rocks, but towards their axis have been metamorphosed into more or less crystalline compounds in which various silicates (garnet, hornblende, mica, &c.) have been developed. He observed fossil plants and animals in some parts of these altered rocks. In one of his specimens of a rock full of garnet, Sandberger determined the presence of the characteristic Devonian shells, *Spirifer macropteris* and *Chonetes sarcinulatus*. Nothing can be more emphatic than the testimony borne by Dumont to the age of these rocks and the fact of their metamorphism. His essay upon them is hardly known to geologists generally, but it deserves to rank as one of the most precise and detailed contributions ever made by a field-geologist to the study of the phenomena of metamorphism.[1] His observations have been singularly confirmed by those of M. Renard. The metamorphic phenomena of the Ardennes are repeated on a greater scale in the extension of the Devonian rocks eastward into the basin of the Rhine, where they have been admirably described by Lossen,[2] whose pregnant memoirs on this and other geological problems deserve the closest study of the student.

Bringing all the assistance which chemical analysis and microscopical investigation now supply to the study of the origin of rocks, M. Renard, in the present communication, which fitly opens the first number of the newly-organised *Bulletin du Musée Royal de Belgique*, presents us with a detailed description of the garnetiferous and hornblendic rocks of Bastogne in the south-eastern portion of the Belgian Ardennes. It is impossible to give any adequate *résumé* of this memoir within the space here available. But attention may be directed to one or two of its more interesting features.

At the outset it should be noted that the band of metamorphosed strata here referred to occurs along a line of plication running in a general east-north-east and west-south-west direction; that it is not associated with any visible eruptive rocks, that it dies away into ordinary unaltered greywacke and shale on the outside, and becomes more and more crystalline towards the axis, until it presents the most intense metamorphism anywhere to be found in Belgium.

In subjecting to microscopic examination thin slices of some of these altered rocks, M. Renard noticed that the quartz-granules, presumably of clastic origin, have lost the liquid inclusions so generally found in the quartz-granules of old sedimentary strata. This fact (already observed by Sorby in the case of sandstone invaded by dolerite) seems to indicate that the sand-grains have not escaped the influence of the changes which have so profoundly affected the other constituents of the former sediment. The original carbonaceous matter of the rocks, now altered into graphite, is spread as a fine dust among the other constituents, generally coating the minerals, sometimes inclosed within them, frequently accumulated at certain points into black, brilliant irregular bands, occasionally as hexagonal flakes. This aggregation of the carbon recalls the way in which the graphite occurs in Archæan limestones. The garnet crystals are marked by a singularly interesting arrangement of lines of crystalline inclusions disposed along the crystallographic axes of the inclosing crystals. In certain rocks the garnets (about three millimetres in diameter) are traversed by a series of paralleled joints or fissures which run in a given direction through all the crystals. These cannot, of course, be cleavage lines. They are attributed by M. Renard to fracture produced by mechanical pressure, and he remarks that the minute flakes interspersed through the ground-mass of the rock are oriented in the same direction.

Taking a general view of the microscopic structure of these rocks the author divides the constituent minerals into two groups: those which represent more or less distinctly the original sediment of which the rocks were formed, and those which have been subsequently developed by metamorphism. The quartz grains, for example, have preserved the closest resemblance to those of the ordinary normal arenaceous rocks of the lower Devonian series. The presence of graphite and anthracite likewise connects these crystalline masses with the sandy strata containing diffused carbonised vegetable matter. But on the other hand the crystalline structure and the presence of such minerals as garnet, hornblende, mica, titanite, and others connects these undoubtedly Devonian rocks with the crystalline schists of the Archæan series, as possibly both referable to the like series of physical and chemical changes.

M. Renard unhesitatingly discards the doctrine of direct chemical precipitation. He admits that the evidence of the physical structure of the country, as Dumont so well enforced, demonstrates that these crystalline rocks lie in the Devonian system and pass laterally into ordinary sedimentary accumulations. He further insists that the study of the minute structure of the rocks under the microscope confirms, in the most satisfactory manner, the view of that geologist that the actual condition of the masses has been produced by metamorphic action, in what way soever this action may have been induced. He connects the metamorphism with the proofs of great plication traceable through the altered Devonian rocks of the Ardennes. The mechanical action involved in the process would, he believes, predispose the sedimentary materials to a more or less complete recrystallisation. As it crushed them under the enormous pressure and partly was itself transformed into heat, it would set into active motion the chemical affinities of the various mineral substances. In this way sand might finally pass into quartzite, argillaceous mud into phyllade or phyllite-schist, sandy clay into more or less schistose micaceous quartzites; the calcareous matter would enter into combination to form the various lime-silicates so characteristic of these garnetiferous and hornblendic rocks; while the carbonaceous ingredient, losing some of its constituent elements, would separate out as graphite.

M. Renard's testimony to the theory of metamorphism is all the more valuable, as it has been extorted from him by the irresistible logic of facts against his own previous convictions. He has now furnished to this theory fresh evidence in its support, showing how well the observations by which it is established in the field are sustained by minute petrographical analysis. Every one interested in geological research will hope that the paper he has

[1] "Memoire sur les terrains Ardennais et Rhénan." *Mem. Acad. Roy. de Belgique*. 1848.

[2] "Geognostische Beschreibung des Taunus," &c. *Zeitschrift der Deutsch. Geo. Gesell.*, 1867, p. 509.

now published is only the first of a series on the same subject with which he will enrich the literature of the science.

ARCH. GEIKIE

HUMAN MORPHOLOGY

Human Morphology; a Treatise on Practical and Applied Anatomy. By Henry Albert Reeves. Vol. I. The Limbs and Perinæum. (London: Smith, Elder, and Co., 1882.)

THE author of this work is evidently very ambitious. In his preface he tells us that his primary wish was to produce a treatise in which he would deal thoroughly with the anatomy of man, and then compare his structure with that of other vertebrates, giving directions as to the dissection of the type-forms chosen in illustration. Further, being dissatisfied with anatomical nomenclature and classification generally, more especially with the terms at present in use in myology, he attempted a revision in this department.

As he proceeded with his task, however, he found that the labour, time, and knowledge necessary for carrying out so extensive a piece of work was too great, and that he had better relinquish his original idea and leave it for execution to more competent labourers.

But even after departing so far, and wisely as we think, from his first conception of what a student's text-book should be, he has found it necessary still further to withdraw from his original plan, and to excise much that he had written on anomalies of arrangement, various paragraphs on dissections which are out of the student's usual course to perform, and to reduce in quantity the sections on the practical applications of anatomy.

Had the author carried out his original idea of what a handbook for students and practitioners should be, he would have produced an encyclopædia of anatomy, and not a text-book for daily use.

But after all this renunciation of so much of the author's primary conception of what is required in a practical work on anatomy, sufficient is left to form a most voluminous treatise.

The volume before us extends to 719 large octavo pages. It comprises only the anatomy of the limbs and perinæum, and we are promised two additional volumes, each of between six and seven hundred pages, in order to complete the work.

It seems to us that the author even yet has not attained a proper idea of what the contents of a book should be, which, to use his own words, "is to be chiefly used *while the student is dissecting*." He has not sufficiently discriminated between the material that should find a place in a text-book of systematic anatomy and that which properly belongs to a practical treatise. We are quite in unison with him in the propriety of omitting all illustrations and detailed description of minute or microscopic anatomy. But we should have gone still further and cut out the historical sketch, the bibliography, the chapter on anatomical technics, which together would have subtracted between 60 and 70 pages from the volume. Also we should have condensed the descriptions and reduced in amount the sections on variations in the arrangements of the bones, muscles, and other soft parts.

A sketch of the rise and progress of anatomy, and a copious bibliography are not required by the student at the dissecting table. On the other hand they are both interesting and useful in a systematic treatise. The variations in arrangement, more especially in the muscular and vascular systems, which have been observed and recorded, are so multitudinous, that they would require a special treatise for their description. What the student has to deal with in his ordinary work, are the commoner departures from the usually described arrangements, such as a third head to the biceps muscle, the high division of the brachial artery, the variations in the place of origin of the obturator, the profunda, the circumflex arteries, and so on. These and such like ought to find a place in all works on practical anatomy, but the more unusual forms are best reserved for such special treatises as Macalister's Catalogue of Muscular Anomalies, or Quain's description of the Arterial System, to which the student, who is desirous of obtaining a more intimate acquaintance with variations in structure, ought to be referred.

A knowledge of anatomical technics also is undoubtedly of primary importance to professed anatomists. But is one student in five hundred ever called upon to inject a body, either with a preservative fluid, or with a coloured arterial or venous injection? This work is done for him either by the demonstrator, or by the practical assistant in charge of the rooms. To introduce therefore into a work intended for medical students generally an account of methods, which they are never required to carry out, seems to us to be uncalled for.

The author directs especial attention to the number and quality of the illustrations. As regards their quality, with a few exceptions they are artistically rendered. But we think they are far too numerous, and by their number, and the size of many of the cuts, they have largely contributed to the unwieldy bulk of this treatise. Too many illustrations in a book to be used at the dissecting table are apt to draw the student's attention away from his part, and to make him rely upon the pictorial representation rather than on his own efforts to display the organ or region in the subject itself.

In our judgment a handbook of practical anatomy ought to be of such a size, that the student can without inconvenience carry it to and from his work. The instructions for the order of the dissections should be clear and concise. The descriptions of the parts should not be too elaborate. The illustrations should be well selected, with a view to guide the student in the method of his work, and to show him what he has to look for, and where it has to be seen. This treatise fails to comply in many respects with these conditions, and much as we may commend the author for his industry and good intentions, we are afraid that he has produced a work which will have only a restricted field of usefulness.

OUR BOOK SHELF

Common British Insects. Selected from the Typical Beetles, Moths, and Butterflies of Great Britain. By the Rev. J. G. Wood, M.A., &c. Pp. i.-284. 8vo. (London: Longmans, Green, and Co., 1882.)

AFTER glancing through this book the question uppermost in our mind is: Why does it exist? The highly-ornamented cover, and the repeated title thereon, lead one

to expect a popular treatise on all orders of insects, an idea at once dissipated by the title-page. There are other books covering the same ground that would answer the young student's purpose as well as this. Judging it in comparison with the multitudinous other compilations from the same pen, we have no very particular fault to find. It is sketchy, but in some respects it compares favourably, especially in some of the explanations concerning the *Coleoptera*. Some of the illustrations are good, others wretchedly bad, and unrecognisable without the explanations. When comparing the "nervures" in the wings of a butterfly with the "rays" in the fins of a fish (p. 178), the writer should have explained the minute structure of both.

The real point at issue in connection with books of this nature is their effect. They are eminently rudimentary, and not elevating. Let us take instances from the book now under review. At p. 14, after an explanation of the terminology of the external skeleton of a beetle, we read:—"At first some of these terms may appear to be harsh, repulsive, and difficult to master. In reality they are not so, and a knowledge of them is absolutely necessary to any one who wishes to understand the description of an insect." This is a very sensible remark. Yet throughout the book the utmost favour is bestowed upon absurd meaningless "English" names. The culminating point of absurdity is reached at p. 276. Amongst the small moths the author "figures" one (under a misspelt generic name), and because it (out of several hundred other fortunate little moths) has received no "popular" name, he terms it the "*Brown Dolly*"!

Anthropo-Geographie oder Grundzüge der Anwendung der Erdkunde auf die Geschichte. Von Dr. Friedrich Ratzel. (Stuttgart: Englehorn, 1882.)

WE have had occasion to speak of the wide extension which geographical science has taken in Germany, and of the broad and intricate field which it covers. The work before us is a good example of this. It is the first of a series of geographical handbooks, which is to include "General Geology," by Prof. von Fritsch; "Oceanography," by Dr. von Boguslawski; "Geographical Distribution of Animals," by Prof. L. von Graff; "Climatology," by Dr. Hann; "Glaciers," by Prof. Heim; "Volcanoes and Earthquakes," by Prof. von Fritsch; and "Botanical Geography," by Dr. Oskar Drude. Dr. Ratzel's volume must not be mistaken for a treatise on Anthropology. That subject it only incidentally includes, its main purpose being to point out in detail the light which geography sheds upon history and the development of social and political economy. The author discusses the various conceptions of geography, its place among the sciences, the human element in geography, and the relations between geography and history. After a brief introduction on these points, the author proceeds to consider, in the second part, natural conditions, and their influence on mankind. Under the head of position and aspect of the dwelling-places of man, pointing out the parts which continents, islands, and peninsulas have played in the distribution of the human species and in history, he devotes a chapter to states and the various conditions which determine their boundaries, and in another discusses the distribution of centres of population. In a chapter on conditions of space he discusses the subject of great and small states, and the connection between the extent and power of states, and has some specially interesting remarks on what he calls the continental type of history. In a section on surface-forms, the author treats of such subjects as the inequalities of the earth's surface and of the contrast, ethnologically and historically, between mountainous and flat countries—of plains, steppes, and deserts. To the important subject of coast-lines, and the dependence of a country's development on their form, a chapter is devoted, and two to the historical importance of water, in its various forms of sea, lakes, rivers, and marshes. Considerable space is, of course, given to climate and to the animal and plant world. One of the most interesting chapters is that on "Natur und Geist," in which Dr. Ratzel attempts to show the great influence of a people's surroundings on their mental and moral development. In two concluding chapters the author gathers up the lines of discussion, referring especially to the subject of human migration, its influence on history, and its effect on the mixture of races; and finally points out the practical bearings of his subject. Thus it will be seen that, whether the subject comes legitimately under the conception of geography or not, Dr. Ratzel has written a work of great interest and of much utility to the historian who wishes to treat history in a scientific spirit. It is both instructive and attractive reading.

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.*]

Mimicry in Moths

I OBSERVED here, a few days ago, a case of mimicry which interested me much, and may deserve mention. The weather has been such as is usual on this part of the Riviera at this season. There has been a very hot sun, with sometimes a very cold "mistral" wind. Insect life is abundant, and not a few of our summer *Sylviadæ* seem to secure a very good living. Flies are a plague. Mosquitos are not wanting. Bees are busy, and large dragonflies hunt continually. But there is one order of insects "conspicuous by its absence," and that is the *Lepidoptera*. Neither the diurnal nor the nocturnal species have been visible.

I was much surprised, therefore, one day last week to see a large insect of this order come from above the olive trees overhead, with the wild dashing flight of the larger moths. Attracted apparently by the sheltered and sunny recess in which I was sitting and by the scarlet geraniums and bignonias which were in full flower in it, the moth darted downwards, and after a little hovering, settled suddenly on the bare ground underneath a geranium plant. I then saw that it was a very handsome species, with an elaborate pattern of light and dark chocolate browns. But the margins of the wings, which were deeply waved or dentated, had a lustrous yellow colour, like a brilliant gleam of light. In this position the moth was a conspicuous object. After resting for a few seconds apparently enjoying the sun, it seemed to notice some movement which gave it alarm. It then turned slightly round, gave a violent jerk to its wings, and instantly became invisible. If it had subsided into a hole in the ground, it could not have more completely disappeared. As, however, my eyes were fixed upon the spot, I soon came to observe that all the interstices among the little clods around it were full of withered and crumpled leaves of a deep blackish brown. I then further noticed that the spot where the moth had sat was apparently occupied by one of these, and it flashed upon me in a moment that I had before me one of the great wonders, and one of the great mysteries of nature. There are some forms of mimicry which are wholly independent of the animals themselves. They are made of the colour and of the shape which are like those of the surrounding objects of their habitat. They have nothing to do except to sit still, or perhaps to crouch. But there are some other forms of mimicry in which the completeness of the deception depends on some co-operation of the animal's own will. This was one of these. The splendid margins of the fore-wings, with the peculiar shape and their shining colour had to be concealed; and so, by an effort which evidently required the exertion of special muscles, these margins were folded down—covered up—and hidden out of sight. The remainder of the wings were so crumpled up that they imitated exactly the dried and withered leaves around.

Knowing the implicit confidence in the effectiveness of this kind of concealment, which is instructive in all creatures furnished with the necessary apparatus, I proceeded to try and test this very curious psychological accompaniment of the physical machinery. I advanced in the full sunlight close up to the moth —so close that I could see the prominent "beaded eyes" with the watchful look—and the roughened outlines of the thorax, which served to complete the illusion. So perfect was the deception that I really could not feel confident that the black spot I was examining was what I believed it to be. Only one little circumstance reassured me. There was some hole or interstice in the outer covering, through which one spot of the inner brilliant margin could be seen shining like a star. Certain now as to the identity of the moth, I advanced still nearer, and finally I found that it was not till the point of a stick was used to move and shake the earth on which it lay, that the creature could believe that it was in danger. Then, in an instant the crumpled leaf became a living moth with powers of flight, which would have defied capture.

I recollect that many years ago Mr. Wallace kindly showed me a butterfly from the Eastern Archipelago whose upper wings were of a brilliant colour, but which, by the simple act of alighting on a branch, and of folding or closing its wings, became transformed into the perfect likeness of a growing leaf—a likeness so perfect that even the closest inspection only discovered new items of resemblance—inasmuch as the leaf-stalk, as well as the venation of the leaf, were all perfectly represented both in the structure and in the colouring of the under-surface of the wings.

I confess that the number and intricacy of the correlated growth and instincts which are involved in the e phenomena strike me more and more as wholly outside the sphere of mere physical causation—by which I do not mean that physical causation has not had its own share of instrumentality in the matter, but that it affords no satisfying explanation of all the elements involved. The ordinary phrases of the Natural Selection Theory appear in the light of such facts to be little better than lean and empty formulæ. ARGYLL

Cannes, November 29

Double Flowers

I AM indebted to Baron von Mueller for the communication of double flowers of *Tetratheca citiata*, which possess interest on several grounds, although the changed appearances they present are not infrequent. It may be well to premise (1) that the plant, like all its fellows of the same order (Tremandraceæ), is native to extra-tropical Australia; (2) that, under ordinary circumstances, it has 4 free sepals, 4 free petals, 8 free stamens in a single row, and a two-celled ovary; (3) that "doubling," in a strict sense, is brought about by the multiplication of petals, or by the more or less complete substitution of petals for stamens, or pistils, or both.

The Australian origin of the plant in question is so far of interest, in this connection, that it affords one more illustration of the occurrence, under natural conditions, of double flowers in a division of the globe where, according to the late Dr. Seemann, such forms are rare. The rarity, however, I believe, is not so much in the existence of such flowers, as in the number of observers, at any rate we now know of several cases of the kind.

Some of the flowers sent by Baron von Mueller were double by multiplication of petals, *i.e.* there was a second row of petals inside the first, others were double not only by multiplication of petals, but also by the partial substitution of petals for stamens; thus in one of these last-mentioned flowers, there were four sepals, three rows of petals, one of the innermost row being partly staminoid, and eight stamens in a single row. Of these eight stamens, six were perfect and the remaining two partially petaloid, one lobe of the ordinarily 4-celled anther being destitute of pollen, but enlarged into a relatively large petal-like lobe with inflected margins. So that according to the old notion, this flower affords an instance both of progressive and of retrogressive metamorphosis, of enhanced and of arrested development associated with compensatory changes. On the hypothesis revived by Mr. Grant Allen—for it is no new notion —the two outer rows of petals would be stamens flattened out of all knowledge, while the inner row and the staminal whorl would, I presume, also afford him evidence of the truth of his opinion. For my own part I prefer to adhere to the established order of things, in which the horse precedes, rather than follows the cart, and I do so because to do otherwise would be to run counter to what we know of the homologies of the foliar and floral organs, of leaf-buds and flower-buds, and to ignore or rather to reverse what we know of the mode and order of development of flowers in general.

Not being aware of the precise order of evolution in the flower in question, I can only reason from analogy when I express my opinion that the changes it presents and the order of arrangements of its parts from the leaves on the flower-stems up to the pistil are more consistent with the generally adopted views of morphology than they are with Mr. Grant Allen's. According to his views, so far as I understand them, I can see no reason why the sepals as well as the petals should not be flattened stamens, and if the sepals why not the bracts? if the bracts why not the leaves? The theory would thus do away with the possibility of indigestion in plants, or at least the primordial plant, could not have been troubled in this way, for it would have had no digestive organs.

I have only to add that the flowers in question offered no explanation of the great peculiarity presented by the existence of a single row of stamens in number double that of the petals. Possibly this may be the result of bifurcation at a very early stage of development. It was hardly to be expected that they would throw any light on the equally curious "obdiplostemonous" arrangement in the nearly-allied genus *Platytheca*, in which there are two rows of stamens, the outermost being superposed or opposite to the petals, instead of being alternate with them, as is usually the case in stamens so placed. A possible explanation of this in a sense partly consistent with Mr. Allen's views would be to consider the petal as in this case an outgrowth from the stamen, and not a separate organ, a view that has been propounded in the case of Primulaceæ and some Malvaceæ. MAXWELL T. MASTERS

Fruit of Opuntia

DR. ERNST'S abnormal fruit of Opuntia, as figured at p. 77, appears to be similar to one described and illustrated by Zuccarini (*Abhandl. d. math. phys. Class.*, B. iv., Abth. I., tab. ii.) in the case of *Cereus serpentinus*, but as Dr. Ernst gives no details as to the arrangement of the vascular bundles, it is impossible to say that the two cases are exactly parallel. The resemblance to certain gourds (Cucurbits), wherein the upper part of the fruit protrudes beyond the dilated end of the flower-stalk, may also be pointed out. MAXWELL T. MASTERS

Hawk Moth Larva

I FORWARD a sketch of the larva of a hawk moth found in the Khasi Hills, Assam, in the position it assumes when disturbed. Its resemblance to a snake will be at once evident.

The head (just visible in the sketch) and two first segments of the body are retracted, and the third pair of leg

pale horn colour have a rough resemblance to lower jaw or teeth. Small imperfect ocelli in the third segment might be taken for nostrils. The ocellus on the 5th segment, which however, is not so conspicuous as that on the 4th, rather spoils the general effect.

The colour is olive brown reticulated with black and imitates a reptile's scales very perfectly. The lower parts are black,

and a portion of the anterior segments dirty yellowish white. I do not yet know the perfect insect. The larva feeds on the wild balsam. The general colour of this larva at once reminded me of two abnormally coloured larvæ of the common death's-head moth that I had brought to me from a potato field in Jersey some years ago, together with others of the ordinary colour.

One was full grown and another half grown. The general colour of these was brown with fine black markings and without a trace of green. The anterior segments were a pale dirty cream colour. There were no ocelli or diagonal stripes on the sides.

I have not seen recorded any similar case of abnormal colouring in the larva of the death's-head moth, but the fact is interesting as indicating a common ancestry in two moths which are probably now classed in different genera.

E. R. JOHNSON
Surgeon Major, Bengal Medical Department
Shillong, October 16

[The form of death's-head larva alluded to is not uncommon; it is a dimorphic condition and finds its parallel in many larvæ of Sphingidæ. ED.]

The Fertilisation of the Common Speedwell

ALTHOUGH it is the wrong time of the year for observing flowers, it will perhaps not seem out of place to draw the attention of your readers to the fertilisation of the common Speedwell (*Veronica officinalis*). The flowers in the plant hang downwards, so as to bring the nearly flat corolla a little under the perpendicular. The two stamens project outwards and downwards on each side of the pistil, which also hangs down, but not so much as the stamens. These latter are very much narrowed at the base. The flower is in this species, proterandrous, and the corolla, as soon as the stamens have shed their pollen, becomes slightly loose.

It at first sight seems quite impossible for either cross or self-fertilisation to take place, as the stamens are quite away from the pistil, and, owing to the position of the flower, insects are compelled to alight in front.

One morning last summer, however, in considering the structure of the flower, &c., I was led to conclude that the explanation must lie in the insect's mode of settling upon it, and accordingly watched two or three plants. In about half an hour's time I had the pleasure of seeing a large fly in the act of fertilisation. As the corolla was flat, and the flower hung down, there was no foothold there, so the insect clasped each of the stamens with its forefeet. Being thin at the base, they were drawn together, and the anthers meeting just below the pistil, dusted the front of its head with the pollen.

On comparing a large number of flowers, I found that when just open, the pistil stood up above the point at which the two anthers would meet, but that in older flowers, especially after the anthers had shed their pollen, it was inclined downwards, If this observation is verified, it will show a most striking adaptation for preventing self-fertilisation.

I may add that in one of the smaller flowered species, *V. hederæfolia*, the stamens and pistil are quite close to each other, so that self-fertilisation must here be the rule. The corolla is also not so easily detached. A. MACKENZIE STAPLEY
The Owens College, Manchester, November 20

Wartmann's Rheolyzer

YOU gave in NATURE a report on "Wartmann's Rheolyzer." I beg to say that I invented and constructed the same apparatus long ago, and described it in the "Sitzungsberichte d. Wiener kast Akademie d. Wissenschaften," July, 1877, under the name of "Rheonom." Some months after that a fair report of my paper appeared in "Beiblätter zu Wiedemann's Annalen." My instrument was for some years in the hands of several physiologists. Prof. Yeo was present when I made experiments with it in Prof. Ludwig's laboratory in Leipzig in the year 1878, and Prof. E. du Bois-Reymond has it also in his collection of physiological and physical instruments for more than five years. There is no doubt that Prof. Wartmann was not acquainted with my apparatus when he described his, but I cannot be expected to see my invention ascribed to another and keep silent. So you will oblige me very much in correcting the above-mentioned mistake in your paper. ERNST VON FLEISCHE
Vienna, Währingerstrasse 11, November 30

Pollution of the Atmosphere

THERE was a letter in NATURE some time since, calling attention to the pollution of the atmosphere by the burning of coal; and it was calculated that in the year 1900, all animal life would cease, from the amount of carbonic dioxide; but the author had overlooked the fact that the rain is continually cleansing the atmosphere of this, and the fall of this rain on the ground, and the combination of this with various salts; besides, the oceans alone would absorb their own bulk at normal pressure, but at an increased pressure of, say half a mile deep, would dissolve more than we are likely to need for hundreds of years.

But there are other products of combustion, or rather of incomplete combustion, that are not brought down in this manner by rain, as hydrogen and the hydrocarbons, chiefly marsh-gas and ethylene. The latter has, I believe, been observed by the spectroscope on the Alps, and was supposed to have come from space.

Since the year 1854 (as near as I can estimate) there has been burnt 10,000 million tons of coal; and if we say (in its consumption by household grates, leakage by gas-pipes, &c.) 1-100th escapes, then 100 million tons of hydrogen and hydrocarbons are floating in the atmosphere, or 1-10,000,000th part in bulk; if we say the average proportion of hydrogen to be ·45, and of marsh gas ·35, and of ethylene ·4, we have ·84 per cent. of gases that are lighter than air, and it is more than probable that the law of diffusion of gases, as demonstrated with jars, does not apply to the atmosphere. The cases are not parallel: in the air we have unconfined space, pressure, and temperature diminishing infinitely, conditions favourable to the lighter and the gas with the greater amount of specific heat rising and maintaining its elevation, especially as we know that in *large* halls carbonic dioxide is found in larger quantities on the floor. According to Prof. Tyndall's researches, hydrogen, marsh gas, and ethylene have the property in a very high degree of absorbing and radiating heat, and so much so that a very small proportion, of only say one thousandth part, had very great effect. From this we may conclude that the increasing pollution of the atmosphere will have a marked influence on the climate of the world. The mountainous regions will be colder, the Arctic regions will be colder, the tropics will be warmer, and throughout the world the nights will be colder, and the days warmer. In the Temperate Zone winter will be colder, and generally differences will be greater, winds, storms, rainfall greater. H. A. PHILLIPS
Tanton House, Stokesley, November 23

A Modern Rip Van Winkle

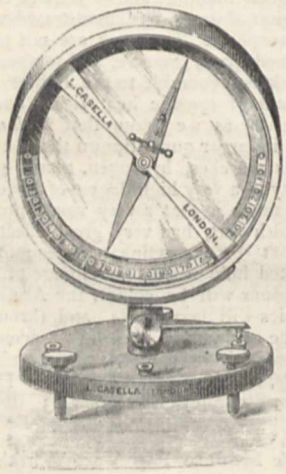
WHEN Mr. Evans asks whether it is impossible for "the so-called flint implements and flint flakes to have been formed by natural causes" he surely must have had a scientific nap of forty or fifty years. He can answer his question by going to any good museum and inspecting the beautifully and clearly manufactured implements which the Curator will show him.

November 28 SALTBURN

GOOLDEN'S SIMPLE DIP-CIRCLE

A DIPPING-NEEDLE suitable for the requirements of schools and science classes has long been a desideratum, there having been no instrument obtainable hitherto which would at a moderate cost afford results of sufficient accuracy. Between the mere needle suspended in a simple stirrup of brass, and the delicate and complicated dip circles of standard pattern there has been no intermediate form of instrument. This deficiency, has, however, been remedied by Mr. Walter Goolden, M.A., Science Master in Tonbridge School, who, in conjunction with Mr. C. Casella, has designed the form of portable dip-circle depicted in the figure, which possesses several novel points. The needle, which is 3½ inches in length, is poised upon an accurate axis working in sapphire centres, and magnetised once for all. In order to ensure the coincidence of the centre of gravity with the centre of suspension, two very light adjustible counterpoises are fixed to the needle, one of them being capable of being moved parallel to the length of the needle, the other lying at right angles to the first, and

adjustible in a direction to the right or to the left. The metallic circle within which the needle revolves is graduated on both faces, and is inclosed within an air-right case. The instrument turns upon a vertical support above a solid metal plate standing on three levelling-screws. A small loose level, which can be placed upon this levelling-plate, accompanies the instrument. The main novelty in Mr. Goolden's instrument, consists, however, in the arrangements by which the angle of dip may be determined without having either a horizontal graduation or a horizontal compass needle upon the apparatus. It will be seen by reference to the figure that the vertical axis of the instrument is furnished with a spring-arm, which can be clamped to it by turning a screw, and that there are four metal studs affixed to the stand at equal distances apart, into any one of which the pin at the end of the spring arm can be pressed down. These arrangements serve to facilitate the following adjustments. Having levelled the instrument the spring-arm must be unclamped and the pin at the end of it pressed down into the conical hole in one of the studs. While this is so held with one hand the vertical circle is turned upon its axis with the other hand *until the needle points directly*



Goolden's simple dip-circle.

vertically downwards to 90°. In this position, which is of course exactly magnetically East-and-West, the vertical circle is clamped by a turn of the screw. The position is verified by turning the whole circle and spring arm together upon the axis until the pin meets the opposite stud, when the needle will again point vertically downwards. The East-and-West position being thus verified, it is clear that the magnetic meridian will lie in a plane at right angles to this. Hence the next process is to turn the circle round and press the pin into one of the two studs which lie at right angles to the pair already employed. The position of the needle in the circle is then read off. The circle is once more turned through a complete semicircle, the pin pressed into the opposite stud, and another reading is taken: the mean of these two being accepted as the true angle of dip. It will be seen that the usual elaborate processes of eliminating possible errors by reversing the needle-axis upon its bearings and reversing the magnetism of the needle itself are not attempted. Everything will therefore depend upon the accuracy of the adjustments of the instrument before it leaves the maker's hands. As it is, it is claimed that the readings are correct to within 10 minutes of arc.

THE COMET

MR. CHANDLER has made another approximation to the orbit of this comet, and now finds the following ellipse (*Science Observer*):—

Perihelion Passage September 17·2304 Greenwich M.T.

Longitude of perihelion	276 28 26·8	M. Eq. 1882·0.
,, ascending node	345 50 34·0	
Inclination	38 5 3·8	
Log. perihelion distance	7·8835636	
Eccentricity	0·9999700	

Retrograde.

The period of revolution corresponding to this ellipse is about 4070 years; in the middle of November there was a decided difference between the calculated and observed positions, part of which may be due to a cause to which Mr. Chandler has already drawn attention, viz. that the same point in the head of the comet may not have been always observed. We may now say pretty confidently that a short period of revolution is inconsistent with the motion of this comet, and consequently that it is not identical either with the great comet of 1880 or with that of 1843. Nevertheless we must repeat that there are indications of sensible perturbation during the flight through the coronal regions of the sun.

Mr. Gill sends us some particulars relating to the early Cape observations of this comet. It was first detected by Mr. Finlay at five o'clock on the morning of September 8, as he was returning to his house from the observatory. He went back and compared the nucleus with a small star in its immediate neighbourhood. On the following morning the comet was observed again, and the same day Mr. Gill sent the following telegram to Sir James Anderson, Chairman of the Eastern Telegraph Company:—"Kindly tell Astronomer Royal, Greenwich, that bright comet was observed here yesterday morning by Finlay. Right Ascension this morning nine hours forty minutes, increasing daily nine minutes, Declination one degree south, increasing half degree south daily." Mr. Gill acknowledges his indebtedness to the courtesy and liberality of Sir James Anderson for the free transmission of many previous messages. Unfortunately this one notifying the discovery of the comet in some way miscarried, and did not reach Mr. Christie's hands, so that the first intimation of the visibility of the comet came from Mr. Cruls at Rio de Janeiro, who, however, so far from being a discoverer, has informed the Academy of Sciences of Paris, through M. Faye, that he received notice of the comet's presence from another quarter on September 10; it was not seen at the observatory of Rio till 5h. 15m. a.m. on September 12.

Cloudy weather prevailed at the Cape between September 10 and 17, and very few observations could be procured, and those had to be made by measuring the difference of altitude and azimuth from bright stars. On Sunday, September 17, the comet was easily visible with the telescope in full sunshine, and in close proximity to the sun. It was followed during the day by Mr. Finlay and Dr. Elkin, and towards afternoon was found to be rapidly approaching the sun. As the distance diminished "all appearance of tail was obliterated, only a round disc about 4″ in diameter remained visible, but this was intrinsically as brilliant as the surface of the sun, if not more so. Still closer this disc approached to the sun's edge, and its disappearance there was observed just like that of a star when it was occulted by the bright limb of the moon." Both Mr. Finlay and Dr. Elkin observed the disappearance, but though the former was using much the more powerful telescope, he only saw the nucleus five seconds longer than Dr. Elkin; the comet had passed on to the sun's disc (not behind it, as Major Herschel erroneously assumes in NATURE last week), but no appearance whatever of its presence there could be perceived. Mr. Gill himself was not able to arrive at this unique observation, having proceeded to Simon's Bay to meet Capt. Morris, R.E., on his way in the *Liguria* to Brisbane to observe the transit of Venus, who returns to South Africa as chief Executive Officer of the Geodetic Survey of the Cape Colony and Natal; but

on the morning of the following day he observed the comet rise just before the sun at Simon's Bay, and says he will never forget the beauty of the scene. Many drawings of the comet were made at the Cape Observatory, and some photographic pictures were obtained with the assistance of Mr. Allis, of Mowbray. To obtain a perfect picture of the more delicate details of the comet, an exposure of not less than half an hour was found to be necessary.

The following places are abbreviated from an ephemeris calculated by Mr. Chandler from his last elliptical elements :—

At Greenwich mean noon.

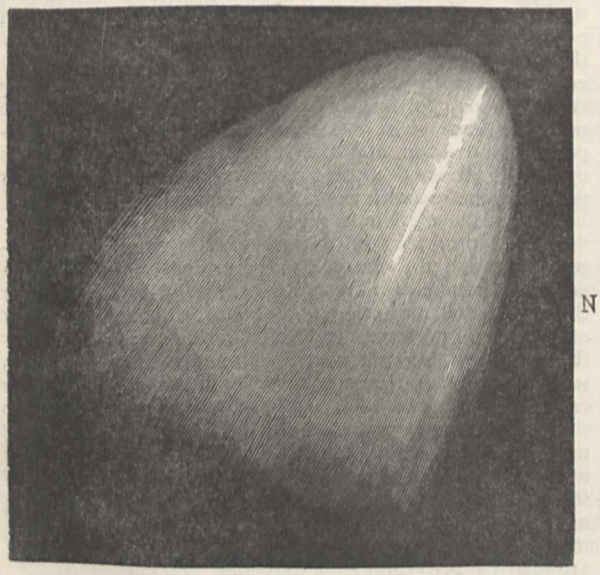
	Right Ascension. h. m. s.	Declination. ° ′	Log. distance from Earth.	Sun.
December 7	8 31 41	−29 42·7	0·1868	0·3110
9	8 25 28	29 57·6		
11	8 19 10	30 9·8	0·1917	0·3250
13	8 12 48	30 19·1		
15	8 6 24	30 25·5	0·1978	0·3384
17	7 59 58	30 28·9		
19	7 53 33	30 29·3	0·2051	0·3512
21	7 47 9	30 26·8		
23	7 40 49	−30 21·4	0·2137	0·3635

Up to Nov. 6 the comet discovered by Mr. Barnard had been sought for unsuccessfully at the Cape Observatory.

We have received the following communications on the comet :—

WITH the permission of Vice Admiral Stephen C. Rowan, U.S.N., Superintendent of the Observatory, I send you a sketch made at 17h. Washington Mean Time, November 15, with the 26-inch Washington equatorial. At the time of observation the head of the comet was about 45 minutes east of the meridian.

As it is extremely difficult to represent such an object faithfully in a woodcut, I will call attention to the following points :—The nucleus presents a very woolly, nebulous appearance, with a main point of condensation, almost circular; near its following end, and about 18″ from this towards the tail, a second point of condensation, prolonged about 54″ in the direction of the tail in a narrow ridge of light. This ridge which has heretofore appeared broken up into four or five beads, is now a continuous line of light with, perhaps, in one or two places, faint indications of condensation. The nucleus is decidedly eccentric with regard to the general direction of the head, and the head is flattened on the *north-following* side.



Comet *b*, 1882, November 15·7, U.S. Naval Observatory, Washington.

The position-angle of the major axis of the nucleus was 309°·4. The distance between the centre of the two main points of condensation, from a series of measures with the filar micrometer was 18″. A magnifying power of about 200 diameters was used. On November 17·7 the extreme length of the nucleus was found by Commander Sampson to be 74″.

The following meridian observation for position was obtained on November 15·7 with the transit circle ;—

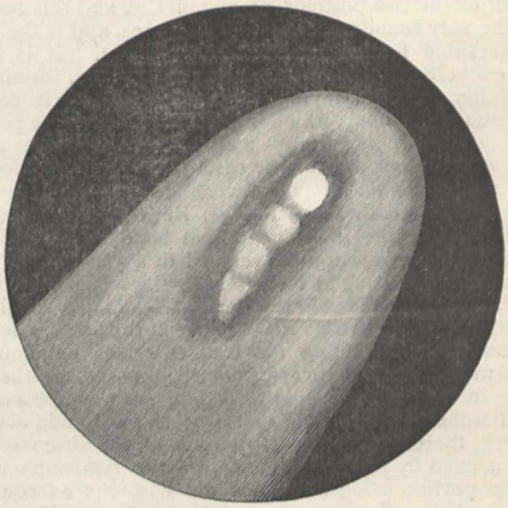
1882 November 15·74 (Washington M.T.)

R.A.	9h.	27m.	50s.·72
N.P.D.	114°	49′	18″·9

The part observed was the main point of condensation near the following end of the nucleus. The observation is corrected for refraction, but not for parallax.

WILLIAM CRAWFORD WINLOCK,
Assistant Astronomer, U.S. Naval Observatory

THE drawing represents the appearance of the great comet at 5 a.m. on the morning of October 12 this year. I delayed the publication of my observations on this morning in the hope of securing some more views, but the bad weather prevented any further observations of this object here. The drawing shows distinctly four condensations in the nucleus, whose angle of position on the 12th was about 102°. Its length was 40″·3, as measured with the filar micrometer on the great refractor. The visible length of the tail was estimated at 21°. No doubt it was really much greater. Its southern side was well defined. As seen with the naked eye the nucleus shone as brightly as a star of between the first and the second magnitude. On the morning of the 6th I had seen the end of the tail, which was then apparently 15° long, present a feature very like that indicated in Major Herschel's drawing (NATURE, vol. xxvi. p. 622), but I am not sure of this, as the sky was partly covered with cirro-cumulus clouds.



The Great Comet seen in the Markree Refractor, October 12, 1882, 5 a.m., by W. Doberck.

On October 28, at 5h. 45m. a.m., the angle of position of the nucleus was about 113°, and its length amounted then to 67″. The tail was less curved than on the 12th.

Markree Observatory, December 2 W. DOBERCK

FUNCTION OF THE MEMBRANA FLACCIDA OF THE TYMPANIC MEMBRANE

WHY should a smart blow, as, for instance, with the palm of the hand on the side of the head, or on the wing of the ear, cause rupture of the membrana tympani?

It was in endeavouring to trace the connection between these events, of no very uncommon occurrence, that I was led to the discovery of a most important factor in the physiology of the ear, and one which gives a new and more rational significance to the mechanism of the ossicles and membrane. In the shape of anatomical details I have nothing new to adduce, but in exhibiting the relationship of a series of minute particulars hitherto enigmatical and glanced at separately and only casually by anatomy, I have obtained a valuable result for otology. I must here present those details in the order most convenient for a brief demonstration, giving only the main features.

The membrana tympani, though but a single membrane, consists of two portions. The lower is firm and transparent, and of conical shape, being attached along its centre to the handle of the malleus, and fixed round its whole circumference to the sulcus tympanicus. The upper is comparatively loose, and much less transparent, and being in reality mainly fastened to the skin of the upper wall and only slightly to the bone, there being here no sulcus, but only a smooth margin (margo tympanicus), is easily displaced with a little gentle pressure outwards or inwards. Between the two there is a line of dense fibres forming a ligament, called by Helmholtz the anterior ligament of the membrane, and towards the anterior border of which the short process of the malleus is inserted. With this marked limiting line there is thus a striking difference in the character and mode of attachment of the two portions of membrane, and this reaches to the very foundations of the structures, and is the most remarkable feature in their development. It is to be remembered that the superior arch of bone, forming at its inner end the tympanic margin alluded to, is part of the squamous bone, which is characterised by the general smoothness of its surface—a character it preserves along the whole upper wall of the osseus meatus, not excepting its termination at the porus acousticus externus, where it presents a smooth bevelled edge. But the os tympanicum which forms the inferior arch of bone is contradistinguished by the general unevenness or asperity of its surface, not only being hollowed out by the sulcus at its inner end, but along the whole floor, maintaining a roughness which culminates in its rugged edge at the porus externus. Nature, in constructing the meatus, selects one bone for its smoothness, another for its roughness, and the evident intention is, that what is laid on the one surface shall adhere, what is laid on the other shall glide over it. While, therefore, the lower portion of the drum of this ear is fixed by its connection with the os tympanicum, the upper portion is loosely connected with the os squamosum, which affords it a movable surface. Helmholtz believes that the lower firm portion is alone concerned with sound-waves, the upper lying above the handle of the malleus, and having therefore no direct connection with the chain of ossicles. On this ground, in his treatise on the mechanism of the membrane and ossicles, he leaves the membrana flaccida out of consideration altogether, and no physiologist, as far as I am aware, has ever hinted at its function. Having from the foregoing description obtained an insight into its relation with the bone, it must now be viewed in connection with the skin lining the upper wall of the passage, which is quite distinct in character from that covering the rest of the osseous passage, and next needs to be specially noticed.

Prof. Henle says: "The skin which covers the external meatus has originally the appearance and structure of the cutis, and retains this character along *the upper wall* beyond the *rounded rim* of the squamous bone which helps to complete the porus acousticus externus up to the site of the membrane, whereas in the rest of the circumference the skin, in passing from the cartilaginous to the osseous meatus, abruptly changes its character, decreasing in thickness and assuming the peculiar silvery glance of a fibrous skin."[1] Thus along the whole passage the skin on the upper wall retains its ordinary character, being elastic and movable, and having, as noticed by Von Fröltsch, the same kind of loose connective tissue glands and hair cysts as any other part, whereas the movability of the remaining portion ceases with the cartilaginous meatus, as beyond that it ceases to be true skin.[2] Add to this that the one lies on a roughened, the other on a smooth surface, and this singular deviation in apparently so simple a matter and in so minute a particular, must strike the examiner as significant of purpose. If we next turn to the arrangements at the porus acousticus externus, it becomes manifest.

What is noticeable in regard to the rim of bone constituting the porus is simply corroborative of what has already been said. Thus, whereas the under semicircle is comparatively rough and uneven, and projects slightly beyond the upper semicircle, the latter has a smooth-rounded edge bevelled in the manner of bone over whose margin a tendon plays. It is to the curved uneven lamella of the under circumference known as the auditory process that the cartilaginous meatus is principally attached. This is effected by means of strong, slightly movable ligamentous tissue, or rather, as Henle puts it, "by means of a compact cartilaginous substance richly interspersed with elastic ligamentous tissue, which fills up the rough interspaces of the lamella and extends the lower portion of the osseous canal about two millimeters."[3] The upper semicircle, on the contrary, is closed simply by a dense fibrous membrane, there being here a large deficiency of cartilage (Quain). The difference is that while below the osseous canal blends insensibly into the cartilaginous with only dawning facility for movement, above it terminates abruptly, admitting there and then a large measure of movement.

Thus then it appears that from the membrana flaccida of the membrane, which is easily movable at its margin, we have a piece of movable skin running over a smooth polished surface along the whole upper meatus of the bone, which is here bevelled off, and is immediately continuous with the movable membranous roof of the cartilaginous portion of the external passage. The movable piece of skin serves, after its manner, the purpose of a tendon, and the muscle which mainly plays upon it is attached to this upper membranous wall at its point of junction with the osseous meatus.

Of this muscle Henle gives the following account:—"Of the lateral portion of the musculus epicranius (occipito-frontalis), the musculus epicranius temporalis is a very thin bundle of fibres, and is anterior to and smaller than the attollens auriculam, which forms the remainder of the lateral portion. It has its tendinous origin below the root of the zigoma, near the rim of the osseous canal, to the capsule of the inter-articular cartilage (operculum cartilagineum), and to a tendinous arch through which the vasa temporalia pass into the deep structures. Its muscular fibres spread out in parallel lines forwards and upwards, some of them stretching to the border of the frontalis, and of the orbicularis oculi, and so partly curving upwards around the lateral border of the frontalis, and intermixing with the upper fibres of the orbicularis, they are finally inserted into the glabella."[4]

It will thus be observed that, when the muscle contracts, it raises the membranous roof of the canal upwards and slightly forwards, making the movable patch of skin glide outwards, and so telling upon the membrana flaccida, which is, even in the adult, almost in a line with the upper wall, and is therefore so much the more easily influenced by such a movement. When the delicacy of the parts concerned are borne in mind, it will be obvious that no extensive movement is thus indicated, and in a

[1] "Anatomie des Menschen," Z. B. s. 732.
[2] "Diseases of the Ear," Roosa's Translation, p. 53.
[3] *Loc. cit.* p. 722.
[4] *Loc. cit.*, s. 136.

more complete demonstration a good deal further illustrating the actual movement, has to be said on that head. Here we have space only for a general outline.

The muscle, of course, has no isolated voluntary action, but its effect is brought into play when the eyebrows are forcibly raised by the contraction of the occipito-frontalis. Indeed, although itself really a muscle as described, much of its effect is derived after the fashion of an elastic tendon connected with the great epicranial muscle. It is further assisted by the consentaneous action of certain small muscles of the auricle, notably the attollens auriculam. Its movement is quite perceptible to the finger placed in the sulcus, between the pinna and side of the head, and to an experienced eye its effect on the membrane is distinctly visible through the speculum when the occipito-frontalis is made to contract.

It would be beyond the scope of a single paper to enter into a demonstration of the effect of this movement of the membrana flaccida on the membrane and ossicles—but it can be shown that, in opposition to the so-called tensor tympani muscle, it helps to bring the umbo or deepest part of the membrane outwards, thus tending to reverse the cone, and bring the membrane generally into a more vertical position, relatively to the lower wall of the meatus. This is beyond all question its position for acutest hearing, and it is thus important to observe that by the single contraction of the occipito frontalis muscle, both eyes and ears are brought simultaneously into the attitudes of strained attention. Hence, in endeavouring to hear as well as to see intently, we involuntarily raise the eyebrows in order to tell upon the drum of the ear.

A smart blow administered on the side of the head, as is too often thoughtlessly done by schoolmasters and parents in correcting children, may cause sudden spasmodic action of the muscle, and thus, through the action of the mechanism described, serious injury or even rupture of the drum. JOHN M. CROMBIE

WEIGHTS AND MEASURES

THE Board of Trade lay before Parliament an Annual Report of their proceedings and business under the Weights and Measures Acts, &c., and their Report for the current year has just been issued.

It is required by law that the three Parliamentary copies of the Imperial Standards of measure and weight, which are deposited at the Royal Mint with the Royal Society, and in the Royal Observatory, respectively, should be compared with each other once in every ten years. The period for such decennial comparisons having recently arrived the Board took the necessary steps for the removal of these Standards to their office. The methods of comparison adopted and the actual differences between the Standards are shown in a memorandum by Mr. H. J. Chaney, which is attached to the Report. It appears that the comparing apparatus in use at the Standards Office is found to require alteration, and that in considering the changes necessary to be made the Board have had the valuable assistance of a Committee of the Royal Society, composed of Sir G. Airy, Major-Gen. A. R. Clarke, and Prof. Stokes. It is really important that a department which is charged with the care and use of our national standards, should have the best apparatus, and we trust, therefore, that the Report of the Committee may be speedily and fully carried out.

Reference is also made to the papers issued by the Comité International des Poids et Measures, Paris, and the Report acknowledges the assistance the Standards Department has received from these papers, particularly with reference to the measurement of heat and the determination of volume and weight. This country is the only civilised country which has not joined the Comité International, and taken part officially in their proceedings, although it would appear that it has not failed to avail itself of their labours.

The two ancient standards of the metric system, the Toise du Perou and the Toise du Nord, are stated to be still at the Paris Observatory, in a good state of preservation, as also are the measures used by Borda, Brisson, and Lavoisier. By a decree of the Sultan, the metric system came into force in Turkey on March 1st last, and the equivalents of the old and new Turkish weights and measures are stated in this Report.

The Board have had their attention directed to the question of a uniform system of screw threads, as well as to that of a standard wire gauge. Reference is made to the want of uniformity in the system of screw threads used in the construction of scientific and optical instruments. It is hoped that the attention which is now being given to this question may result in the adoption of a standard system of screw threads. Any step which tends to lessen the high cost of construction and of repair of scientific apparatus is to be welcomed.

From time to time, as science advances and commerce extends, it is found that new kinds of standards are needed, and the attention of the Department has therefore been this year called to the expediency of adopting new photometric tests for gas, and also as to possible means of measuring electrical energy. In the proposed Bill for amending the enactments for regulating the sale of gas, and of dealing with the mode of testing the illuminating power of gas, we trust that Mr. Vernon Harcourt's new air gas-flame test, on which Dr. Williamson and Dr. Odling have reported, may receive favourable consideration.

Under the Petroleum Acts rules are laid down for determining the "flashing-point" of oils, or the temperature at which they begin to give off inflammable vapours, but it appears by the Report that Dr. Foerster has lately called attention to the omission in these rules of any allowance for variations of atmospheric pressure. The rules in this respect evidently, therefore, require some amendment.

The Report also contains much information valuable to local inspectors and others practically interested in weighing and measuring.

ON THE PROPOSED FORTH BRIDGE

IN offering some remarks (which I trust may be final) merely explanatory of preceding notes on this proposed structure, I shall refer generally to my letter of October 19 (NATURE, vol. xxvi. pp. 598-601).

First, I have to modify the force of my expressions relating to the danger arising from the use of certain long struts to support very heavy end-pressures. My remarks were the consequence of error in the engraved longitudinal vertical plan, circulated (I understood) under the authority of the Official Board. In this plan, by the indiscretion of the engraver, the tubular struts of 340 feet length and 240 feet length respectively, are drawn clearly and distinctly as unconnected in their entire length with any other braces. In other parts of the plan, each connection of that class is indicated by a rose; but there is no such mark upon these rods. A person scrutinising the plan might well feel alarm at the prospect of unbraced rods 340 feet long, intended to support end-pressures exceeding 600 tons. But Mr. Fowler has kindly informed me that the plan is erroneous, and that there is connection at each place where the strut crosses a brace, and that the flexible length of the strut is thus reduced to 170 feet. This diminishes the danger of buckling in a vertical plane so greatly that I imagine it may be passed without further notice. Still I remark that the danger of buckling in a horizontal direction, with a length of 340 feet, remains undiminished, unless it is counteracted by bracing not known to me.

In regard to some effects of the wind, the following comparison between the proposed Forth Bridge and the

late Tay Bridge may be interesting. I suppose that equal trains are upon the two bridges; and I assume that the force of the wind on the Tay Bridge train tore one pier from its foundation-attachment. (I imagine that the ruin of the bridge commenced thus). The height of the centre of the Tay Bridge train was about 92 feet, and the momentum of the wind was, therefore, wind × train × 92 feet. (The reader will easily interpret my brief notation). To resist this there were three pairs of attachments to the foundation, with lever-widths of 10 feet, 22 feet, 10 feet, respectively. So that, supposing the holding powers of each attachment the same, we must have had for momentum of resistance, one Tay-attachment × (10 + 22 + 10) feet. At the instant of breakage, this was equal to the momentum of the wind, or to wind × train × 92 feet. So that one Tay-attachment $= \frac{92}{42} \times$ wind × train = 2·19 × wind × train. If we treat the proposed Forth Bridge in the same manner, we must use, length of lever about 660 feet, and two pairs of attachments of the cantilever to the pier (if I read the plan correctly), at distances of 30 and 120 feet. And thus we shall have the equation at a moment of breakage.

One Forth-attachment × (30 + 120) = wind × train × 660; or one Forth-attachment must = 4·4 × wind × train, or double that required for the Tay Bridge.

A numerical value (possibly subject to modification) may be given thus:—Suppose the surface of a train to = 3000 square feet. With the Government scale of 56 lbs. for high wind, the lateral pressure = 75 tons; and, using leverage numbers as above, one Forth-attachment = 330 tons. And this is the strain which each attachment must be able to sustain in respect of resistance to the effect of wind upon a train. I imagine that this has been provided, at least in great measure; but I think it desirable that attention should be called to the magnitude of the forces here concerned.

The able and experienced engineer who has undertaken the prosecution of this great work, will, I am confident, recognise the possibility of serious inconvenience (yet unforeseen) arising from the points to which I have alluded in NATURE, vol. xxvi. p. 599—the novelty of plan, at least in this country—the magnitude of plan—the want of experience in a rising scale of magnitude. Should the bridge be erected successfully, I can imagine that many difficulties on small points might arise. For instance:—all matter yields to force; the brackets of furlong-length, could not strictly preserve their form under the passage of a train; the connection of the end of one bracket with the beginning of the next is not very perfect, and I can hardly imagine that trains could be run through at speed (which, as I understood, is one of the conditions to be secured).

I still prefer the principle of suspension. I would propose for further consideration the modifications which I have suggested in NATURE, vol. xxvi. p. 600, for giving enlarged width with diminished height to the top of the piers, and for use of wire in forming the suspension-chains. G. B. AIRY

The White House, Greenwich, December 4

NOTES

MONDAY'S sitting of the Paris Academy of Sciences was one of unusual interest. M. Jamin, who was in the chair, delivered an eloquent address on the services rendered to science and to the Academy by M. Dumas, and presented to the illustrious Perpetual Secretary the medal subscribed for by his admirers as a testimonial on the occasion of the fiftieth year of his nomination as an academician. The medal is accompanied by silver and bronze replicas. The whole of the audience, which was very numerous, broke into enthusiastic plaudits. When the enthusiasm subsided, M. Dumas returned thanks, which he did with masterly eloquence.

WE regret to announce the death of the Rev. James Challis, M.A., F.R.S., Plumian Professor of Astronomy and Fellow of Trinity College, which took place on Sunday morning at his residence in Cambridge, after a long illness. The late Professor was born in 1803, and educated at Trinity College, where he graduated B.A. in 1825 as Senior Wrangler and first Smith's prizeman. In 1836 he was elected Plumian Professor of Astronomy in succession to Mr. (now Sir) G. B. Airy, and also held the important post of Director of the Cambridge Observatory. The latter post he resigned in 1861, and was succeeded by Prof. Adams. He was at the time of his death the Senior of the Professors at Cambridge, and until about two years ago personally discharged the duties of his professorship, when increasing age and infirmities compelled him to appoint a deputy. Prof. Challis has published a considerable number of scientific works, including twelve volumes of astronomical observations.

THE death is announced of Dr. Gustave Svanberg, formerly Professor of Astronomy and Director of the Observatory of Upsala University. He died on November 21, in his eighty-first year.

NEWS from Aden reports the death of Marchese Orazio Antinori, the well-known zoologist and African traveller, who had recently started on a new expedition to the Upper Nile. He was seventy-one years of age.

ELABORATE preparations were made in various parts of America to observe the transit of Venus yesterday. The Western Union Telegraph, to facilitate observations, arranged to transmit Washington time wherever desired, in order to secure accuracy in recording results. Some enthusiastic astronomers had proposed general prayer in the churches on Sunday last for clear weather.

M. W. DE FONVIELLE has published the first number of a new astronomical journal, called "Les Passages de Venus," which explains the great astronomical event, and is being sold in the streets of Paris at 1 sou, with illustrations indicating the phases, and giving instructions for their observation in France. The editor states that he trusts that the second number will appear at the right date, June 8, 2004, and the third in June, 2012, and so on, as long as there will be on the earth rational beings intelligent enough to take an interest in the transit of Venus. He congratulates himself on having established a "periodical" which will be perhaps the most durable foundation of his age.

A SWISS Geological Society has lately been formed. It is an offshoot from the Helvetic Society of Natural Sciences. While a permanent section of this, it will have its own life, its committee, its funds, its distinct *séances*, and its publications if thought desirable. It will have members who do not belong to the mother society; will send a delegate to the preparatory assembly of the latter, and will have the right of presentation of members. The number of adherents of the new society is already over sixty. It has absorbed the *Congress der Feld Geologen* and the *Comité d'Unification géologique*. Among other things it will encourage excursions along with discussion on the ground, and will represent Switzerland in the International Geological Congresses. The Society has testified its respect for MM. Studen, Heer, and Merian, by (exceptionally) giving them the title of Honorary Members.

THE Council of the British Association, acting under the powers conferred upon them by the General Committee, in accordance with their Report, have appointed the following to be a Committee, "to draw up suggestions upon methods of more

systematic observations, and plans of operation for local societies, together with a more uniform mode of publication of the results of their work," and to "draw up a list of local societies which publish their proceedings," Mr. H. G. Fordham (Secretary), Rev. Dr. Crosskey, Mr. C. E. De Rance, Sir Walter Elliot, Mr. Francis Galton, Mr. John Hopkinson, Mr. R. Meldola, Mr. A. Ramsay, Prof. W. J. Sollas, Mr. G. J. Symons, Mr. W. Whitaker.

COLONEL PREJEVALSKY, the distinguished traveller, intends to resume his explorations in Central Asia in the spring, and to make another attempt to penetrate to the capital of Thibet. He is now suffering slightly from weakness of sight.

PROFESSORS have been appointed to give courses of lectures at the Louvre upon its collections, and the school opens this week. Gaulish antiquities will be expounded by M. Bertrand, curator of St. Germain Museum; Egyptian remains by MM. Pierret and Revillout; Semitic epigraphy and archæology by M. Ledrain; and ancient art by M. Ravaisson.

A "PROJET de Mer Intérieure dans le sud de l'Algérie et de la Tunisse" (occupying the space usually known as "The Schots" or "Les Chotts," which is lower by several feet than the Mediterranean Sea), suggested by M. le Commandant Roudaire, was communicated some time since to the French Government, and was in May last laid by M. de Freycinet before a "Commission Supérieure." This Commission has examined the question under every point of view, antiquarian, political, practical, and commercial, and their labours are recorded in a quarto volume of 546 pages, illustrated by a map. On July 7, 1882, the Commission made the following Report:—

"La Commission,
Considérant que les dépenses de l'établissement de la mer intérieure seraient hors de proportion avec les résultats qu'on peut en espérer,
Est d'avis qu'il n'y a pas lieu pour le Gouvernement Français d'encourager cette enterprise."

IN the course of the coming winter Prof. Emil Selenka hopes to publish a Monograph of the Sipunculacea, in which he will be assisted by Doctors J. G. de Man and C. Bülow. The volume will contain the descriptions of 81 distinct species placed in 10 genera. Some of the species are new. The Monograph will form vol. iv. of Semper's "Reisen im Archipel der Philippinen," and will contain the forms collected by Semper; but in order to make it a more or less complete revision of the group, Dr. Selenka also describes in it the species collected at the Mauritius by Dr. Möbius, those in the Berlin Museum through the goodness of Prof. Peters (this collection contains the types of Grube), those from Stuttgart containing Dr. Klunzinger's Red Sea collection (through Dr. Krauss), those from the British Museum (through Dr. Günther), and those from Göttingen, the types of Keferstein (through Dr. Ehlers). In addition, Dr. Selenka has been indebted for specimens to the liberality of Dr. von Martens, Dr. Hilgendorff, Dr. Krapelin, and Dr. Lang. Dr. Græffe was able to forward living examples of *Aspidosiphon müllerí*. Besides a general introduction and description of the genera and species, there will be dissertations on the tentacular and blood systems, while special care has been taken about the subjects of the geographical distribution, anatomical relations, and synonymy of the species. The volume will be accompanied by 15 plates with more than 200 partly coloured drawings.

SINCE the commencement of the present Session the Society of Arts meeting room has been lighted by means of electricity. A Siemens dynamo is employed driven by an 8 horse-power Crossley gas engine. Nearly the whole cost of these was defrayed by subscriptions from a few past and present members of the Society's Council. The lamps used are those of Edison, and there are at present fifty of them in the room. The chandeliers now in use have been lent by Messrs. Verity, who are constructing chandeliers to be permanently fitted, now that the number of lights to be used has been decided upon. Temporary fittings have been put up in the council room, and the result having been proved satisfactory, it is in contemplation to arrange for the lighting by electricity of this and other parts of the building.

AN unusually large number of seals have made their appearance in the Baltic, a few miles north of the Samland coast. Should these animals make that spot their permanent residence, the salmon fisheries would be in a sad plight. On the Pomeranian coast the damage to salmon fisheries done by seals is very considerable.

NO less than thirty-four communes in the district of Chambery (Savoie) are now infected by Phylloxera.

A COMMISSION has been appointed by the Prefect of the Seine to reconsider the disposal of the Paris sewage. A deputation will be sent, at the expense of the Municipal Council, to Brussels, Antwerp, Amsterdam, Berlin, and London to report on the matter.

A BRUSSELS paper, *L'Athenæum Belge*, reports some interesting observations made by M. W. Spring regarding the seat and origin of thunderstorms. During the summer 1881 M. Spring ascended the Schnæhorn in the Bernese Oberland during a thunderstorm. He then noticed that for a considerable time no rain fell, but that a vivid formation of hail took place. From time to time the hail fell very much thicker, and in such moments came a bright flash of lightning followed by a tremendous clap of thunder. After a pause rain-drops mixed with the hail. The same observations were made on the summit of S. Giacomo, where he again observed a thunderstorm. He concludes from his observations that the actual seat of thunderstorms, *i.e.* of the aërial electricity is not in moist regions of the atmosphere but in the dry and cold region of hail.

PROF. HEULE, the eminent anatomist, has been elected, in the place of the late Prof. Wöhler, as permanent secretary of the Royal Academy of Sciences at Göttingen.

NEWS from Champagne states that a new enemy to the vine has made his appearance in the shape of a minute fungus, a kind of *Peronosporæ*, the dangers of which are said to be far more serious even than those of Phylloxera.

DR. C. W. SIEMENS, F.R.S., has consented to distribute the prizes and certificates gained by the successful candidates of the metropolitan centres at the recent technological examinations, as well as by the students of the City and Guilds of London Technical College, Finsbury, and of the City and Guilds of London Technical Art School, Kennington. The distribution will take place on Thursday evening, December 14, at 7 o'clock, at Goldsmiths' Hall, Foster Lane, E.C.

TELEGRAMS from General Nansouty to Admiral Mouchez announce that an avalanche of fresh fallen snow had swept away five labourers who were trying to carry victuals to the Pic du Midi for MM. Henry, who are at that place to observe the transit of Venus. Two of these poor people lost their lives.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. W. Nash; a Capybara (*Hydrochærus capybara*) from Venezuela, presented by Mrs. R. H. Fitz-Simons; a European Scops Owl (*Scops giu*), European, deposited.

THE ROYAL SOCIETY[1]

OUR anniversary is in one sense the opening of a new year, in another it is the close of an old one. With one hand we weclome the coming, with the other we bid farewell to the departing guest. In the later parts of my present address I shall have to speak, as on former occassions, of our prospects and hopes for the future. At our more festive gathering in the evening we shall recount some of the victories which have been won over difficulties in the extension of knowledge, and shall rejoice at the gathering of old comrades and friends after our usual period of dispersion. But at the moment of taking my place in the chair to which you have now for the fourth time elected me, I must confess that the sadder side of the picture is the most prominent. We seem almost for the moment to enter the Valley of the Shadow of Death, or, like Dante, to descend to the place of Departed Spirits, and to commune with them once more after they have vanished from the upper world. Each year during my own term of office the numbers lost to us have been greater than the numbers gained; but this year, although the list of deaths is long and comprises not a few distinguished Fellows, they all seem overshadowed by two prominent figures. One of these died in the fulness of years, of honours, and of world-wide reputation; the other in the strength and bouyancy of youth, a buoyancy which appears to have even contributed to his end.

Of Darwin and his works it is not for me to speak. Others, with wider knowledge, after longer intercourse, and with greater authority, have said what was possible at the moment, and the full story of his life is now being written by faithful hands. But I consider it no common piece of fortune to have lived within easy distance of his house: to have been able by a short pilgrimage to enjoy his bright welcome, and his genial conversation, and to revive from time to time a mental picture of that my ideal of the philosophic life.

Of Balfour I knew far less, and his works are beyond my range of knowledge. But such was the fascination of his speech and his demeanour that to have seen him was to desire to know him better. To have been selected at his age as one of the Secretaries of the British Association, a post usually reserved for men of more advanced years and of longer experience, to have been appointed to a professorship founded almost on the basis of his own work, and thereby to have become the coadjutor of his own great master in the Physiological School at Cambridge and all this without one word of cavil or of criticism, was a high testimony to his scientific eminence. But far wider afield, it will be remembered of him, not so much that he was brilliant in intellect, or keen of insight, or varied in his attainments, but that he always found himself among friends, whether in college or in the laboratory, in his own home over the northern border, or on the wild mountain side where he breathed his last.

The list of deceased Fellows comprises other eminent names, many of whom will receive mention in our obituary notices. The list, moreover, serves again to exemplify the variety of qualifications which have opened our doors to election. In Decimus Burton we find an architect of refined taste and cultivated mind; in Stanley Jevons and William Newmarch statisticians of weight, and the former already an authority on political and other philosophy; in Sir Woodbine Parish a geographer, and more than a geographer, a man who by service as well as by study in foreign lands had acquired an unusual amount of first hand and accarate information; in Scott Russell an engineer whose brilliant early strokes of work will be remembered when the difficulties which entangled his later efforts have been long forgotten; in Dr. Robinson a veteran and mentor in science, whose work and whose judgment were alike sound. Of Sir Wyville Thomson mention will be made elsewhere.

To this list of names there was well nigh added yet another, namely, my own. An accident, under circumstances which the issue of events and more mature reflection have shown that I was hardly justified in incurring, has for some time past interfered materially with my usual avocations in life, and thereby, as I fear, with my usefulness to the Society. But the ready and efficient assistance of the other officers has, I doubt not, gone far to supply the deficiency. For myself, I am consoled by the kind expression of sympathy from many, some even unknown, friends; and by the consideration, ever present to my mind, that, except through a combination of circumstances over which I had certainly no conscious control, the result to myself might have been far more serious.

[1] Address of the President, William Spottiswoode, D.C.L., LL.D., delivered at the Anniversary Meeting, November 30, 1882.

The total number of Fellows lost to our ranks during the past year is twenty-two on the home list (one of whom has withdrawn on account of growing infirmities), and four on the foreign list; a result, on the whole, not very different from that of last year.

Of these two fell young, and by accident. Of the remainder, two died between the ages of 50 and 60, four between those of 60 and 70, six between those of 70 and 80; and the remaining five attained ages between four score and 90.

In Liouville we have again lost a veteran mathematician; in Wöhler, a chemist whose years, numbered from the beginning of the present century, reached to a period almost prehistoric in the records of his science.

I am happy to report that the sale of the Acton estate has been completed; and that of the proceeds, amounting to 32,250*l.*, 17,000*l.* has been invested in preference or guaranteed railway stock; and the remainder will be expended in the purchase of ground rents, partly in the City of London, and partly in the western suburbs. The income from the latter source, already representing a very fair interest on the outlay, may be expected materially to increase at the expiration of the existing building leases. Some additional expense was incurred this year in painting a portion of the Society's apartments. A considerable portion still remains to be painted, either next year, or at some not very distant period.

While on the subject of property, I should mention that Her Majesty has sanctioned "the continuance of the occupation of the Royal Observatory at Kew by the Royal Society," upon certain conditions, which have been accepted. The building will be devoted, as heretofore, to the use of the Kew Committee, whose work, it must be remembered, is provided for in the main by the Gassiot Fund.

Last year the Society accepted a portrait of Sir J. D. Hooker, painted by Mr. John Collier, at the request and at the expense of a considerable number of Fellows. I trust that the Society will approve the action of myself and a few others, in this year offering for our collection a portrait, by the same artist, of Mr. Joule.

Mr. A. Le Gros has presented to the Society a bronze medallion head, executed by himself, of the late Mr. Darwin.

The Library has received many valuable contributions both from our Fellows and from others. Among the latter I may mention the completion of "The Lepidoptera of Ceylon," from the Government of Ceylon; G. Retzius' "Gehörorgan der Wirbelthiere," from the author; a new edition of Abel's works, from the Norwegian Government; and facsimile lithographs of some of the late Prof. Clifford's mathematical fragments, and the catalogue in two handsome volumes from the Public Library of Victoria.

The printing of the general part of our library catalogue is in progress; and although, owing to unforeseen difficulties the hope expressed last year, that it would have been now finished, has not been fulfilled, yet there seems little doubt that early next year it may be in the hands of the Fellows.

On the completion of this work the Library Committee contemplate resuming another decade, 1874-83, of the great Catalogue of Scientific papers; and the President and Council trust that the success which has attended the publication of the eight volumes already in existence will justify the Treasury in undertaking the printing of the second supplement when the MS. has been prepared.

In the staff of the Society I have happily no change to report. Of the existing members my own feelings would impel me to say much more; but, while they would probably wish me to be silent, I trust they will pardon me in this one remark: that while recent changes make me less apprehensive of any future alterations, they at the same time make me hope that any alteration may be long postponed.

Although the number of papers presented to the Society during the past year, apart from their contents, does not convey any very important information, yet in continuation of past practice I may perhaps carry on the ten years' table. It is as follows, showing a slight diminution in the past year:—

1873	92	papers received.
1874	98	,, ,,
1875	88	,, ,,
1876	113	,, ,,
1877	97	,, ,,
1878	110	,, ,,
1879	118	,, ,,

1880.....123 papers received.
1881.....127 ,, ,,
1882.....109 ,, ,,

Among the papers of this year, I may notice the elaborate research by Dr. Debus on "The Chemical Theory of Gunpowder," forming the Bakerian lecture; the careful and long-continued investigations by Professors Liveing and Dewar on the spectra of water, and of carbon, and of mixed vapours.

Nor must I omit mention of Dr. C. W. Siemens' bold and original theory of the conversation of the solar energy, which has already given rise to so much discussion. It will be sufficient for me here to say that upon the questions therein raised the last word has been by no means said; and that, whether the theory be ultimately established, or whether, like a phœnix, it shall hereafter give rise to some other outcome from its own ashes, it will ever be remembered as having set many active minds at work, and will always have a place in the history of Solar Physics.

In Mathematics, definite integrals, and elliptic and the higher transcendents continue to occupy much attention, and in particular our "Transactions" contain an excellent contribution to the theta-functions of two variables, by Mr. Forsyth, of Liverpool. To the theory of invariants, Prof. Malet, of Cork, has given a happy extension in the direction of linear differential equations; but it is unnecessary to speak in detail of papers which either already are, or will shortly be, in the hands of the Fellows. I will only add that the "Philosophical Transactions" for 1882 will probably exceed in bulk, and not yield in interest to, those of any former year.

Looking outside the circle of our own publications, there has been one step gained during the past year, which, although in some sense a matter of detail, is really of great importance and interest. I allude to the paper by Lindemann, "Ueber die Zahl π" ("Mathematische Annalen," Band xx, p. 213). It had long since been shown that both the numbers π and π^2 are irrational; but hitherto no proof existed of the impossibility of effecting the quadrature of the circle by means of the straight line and circle, and ruler and compasses. Regarded from an algebraical point of view, every such construction must depend upon the solution of a quadratic equation, or rather of a series of quadratics whereof the first has for its coefficients rational numbers, and the succeeding members of the series only such irrational numbers as occur in the solution of their predecessors. This being so, the final equation can always be transformed, by transposition of terms and squaring, into an equation of an even degree with rational coefficients. And, consequently, if it can be proved that π cannot be the root of any algebraic equation whatever with rational coefficients, the impossibility of the quadrature of the circle will be thereby also proved. Starting from Hermite's researches ("Comptes Rendus," 1873), in which he established the transcendental nature of the number e, Lindemann has supplied the proof required with reference to the number π. It must be admitted that the proof is neither very simple nor very easy to follow; and it remains only to be hoped that it may some day assume such a form as may influence the minds which still exercise themselves upon the hopeless problem of squaring the circle.

A most important change in the relations between the Society and the Government in respect of State aid to science has been made this year. It will be in the recollection of the Fellows that an experiment was made for a period of five years, during which the sum of 4,000*l.* was annually voted to the Science and Art Department, to be distributed at the recommendation of the Government Fund Commitee of the Royal Society. That experimental period terminated, as then mentioned in my address, last year. The grant to the Science and Art Department has been discontinued, and in the place of it an addition of 3,000*l.* per annum has been made to the Government grant, making 4,000*l.* in all. In concluding this arrangement the following stipulations were agreed to. The increased grant is to be administered by a Committee identical with the late Government Fund Committee; a portion may be devoted to personal grants, subject, however, to special recommendations to the Treasury; and, lastly, unexpended balances may be carried forward from year to year, as has hitherto been the case with the old government grant only. To the stipulation that the increased fund should be administered by the more extended committee the Society felt that no reasonable objection could be offered, because upon it the President and Council are represented in full, and the *ex officio* members are in the majority of cases Fellows of the Society. The object of the second stipulation was, so far as the Society is concerned, to secure at the outset for the personal grants the consent and support of the Treasury, and thereby to preclude the chance of objection being subsequently taken to any of our proposals under this head. The President and Council, however, recognising the importance of great caution in respect of personal grants, have of their own motion appointed a special sub-committee (in addition to the three previously existing), to which all personal applications recommended by any of the other sub-committees are specially referred, and without whose recommendation none can come before the General Committee. To the third mentioned point, viz., the power of retaining unexpended balances, the President and Council attach great value, because that power may enable the Committee to devote more of its funds than heretofore to some of the larger undertakings in scientific inquiry, leaving more of the smaller grants to the special funds already in existence in the hands of the Royal and other societies. The meetings of this Committee will probably take place twice a year, in May and November. In the present year it will not be possible to hold the second meeting before December, but there will be advantages in holding it hereafter in November, as the entire annual grants will then be made by the same Committee, and under the sanction of the same President and Council. In concluding these few remarks on the new arrangements, I cannot refrain from expressing my sense of the obligation under which the Society and Science at large are laid by the sympathetic and intelligent attention bestowed upon the subject by the then Financial Secretary of the Treasury, the late Lord Frederick Cavendish.

Among other subjects referred to the Royal Society by Public Departments I may mention a request from the Board of Trade for advice upon the question of improving the existing means at the Standard Office for the purpose of comparisons. At the request of the President and Council, Sir George Airy, Colonel A. Ross Clarke, and Prof. Stokes acted as a Committee, and drew up a very careful report, the value of which was fully recognised by the Board of Trade. The report suggested certain improvements in the present arrangements; but, having reference to the duties of the Standard Office as defined by Act of Parliament, it was not considered necessary to insist upon extreme scientific accuracy, such, *e.g.*, as that attained by Colonel Clarke himself in his "Comparison of Standards" made at the Ordnance Survey Office at Southampton in 1866.

The arrangements for the observation of the Transit of Venus have been steadily progressing. The parties have now all started for their stations, after their period of training under the superintendence of Mr. Stone at Oxford. An adequate supply of instruments has been secured at moderate cost, and all the accessory parts have been procured and applied by the indefatigable care and forethought of our directing Astronomer.

The English Expeditions for the observation of the approaching Transit of Venus are organized as follows:—

ACCELERATED INGRESS.

Madagascar Observers.—Rev. S. J. Perry. Rev. W. Sidgreaves Mr. Carlisle.
Cape Observatory Observers.—Mr. Gill and Staff.
Aberdeen Road Observers.—Mr. Finlay, First Assistant of the Cape Observatory. Mr. Pett, Third Assistant of the Cape Observatory.
Montagu Road Observers.—Mr. A. Marth. Mr. C. M. Stevens.

RETARDED INGRESS.

Bermuda Observers.—Mr. J. Plummer. Lieut. Neate, R.N. Capt. Washington, R.E.
Jamaica Observers.—Dr. Copeland. Capt. Mackinlay, R.A. Mr. Maxwell Hall.
Barbadoes Observers.—Mr. C. G. Talmage. Lieut. Thomson, R.A.

Besides the observers at these stations, the Canadian Government has arranged to place three 6-inch and some smaller telescopes in the field. Lieut. Gordon of Toronto was sent by the Canadian Government to England to make himself master of the proposed arrangements, and to secure the necessary instrumental equipment.

ACCELERATED EGRESS.

The stations for Retarded Ingress are also available for Accelerated Egress.

RETARDED EGRESS.

Brisbane Observers.—Capt. W. G. Morris, R.E. Lieut. H. Darwin, R.E. Mr. Peek.

New Zealand Observers.—Lieut.-Col. Tupman, R.M.A. Lieut. Coke, R.N.

Besides these observers sent specially from England, the Observatories at Melbourne and Sydney are most favourably situated for observing the Egress. The Directors of these Observatories, Mr. Ellery and Mr. Russell, have promised their co-operation, and their Governments have placed funds at their disposal to cover any necessary expenses.

Unless unfavourable weather should prevent the transit being seen at some of the stations, we may expect some nine or ten pairs of corresponding observations, both at Ingress and Egress, from the British expeditions alone. These observations are certain to be largely supplemented by those made by the observers of other nations; and it is hoped, from close agreement between the instructions issued to the different observers, that the whole may ultimately be available for combination in one general discussion.

The American astronomers, encouraged by the partial success which attended the plan they adopted in 1874, are relying chiefly upon the photographic method; they have sent expeditions to South America and the Cape of Good Hope.

Austria does not take any active part in observing the Transit.

France sends out eight well equipped expeditions, full particulars of which have been published in the "Comptes Rendus" for October 2.

From Holland no special expedition will be sent out, but Lieutenent Heyming, of the Dutch Navy, will observe the transit in the West Indies, probably at Curaçoa.

Italy will confine its operations to observatories in that country.

Russia, also, has decided to send out no expeditions of its own, but it has aided the efforts of other countries by lending a 6·5-inch reflector to the Danish Government, and has placed two excellent 4·3-inch heliometers in the hands of the French astronomers, MM. Tisserand and Perrotin. The considerations which led the Russian Government to this conclusion have been explained in the following paragraphs of a letter from Mr. Struve to myself:

"Experience since 1874 has sufficiently proved that there is no prospect whatever, even with combined international efforts, of obtaining by the present transit a geometrical determination of the parallax of the sun, which would not soon be surpassed in accuracy by other recent methods (for example, that suggested by Mr. Gill), methods which are capable of being repeatedly employed, and that without any costly expeditions.

"Further, although it must be admitted that so rare an opportunity of studying the atmosphere of the planet ought not to be neglected, yet it seems certain that so many and such excellent data will be obtained through the agency of the United States, as well as by other countries having well provided observatories in the southern hemisphere, as well as by other seafaring nations." Under these circumstances Russia has not considered it incumbent on itself to organise any observing parties.

Spain has sent two parties of naval officers, well equipped with 6-inch equatoreals and other instruments, to the Havana and Porto Rico.

Last year I expressed a hope that the difference of longitude between Singapore and Port Darwin in Australia would be determined by Commander Green of the United States' Navy in concert with Mr. Todd. This operation, however, in consequence of some incorrect information furnished to Commander Green as to the intentions of our home authorities in the matter, was not carried out. After various proposals, extending over a period of not less than two years, I am happy to say that it now appears likely that the work will be performed. Through the liberality of the Secretary of State for War an extension of leave has been granted to Lieutenant Darwin, who accompanies Captain Morris to Brisbane to observe the transit of Venus, enabling him to undertake the work. He has received instructions to arrange with Mr. Todd all details of the operation. The publication of the results obtained by Oudemans and Pogson for the difference of longitude between Madras and Singapore has now left only one link wanting, namely, that between Batavia and Port Darwin, to connect Australia with English longitudes. Lieutenant Darwin is eminently qualified for the work; and it seems a happy coincidence that it should fall to his lot to connect astronomically the distant port named after his father with the furtherest ascertained point in that direction. I should not omit to add that Mr. Todd has placed all the telegraphic appliances under his command at the disposal of this service, and it is to be hoped that the determination will prove as useful to the Australian colonies as it will be valuable for the purposes of the transit. The best thanks of the Committee have already been given, but I am glad here publicly to recognise the valuable assistance rendered to the Committee in these long negotiations by the Great Eastern Telegraph Company.

In the course of last year the Treasury made known to the Society that in consequence of Sir Wyville Thomson's ill health, their Lordships proposed that his chief assistant, Mr. Murray, should undertake the general editorship of the Reports of the *Challenger* Expedition; so that Sir Wyville might devote himself more exclusively to the personal narrative. At the request of their Lordships a small Committee, with whom Mr. Murray might consult from time to time, was appointed, consisting of the President and Officers, Sir Joseph Hooker and Prof. Huxley; but before the Committee could meet the lamentable death of Sir Wyville Thomson occurred. They met, however, shortly afterwards, and having added Prof. Mosely to their number, they received from Mr. Murray, who attended, a detailed statement of the existing condition of the whole arrangements conected with the Report. From this statement it appeared that, in addition to the original estimate of 20,000*l.* given by Sir Wyville Thomson, the work actually in progress and entrusted to the several authors required a further sum of about 20,000*l.*, and that if the series should be completed, by describing on the same scale groups as yet unallotted, an additional expense of about 6,000*l.* would be entailed. In forwarding this statement to the Treasury, the Committee stated that, in their opinion, Mr. Murray's estimates were drawn up with great care and judgment, and that in view of the remaining Reports being carried out on the same scale as those already published, they were reasonable and sound. As to the cause of the great discrepancy the Committee felt themselves unable to offer any explanation; the conduct of the whole business having been left in Sir Wyville's hands, without reference to the Society. They further were of opinion that Mr. Murray might safely be entrusted, under the control and supervision of the Committee, with the entire future management of the undertaking.

After some further correspondence it was suggested that Mr. Murray should furnish the Committee with a statement of the existing condition of the Reports and their management, which should form a starting point for the responsibility of the Committee; and that he should keep the Committee well informed from time to time of the progress of the undertaking. These suggestions were cordially accepted by their Lordships, and with the general statement which Mr. Murray submitted in October, the special duties and responsibilities of the Committee have begun.

Since last year, three more volumes of the Report have been published, making six in all. The new volumes form volumes iv. and v. of the Zoology, and volume ii. of the Narrative. The latter volume comprises the magnetic results, the meteorological observations, the report on the pressure errors of the thermometers, and the petrology of St. Paul's rocks. Vol. i. of this section, containing the narrative proper, is partly in type; and will, it is hoped, be issued during the summer of 1883. Other volumes will also appear from time to time.

In connection with this subject, I may mention that the collection of specimens from the *Challenger* Expedition are being received at the British Museum, as the particular portions are released by the progress of the publication of the Report. Those derived from the *Alert* Expedition to the South Pacific Ocean, have been deposited in the Museum by the Admiralty, and are now being arranged and described. Dr. Günther hopes to be able to produce a printed descriptive catalogue of the collection before the expiration of the present year. And I desire here to acknowledge the service rendered to science by the Admiralty in commissioning Dr. Coppinger to accompany that expedition for scientific purposes.

I am indebted to Mr. Murray for the following interesting account of a cruise made last summer to complete some part of the *Challenger* work.

H.M.S. *Triton* was engaged, from the 4th of August to the 4th of September, in a re-examination of the physical and biological conditions of the Faroe Channel.

The chief objects of the cruise were to ascertain by actual

soundings, the character of a ridge running from the north of Scotland to the Faroe fishing banks, and separating, at depths exceeding 300 fathoms, the cold Arctic water with a temperature about 32° from the so-called Gulf Stream water on the Atlantic side with a temperature of 47° F. This ridge was traced in considerable detail by means of cross soundings directly across the channel, and the top was found to be on an average about 260 fathoms, beneath the surface. In the northern half of the ridge, however, a small saddle-back was found with a depth of a little over 300 fathoms, through which some of the Arctic water seemed to flow and to spread itself over the bottom on the Atlantic side of the ridge. The top of the ridge is entirely composed of gravel and stones, but mud and clay are found on either side at depths exceeding 300 fathoms. Many of the stones are rounded, and some of them have distinct glacial markings. They are fragments of sandstone, diorite, mica-schist, gneiss, amphibolite, chloritic rock, micaceous sandstone, limestone, and other minerals. The ocean currents here appear to be strong enough, at a depth of between 250 and 300 fathoms, to prevent any fine deposit, such as mud or clay, being formed on the top of the ridge. All the indications obtained of the nature of this ridge, seem to imply that it may be a huge (terminal?) moraine.

It is worthy of notice that the "Wyville Thomson Ridge" is only a little to the east of the position marked out by Croll from the observations of Geikie, Peach, and others, as the probable limit of the perpendicular ice cliff formed in North Western Europe during the period of maximum glaciation.

The dredging captures show the same marked difference as had previously been pointed out in the fauna of the two areas; those in the cold area being of a distinctly Arctic character, and those in the warm area resembling the universally distributed deep-sea fauna of the great oceans. A fair proportion of new species were also found.

The last trip of the *Triton* took place from Oban, on the 11th September, to the deep water in the Atlantic westward of Ireland. The object of this trip was to get *directly* a determination of the pressure unit of the guages employed in testing the *Challenger* thermometers. The original determinations were made *indirectly* by the help of Amagat's results as to compression of air. The observations taken are not yet reduced, but several successful trials were made at depths of 500, 800, and 1,400 fathoms.

(*To be continued.*)

M. MIKLUKHO-MACLAY ON NEW GUINEA

ON October 11 M. Miklukho-Maclay gave, at the Russian Geographical Society, the first of a series of lectures on his sojourn in New Guinea. These lectures have attracted great audiences. His remarkable collections of household articles and implements of Papuans and of various tribes of the Malacca Peninsula, and the many drawings reproducing scenes of the life, dwellings, graves, anthropological types, &c., of the natives, are exhibited in the rooms of the Geographical Society, and attract many visitors.

M. Miklukho-Maclay left St. Petersburg in 1872, and went on board a Russian ship to New Guinea. He expressed the wish to be left there for at least a year, and it was fifteen months after his being landed that he was taken up by a ship which brought him to Batavia. His stay in New Guinea was beset with difficulties. He lived in a small hut, was short of provisions, which he had to supply by hunting, and his health was quite broken down. But he entered into very close relations with the natives. In Batavia he stayed for several years, and published (in German) the results of his anthropological and ethnological observations among the Papuans, on the Brachycephaly of the same, and on the climate of the "Maclay-coast" in the Batavian scientific journal, *Natuurkundig Tijdschrift voor Nederlandsch Indie*. A paper (in French) on the Vestiges of Art among the Papuans appeared in the *Bulletin de la Société d'Anthropologie de Paris* for 1878. In 1876 he undertook a new journey on board the English schooner *Sea Bird*, and visited the Yap, Pelau, Admiralty, and Ninigo Islands, and went again to the coast of New Guinea, to which his name is now attached. An account of this journey has appeared in the *Izvestia* of the Russian Geographical Society and in *Petermann's Mittheilungen* for 1879. During this second sojourn in New Guinea M. Miklukho-Maclay was lodged more comfortably, and was enabled to pursue scientific investigations (anthropological measurements and anatomical researches) with less difficulty. He also explored in a canoe, with natives, the coast of New Guinea between Cape Croaz and Cape Teliata. Having undertaken his adventurous journey on his own account with but a little occasional support from the Geographical Society, M. Miklukho-Maclay was often in difficult circumstances; but a few years ago a public subscription was opened by the Russian papers, and the Russian Society immediately came to his aid, thus enabling him to continue his researches.

When in search of a place at which to study the customs and life of the primitive people at the lowest stage of culture, M. Maclay chose the north-western coast of New Guinea, close by Astrolabe Bay, which was never visited before by Europeans. Neither Dampier nor Dumont D'Urville, who both passed close by, had landed there. He built his hut between two Papuan villages, on a promontory that was occupied by nobody. At the beginning the Papuans wished him to go back whence he came, and obstinately showed him the sea; sometimes they launched their arrows close by him, but without wounding. By great endurance however, by his good nature, and especially by a continuous self-control and severe watching over his own actions, M. Maclay soon won the confidence of the natives. He always strictly kept his word, even in the most insignificant circumstances, and therefore had afterwards the satisfaction of hearing the natives saying "*Balan Maclay hoodi*" ("The word of Maclay is one"). The natives used to call him *Kaaram-tamo*, "The Moonman," partly on account of the supernatural capacities they ascribed to him, and partly on account of his having once, when searching for something about his hut in the night, lighted a white signal-fire that was left from the ship which brought him. The first visits of M. Maclay to the Papuan villages were a source of great trouble among the natives; the women were concealed and the men seized their arms. M. Maclay used then to announce beforehand his arrival by loud whistling, and the natives concluded he did not wish to do them harm. By and by he won the confidence of the natives to such an extent that an attack of a hostile tribe having been expected, his neighbours brought their women and children to his hut, to be under his protection. The war was thus prevented, and the authority of the "Moon-man" was sufficient to prevent further wars.

The natives of this coast are at the lowest stage of culture. Before M. Maclay's arrival they did not know the use of metals, all their implements being made of stone, bones, and wood. They did not even know how to make fire. If the fire were extinguished in a hut, it was taken from another; it would be taken from a neighbouring village if extinguished in all the huts of the village at once. Their grandfathers told them of a time when they had no fire; then they ate their food quite raw, and a disease of the gums spread among them. They do not bury their dead. The dead are put in a sitting position, the corpse is covered with leaves of the cocoa-palm, and the wife must keep a fire close by him for two or three weeks, until the corpse is dried. Corpses are buried only if there is nobody to keep the fire.

M. Maclay left the Papuans with regret, when a passing schooner took him, in 1878, to Singapore. He expects for his friends the fate of the inhabitants of the Melanesian Archipelago, where the population rapidly diminishes on account of the "kidnapping" of men and women to sell them into slavery, which is practised to a great extent by crews of ships of all nationalities of the civilised world.

In his second lecture, M. Miklukho Maclay gave further information with regard to the Papuans of New Guinea. Previous anthropologists had admitted the existence of at least two different races in New Guinea, and had made a distinction between the Papuans inhabiting the coast and those of the interior. After several visits to New Guinea, as well to the coast, as to the interior, M. Maclay came to the conclusion that this supposition is not correct. The Papuans of the interior belong to the same race as those of the coast, and there is throughout New Guinea but one single Papuan race. Virchow found it also necessary, on the ground of craniological measurements, to distinguish the Papuans from the Negritos of the Philippine Islands, and to admit that the former are dolichocephalic, and the second brachiocephalic. Hundreds of measurements made by M. Maclay brought him to the conclusion that both types have their representatives even among the purest Papuans of the Maclay coast, and that the transversal diameter of the skulls of Papuans varies everywhere within so wide limits (62 to 86 per cent. of the length of the skull), that no classification can rest on this feature. It was stated also that a special

feature of the Papuans which distinguishes them from other curly-haired races, is that their hairs grow in clusters, separated from one another by sinuous spaces devoid of hair. Extensive researches proved, however, that this cluster-like disposition of hairs does not exist among Papuans, not even among children. Finally, several anthropologists considered the diameter of the curls of the hairs as a feature that may help to establish a distinction between the Papuans and the Negritos; these last have been supposed to have smaller curls than the former, that is, no more than one or two millimetres wide. M. Maclay found, however, that the diameter of the curls of the Papuan also does not exceed one and a half millimetre, and that it varies very much in different parts of the head, so that this feature cannot be taken as a basis for anthropological classification.

After having taken some rest at Buitenzorg, M. Maclay left Batavia in January, 1873, for a third visit to New Guinea. The Malayans of Celebes have carried on an intercourse with New Guinea for more than three or four hundred years; they go there, as well as the inhabitants of the islands Lant, Seram, and Key, for the purchase of slaves, turtles, trepang, and pearl shells. To establish closer relations with the natives, the Malayans of Celebes bring with them Malayan girls, give them as wives to the Papuans, and export in exchange Papuan girls who are married in Celebes. (These relations were described by P. A. Leupe in the "Bijdragen tot de Taal-Land en Volkenkunde van Nederlandsch-Indie" for 1865.) Therefore it is impossible to find pure Papuans on the Papua-Onim and Papua-Notan coasts, and M. Maclay took the resolution to go to the Papua-Koviay coast. The inhabitants of this coast have a very bad reputation as robbers and anthropophagi; but still, M. Maclay hired a Malayan "praw," or "urumbay," that is, a boat thirty feet long, and, with a crew of two Christians from Amboyna, and fourteen Malayans and Papuans, he left the islands Seram-Lamut, and reached the Koviay coast. Triton Bay (where the Dutch had formerly a military settlement) proved to be a beautiful strait, to which M. Maclay gave the name of the Russian Grand Duchess Helena Pavlovna. He discovered also another bay that separates the island Namatote from the mainland of New Guinea. He stopped at Aiva, between these two straits, and his men immediately erected a hut from the "ataps" (a kind of mat made from leaves of the tapioca palm) that were brought in the boat. The inhabitants of this coast proved to belong to the same race as those of the Maclay coast; however, it was easy to perceive, especially among children, unmistakable traces of mixture of Malayan blood The size of the men on the Maclay coast varies from 1·74 metres to 1·42; the size of full-grown women was 1·32. On the Papua-Koviay coast the size of the men was from 1·75 to 1·48 metres, and the size of the women 1·31. On the Maclay coast the length of the transversal diameter of the skull was from 64·0 to 86·4 per cent. of the longitudinal diameter, and from 62 to 80 per cent. on the Koviay coast.

Leaving ten men at Aiva, M. Maclay went with the remainder of his crew to explore the interior of the mainland. He landed opposite Coira Island, and, crossing a range of mountains 1200 feet high, reached Lake Kamaka-Vallar. He found there a tribe which calls itself Vaasirau, but does not differ from the inhabitants of the coast. The water of the lake was very warm (31° Celsius), and contained an interesting new kind of sponge, belonging to the *Hallichondriæ*. The rains in this part of New Guinea are so copious that Triton Bay is sometimes covered with a sheet of sweet water that can be taken in vessels and used for drinking. As the lake has no outlet, its water rises many years, sometimes fifteen and twenty feet, and covers the trees that grow on its shores; but after a period of rising, the rocks at its bottom give way, and the water is discharged through a temporary outlet, which is soon checked by stones and mud. Returning to the shore, M. Maclay made excursions to the neighbouring islands (discovering coal on Lakahia Island), as well as several other excursions to the highlands of New Guinea. In Telok Bay the boat of M. Maclay was attacked by a number of pirogues of Papuans, but made his escape by rowing all night. But his men at Aiva were not so fortunate. They were attacked by 200 Papuans, who destroyed the hut and killed an old man who was interpreter, as well as his wife and child. A further stay at Aiva was impossible, as the Papuans had poisoned the springs; and so the party went to stay on Aidum Island, where M. Maclay's hunter brought him every day plenty of interesting birds and other animals. The New Guinea kangaroo, *Dendrologus ursinus*, is worthy of mention, as it has to adapt itself to local conditions, strong nails, and lost at the same time the strength of the muscles of the tail; it has become thus a climbing animal and lives mostly in trees. After having taken prisoner the chief of the Papuans who had robbed his hut, (M Maclay went one day with a few men to their camp, and simply ordered them to tie the chief; the Papuans, terrified by the sudden appearance of a white, opposed no resistance), the party returned to the Seram-Lamut Islands, where M. Maclay studied the mixed race from the crossing of Malayans with Papuans. The anthroplogical results of these studies have appeared in the above-mentioned periodical as an appendix to the paper entitled "Meine zweite Excursion nach Neue Guinea," 1874."

The Papuans of the Koviay coast are a very interesting race of aquatic nomads. They were centuries since in relations with Malayans, who came to New Guinea especially to purchase slaves, exported to a great extent to the Malayan Islands. The slaves were formerly purchased among the inhabitants of the sea-coast; but to have more slaves these last have begun to make raids on the highlanders, who took revenge by raids themselves, so that the inhabitants of the coast were compelled to abandon all their villages. They are living now in covered boats, and continually cruise in them along the shore in search of food, landing only during storms, for in the night, at a few well-known places, where they are safe from attacks by the highlanders. The Malayans have introduced among them the use of gold, opium, and fire-arms, and they are very miserable.

From the Koviag coast, M. Maclay returned to Java, but soon undertook a fourth journey to New Guinea, to the southern coast, in order to ascertain the existence of a yellow Malayan race, which was mentioned several times by missionaries and travellers. After an eleven months' cruise on board a schooner, during which he visited the Solomon and Luisiada Islands, M. Maclay stopped on Teste Island, and thence proceeded on board a schooner to Port Maresby (Anapuata), on the southern coast of New Guinea. During his visits to the neighbouring villages, he perceived, indeed, a mixture of Polynesian blood among the Papuans. These metiss have a lighter skin and uncurled hair. They have also taken from the Polynesians the use of tattooing; all women tattoo themselves as long as they have children, and M. Maclay remarks that not only himself, but also many Europeans, find that the tattooed Papuan women are really better looking than the un-tattooed. They cover themselves with tattooing from the forehead to the feet, and often shave the head to tattoo it. The men are tattooed only to exhibit some of their exploits; by simply looking at a tattooed man you can say how many foes he has killed. The south coast is inhabited by the same Papuans as the other parts of New Guinea. Here also brachiocephalic skulls are not uncommon; but the skulls are also distorted, as the women used to bear loads on their backs, in bags that are attached by a rope to the head. The transversal depression of the bones at the *Satura sagitalis*, which results from this custom, is met with very often, and must be transmitted by heredity.

M. Maclay made a fifth visit to New Guinea on board an English man-of-war, to exercise his conciliating influence on the commander, who was going to burn a whole village and destroy the 2000 inhabitants, in order to punish them for killing four missionaries. The visit was very short.

M. Maclay concluded his lecture with a few remarks on the influence of the whites on the inhabitants of the south coast of New Guinea. Whilst rendering justice to the efforts of the London Missionary Society, who spread, by means of their black staff, the Christian religion, and teach the natives to read and write, M. Maclay pointed out that traders follow immediately the missionaries, and spread among the natives diseases, drunkenness, and the use of fire arms, which completely counterbalance the good influence of the very small amount of knowledge that might be spread by missionaries. The London Missionary Society does not allow its members to be at the same time the bearers of religion and of the above-said "benefits of civilisation"; but several missionaries of other societies appear in both these qualities. M. Maclay hopes, however, that the climate of New Guinea will be a good ally of the natives in their struggle against the white.

THE AURORA

WE have received the following further communications relating to the electric storm and auroral display of November 17:—

HAVING read in the English journals how very extensively and simultaneously the remarkable display of aurora borealis was observed in Europe and the United States, I beg to forward the inclosed report from Prof. Tacchini (see below), taken from a newspaper in Rome, describing that splendid phenomenon as it appeared in this country on the evening of the 17th inst, which probably may interest some of your readers. I would merely add that on the evening in question I was travelling between Spezzia and this city, when my observation was absorbed by the brilliancy of the beautiful phenomenon as seen from a railway carriage, and which accords very closely with the appearance of it in Rome. Soon after sunset the north-western sky was diffused with richly-coloured roseate tints blending into crimson at the horizon, which continued up to 7 p.m.; the transparency of this apparently roseate cloud was also a very remarkable feature, for the stars of the Great Bear were seen through it with little diminution of lustre; the sunset was very noticeable, which I remarked before branching from the coast where I had the sea horizon, and I never saw a more distinct and clear disappearance of the sun at sea below the horizon, even to the clearness of the atmosphere. Aurora borealis is so seldom seen in this country that its appearance caused much public curiosity. ERASMUS OMMANNEY

Florence, 12, Lungarno, November 30

THE following account of aurora borealis, seen on the 17th ult., at the Observatory of the Roman College, was sent by Prof. Tacchini to the Roman journals:—

"Yesterday evening (the 17th), a few hours after sunset, a fine aurora borealis appeared on our horizon. Besides the magnificent rosy arch melting away above, I saw, below, the so-called dark segment, which had a most lovely azure-greenish colour.

"At 5h. 50m. the red ribband rose more than 30° above the horizon, but at 5h. 55m. clouds suddenly covered almost the whole of that part of the sky occupied by the aurora, and a storm, with lightning, arose in the north. At 6h. 18m. there was a slight clearance, and through the aurora, which had already paled, shone some of the stars of Ursa Major. The highest point of the dark segment was precisely between the stars α and ζ of that constellation, being about 14° above the horizon, and 17° from the north towards west, therefore nearly in the direction of the magnetic meridian, and with an amplitude of about 45°. The weather continued bad, and at intervals rainy, and at 6h. 32m. were seen the last traces of the phenomenon. From the auroral light only a very faint continuous spectrum could be obtained, but I could not make such observations at the most opportune moment.

"Several falling stars were observed through the aurora. A magnetic perturbation occurred yesterday, and in the night, and continued also to-day; and, moreover, there is on the sun a large spot, easily visible on using merely a piece of smoked glass.

"The large diameter of this spot is slightly less than the thirteenth part of the apparent diameter of the solar disc. The spot appeared on November 12, at the eastern limb in the sun's boreal hemisphere, and on the 12th and 13th magnetic perturbations occurred. Yesterday I could not observe it well, because of the bad weather; but the day before, clouds of hydrogen were seen on its nuclei, and this morning still the phenomenon is most brilliant, demonstrating the greater intensity of solar phenomena over the spots in the atmosphere of the sun, which may thus be called solar auroras.

"Again, the magnetic perturbation of yesterday and last night is connected with that vast storm depression, which embraced a great part of Central Europe and especially Italy.

"We will further record here, that in the beginning of last October another aurora borealis was observed, and that then also there were strong magnetic perturbations in the earth, and large spots on the sun, seen on the limb on September 25.

"The Director of the Telegraphs has announced that very great perturbations occurred yesterday on all the lines, and from Belluno, Milan, Turin, Moncalieri, Venice, Porto Maurizio, Parma, Modena, Genoa, Luveno, and Viesti have come telegrams, showing that in the north the phenomena must have been very splendid. From Venice the Director of the Observatory states that yesterday morning at 4 o'clock, gleams of auroral light were observed. "P. TACCHINI

"Observatory of the Roman College, November 18"

I AM afraid you must have been overburdened with auroral communications, but perhaps you will kindly allow me on this occasion a little more space. Mr. E. Dowlen witnessed at Medway, Poynton, Cheshire, but little of that of the 17th; but on the 13th saw an auroral haze with shafts of white light, at 6 p.m. in the north and north-west. This had been preceded by a rose-red sunset, unlike an ordinary one, and accompanied by magnetic clouds. He also noticed an auroral glow on several subsequent nights.

On Friday last (the 24th) the Rev. W. Pearce saw a fine aurora at West Horsley, about six miles east from here. It commenced about 9h. 15m. by a yellow glow in the north-north-east and north-north-west, which increased in brightness and rose upwards, until at 9h. 30m. the Great Bear was hidden by it. It then changed to a rose tint, and spread laterally; was at its greatest brilliancy at 9h. 50m., and disappeared at 10h. 15m. Mr. Prince, of Crowborough (who, from the movements of certain insects and the magnetic disturbances, anticipates a severe winter), remarks that the "bright beam" must have been like a row of patches of light he saw on last October 3, southward and nearly parallel with the auroral arch northward. As some of your correspondents seem to ascribe a meteoric character to this beam, I may add I examined it carefully with a large Browning direct-vision spectroscope designed for auroral observations, and found only the well-known citron line, and none other. Also a faint greenish-white continuous spectrum extending a short way from that line towards the violet. This might have been auroral or from moon reflection. I had just previously examined the sky in that direction, and found no auroral line.

Mr. Saxby's letter is interesting in fixing approximately the position and height of the beam, especially when read in connection with Messrs. De la Rue and Müller's vacuum experiments and their table of heights assigned to auroræ, and it is still paradoxical that if such electric displays be within the limits of our atmosphere the air-spectrum is conspicuous for its absence, while it is replaced by one the principal line of which is not found in any other form of matter in the sky or on the earth.

On the other hand this point would not be inexplicable if the aurora be considered a something *per se*, as, for example, phosphorescence (strongly marked in the recent auroræ), excited by the electric discharge. That in such case it might wholly or in great part appropriate the spectrum to itself is shown by the instances of indium, thallium, and some other volatile metals which, when used as electrodes for the condensed spark, give spectra in which the air lines are either absent or faint, and when burnt in the arc have a similar effect on the carbon lines. I have elsewhere pointed out the probability of the aurora being referable to a form of phosphorescence.

The moonlight was unfortunate as regards the masking the fainter lines of the spectrum. I see one record of a faint red line, but except this of no other lines. If any of your readers have fixed the other lines, you will no doubt find space for so important an observation, for it is curious how little we know of the exact positions of these. I believe the measurements of a full set of the auroral lines made by my friend Prof. Vogel of Potsdam, in April, 1872, still remain the only standard, and as we now seem at an auroral period I would earnestly urge upon spectroscopists their special attention to these fainter lines, with a view to fixing their positions. This, too, is important, as there is a suspicion they are not always the same in different displays. The mode of doing this is not, however, very easy. If the spectroscope is of very small dispersion, the lines will be too close for useful measurement. With one of larger dispersion the introduction of a comparison spectrum or an illuminated micrometer scale will swamp the lines. A single illuminated point or line working across the field, the eclipsing the lines successively behind a diaphragm of tinfoil (as suggested by Mr. Lockyer), and a scale photographed on thin glass, through which the lines are seen, and which is itself illuminated by the spectrum, are severally better methods, and might perhaps yield some available results.

Guildown, Guildford, December 1 J. RAND CAPRON

THE unique nature of this meteor must be the excuse for adding another letter on the subject. Your correspondents, Mr. Taylor of Heworth Green, York, and Mr. Elger of Kempton, have kindly answered queries of mine as to the exact place of the passage; these stations being the most important, after the transit stations of Woodbridge and Old Windsor. After Mr. Saxby's letter of November 30, any farther notice may seem superfluous, were it not that the elements he assigns cannot explain the observations. At York the meteor could not have

appeared at only 8° altitude, and it is described as 6° under the moon, or 19° alt. ; and the passage from Woodbridge to Bristol could not occupy over two hours (at a mile a minute), as the whole difference of time is certainly only a minute or two. We must then seek for more consistent elements.

From the York, Bedford, and Old Windsor observations, the meteor was at about 170 miles elevation, allowing the first station half the weight of the second. Or, combining York and Bristol, which were more nearly simultaneous, it was at over 300 miles elevation. Its visible passage of about 200 miles in length did not occupy two minutes, and was so brief as to be masked by the watch errors of observers ; it therefore moved more than 100 miles a minute. Again, it was two minutes in view, by Greenwich ; and it passed the meridian with at least twice its mean apparent velocity (as most observers mention its lingering in both east and west) ; this, with the least height of 170 miles, gives a minimum of fifteen miles per second for its velocity. Another proof of its height is, that though seen in Sweden, yet it appeared to form and pause at 10° alt., as seen at Bristol and Heworth, and did not come up from the horizon.

Can it be supposed that an auroral ray would sweep over 1000 miles from Sweden to Sidmouth, with a velocity of over fifteen miles a second? This is, however, just the velocity of planetary matter ; and apparently the most probable explanation of it is that it was a cloud of meteorites ("quite unlike an auroral ray," says Mr. Capron) which just escaped grazing the earth's surface. In this case their velocity would be at least over twenty miles a second, moving in about the plane of the earth's orbit, and crossing the earth's path at least at 45°, or more radially. Perhaps some computer will work out the path approximately, as other meteors have been so discussed.

Such a cloud of meteorites must have been at least 130 × 20 miles and 20 miles deep if cylindrical, and was apparently accompanied by a smaller cloud, as seen at Clevedon. As it was seen brightly in the moonlight, and yet scarcely dulled the moon in crossing it, the visual area of the solid mass might be about a tenth of the whole area of the cloud ; so that if the particles were as dark as the moon, the cloud would reflect one-tenth as much sunlight in an equal visual area. If then the mean diameter of the meteors was but 1 inch, their volume would equal a sphere of 800 feet diameter, and would have thrown down a rain of meteors, averaging ninety one-inch balls to the square foot, over a district about twenty miles across.

Falling meteors lose practically all their velocity by friction in the atmosphere, before they strike the earth ; since travelling at even 15 miles a second, they would be heated to over 1,000,000° F. by arrest, and yet they do not show in themselves or by their effects, a sign of a thousandth of this heat. All this heat then is produced in the air ; and if a meteor strike the earth obliquely, it will be checked and fall within a very few miles. All the heating of the air must thus take place within a small area, in whatever way the meteor may strike. The result then of such a meteor cloud as has been just seen, hitting the atmosphere (as it only escaped doing by a quarter of a minute) would be to heat the air for some twenty miles in each direction to about 10,000° F., or still more if the arrest occurs entirely in the upper regions. This hot air would quickly rise, and spread out above the cooler atmosphere, causing a great in-suck along the earth from surrounding parts. On the upper surface it would quickly cool by radiation into space ; and the effects of such a shower to terrestrials would be a terrible gale, blowing towards a centre and upwards, with considerable heat radiating from above.

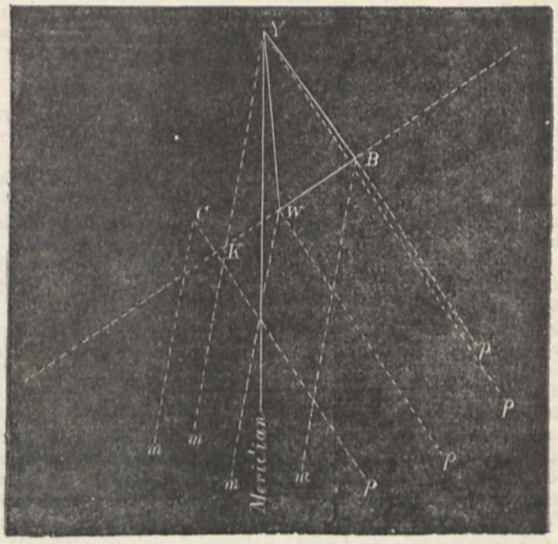
W. M. FLINDERS PETRIE

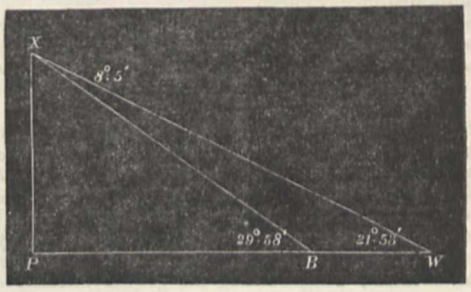
Bromley, Kent, December 2

CONCERNING the apparition during the aurora of the 17th, I ought to have stated the apparent altitude angle between it and the moon when at nearest approach, but as the angle was larger here than anywhere south, it was more difficult to estimate ; but I think it was about 12 moon-breadths, at the very most or 6° (centre to centre). Also I foolishly forgot to note the *exact* time, but it was 4 or 5 minutes past 6 p.m. I saw no repetition of the phenomenon for 5 minutes after, and I then went indoors. It is evident that if it was the same object that was seen to transit the moon's disc both at Woodbridge (near Ipswich) and Windsor, that it must have followed a path from north-east by east to south-west by west (astronomical) since the intersection of its plane of motion with the plane containing York, Woodbridge, and Windsor, lies in that direction. Most of the observers state that it seemed to appear about east, and disappear south of west. Let *Y*, *W*, and *B* represent York, Windsor, and Woodbridge respectively in their relative positions. *C* represents Clifton.

We have $Y B = 162$ miles.
$Y W = 172$,,
$B W = 94$,,
$C K = 40$,,

If it be supposed that the object pursued a *nearly straight path*, keeping at a nearly constant height (and this is not inconsistent with the observations), then it ought to have reached its greatest angle of elevation along lines drawn perpendicular to line *B W* from each place of observation (it seemed to do so at Greenwich, Bedford, and Cambridge, though all the observers do not state whether they reckoned by magnetic or astronomical bearings). The moon was about 8° past meridian, and at York the altitude was about 24°, and at Woodbridge 26° (there being 2° of latitude between). If we consider the angles with respect to the *plane Y B W*, which simplifies matters, then elevation at York = 25°, and at Woodbridge the same ; and as





angle between directions *Y m* and *Y P* = 36°. Then tan of angle of culmination at York will be equal to

$$\frac{\tan (25^\circ - 7^\circ)}{\cos 36^\circ} = \tan (21^\circ\ 53'),$$

and tan angle of culm. at Woodbridge will be equal to

$$\frac{\tan 25^\circ}{\cos 36^\circ} = \tan (29^\circ\ 58').$$

I am supposing the angle below the moon to be 7° for the sake of not exaggerating the height.

York and Woodbridge are in a line almost at right angles to *B W*. Then the parallax of the object when seen along this line (being the line of culmination) = 29° 58′ − 21° 53′ = 8° 5 about.

Thus in diagram No. (2) we have—

$$B x = 160 \text{ miles} \times \frac{\sin (21^\circ\ 53')}{\sin (8^\circ\ 5')}$$

and required height $x P = B x \sin (29^\circ\ 58')$.

This, when worked out, gives the astonishing height of 212 miles above the *plane YWB*. Nor can I see how this result can be lessened in any way, for I have allowed an exaggerated parallax. Again, if the mysterious object was *not* pursuing a path almost straight and parallel to the plane *YWB*, as I have supposed, for the sake of a rough calculation, it must have travelled in a *crooked* one, for which there will be evidence forthcoming no doubt. Now Clifton is forty miles off the line *B W*, and as Mr. A. M. Worthington carefully estimated the depression below the moon from centre to centre to be scarcely $3\frac{1}{2}$ moon diameters, or about $1\frac{3}{4}$ degrees, then at York, which is 160 miles off line *WB*, the depression ought to be $1\frac{3}{4}° \times 4$ nearly = nearly 7° (but it was not so much). I and Mr. Worthington would see it beneath the moon nearly at the same time, he a little later than I. If the height should be anything near 212 miles, then we ought to hear of it being seen overhead in the north of Italy and Southern France, and it would be 200 miles or so in length. I hope that more accurate observations will be forthcoming to enable some scientific man to calculate the path of this strange apparition with some accuracy. Of course, if the thing laid straight along its path, it would appear to observers in England to be curved along its trajectory, as it did to me. I ought to say that at its apparent formation it was partly obscured by cloud in the S.E.E. (astronomical).

Heworth, York, November 26 H. DENNIS TAYLOR

P.S.—Might I be allowed a little more space just to state that my estimate of the meteoroid's depression below the moon is considered far too much by my mother, who, happening to look out at the same time from a window, noticed it beneath the moon. She described it exactly as I had seen it, but did not notice its movement, as she only looked for a few seconds. If there had been two similar appearances at the same time, I do not see how I could have failed to notice them. Mr. S. H. Saxby estimates its height to have been 44 miles, but he will see that if that were so, then I ought to have seen it pass 17° below the moon. One cannot reasonably suppose that a different object of the same nature has been seen from the South of England, from the one that I saw. I see that Mr. A. Batson has observed it crossing the moon exactly from Hungerford, which place is in almost a direct line with York and the moon at the time of observation. Our observations would be simultaneous, and they give a height of 192 miles. The course of the meteoroid would be 22° south of west, almost as Mr. S. H. Saxby states. Being very anxious to obtain more exact data from observers in Yorkshire I sent a letter asking for information from any such to the *York Herald*, but it has not been inserted. Is there anything inherently improbable in supposing this phenomenon to have been at a height of 190 miles, for have not rapid shooting stars now and then been seen incandescent at nearly that height, indicating the existence of an attenuated atmosphere.—H. D. T.

December 3

ON Friday November 17 last, as I was walking along the north side of Lincoln's Inn Fields, at about 6 p.m., my attention was attracted to the moon, which was then shining brightly in a cloudless sky. I observed a broad band of light having somewhat the appearance of a light cloud, only much brighter, moving across the face of the moon from east to west, which was the direction of its (the light's) long diameter. It appeared to me to extend above and below the moon to about the distance of the moon's diameter, and to be in length about four times its own width; when it had passed about half its own length from the moon, it seemed to disappear entirely. The time during which it was visible, I should think, was not more than half a minute, probably not more than a quarter, and its movement across the moon as rapid as that of a cloud when a very high wind is blowing. EDWARD POLLOCK

20, York Terrace, Regent's Park, December 1

A GREAT manifestation of aurora was visible here last night. It attracted my notice at 11 p.m. At the time of observation by me the aurora was very active, projecting white streamers from a point in the south-west, and these, crossing the zenith, faded in the south-eastern sky. There was a stiff, cold north-west wind blowing, and the night was frosty. No prismatic colours were noticeable, only the usual green auroral glow in the north-west sky, where it was crossed by the shooting streamers. A grand band of vapour rested on the western, north-western, and northern horizons. In the east and north-east was a soft blue sky. The display seemed to me to last throughout the night, and to continue through the day; as all day long, at intervals, streamers shot up from a bank of clouds in the north-west horizon. At 5.30 p.m. this evening there was a powerful auroral glare in the west and north-west. After that time a cloud canopy formed and hid the sky. The weather here in the afternoon of Monday was stormy, with a rising barometer and a falling thermometer, wind nearly a gale, hail, rain, and snow falling at intervals. X.

Worcester, November 28

IN NATURE, vol. xxvii. p. 548-9, and 571, will be found accounts of the aurora borealis, as seen by your correspondents on Monday evening, October 2 last. I wish to draw attention to the fact that a grand Aurora Australis of magnificent appearance was visible in Australia on Monday evening, also on October 2, but of course was seen by our Antipodean friends about twelve hours before the one seen at this end of the globe. The reports that I have of the Aurora Australis are from Adelaide, Melbourne, Sydney, Sandhurst, Ballarat, &c. So brilliant was it that the firemen turned out, imagining that there was some enormous conflagration in their neighbourhood. This concurrence opens up the question, was there any connection between these two displays? J. FRANCIS COLE

Westfield, Sutton, Surrey, November 28

BY kindness of Astronomer Royal, Greenwich, I am able to add the exact position of moon at Ramsbury, November 17, inst., at 6h. 2m.:—

R.A. = 21h. 12m. 56s.
N.P.D. = 100° 35′ 7″.

At this time the hour angle of the moon was 35m. 49s., or 8° 57′ 15″ west of the meridian.

The above is the most accurate observation possible for calculating the real position with regard to the earth.

Ramsbury, Wilts ALFRED BATSON

I DO not know whether you will publish more auroral accounts, but if you do, the inclosed seems very interesting. The phenomena, as seen in the north, differed much from *our* views of them. J. RAND CAPRON

Guildown, December 4

"A singular pinkish light appeared in the western sky between 5 and 6 p.m. At the same time I noticed a light of a peculiar yellowish white rising up from the eastern horizon. The general appearance was that of two conical-shaped lights about 40° to 50° wide at base, east and west horizon, their apexes meeting at or about the zenith, z. The whole of the northern sky was more or less illuminated, but much more marked in the transverse streaks extending east and west, or nearly so in the former case, deepening to a rich crimson pink towards the western horizon, and to the eastern horizon a bright yellowish white. Its southern termination was a well-defined sharp outline forming an arc about 30° to 40° from the south horizon, inside which the sky appeared almost black by contrast, the new moon lending additional interest to this peculiar atmospheric display.

" F. R. CLAPHAM

"Austwick Hall, Clapham, Lancaster, December 1"

WITH reference to J. E. Clark's remarks on p. 85, I would remind your readers that Sophus Tromholt, of Bergen, has organised a system of simultaneous observations on auroras, and that he will supply forms for recording them to any observer who will apply for them. I am not aware whether he has yet arrived at any definite results as regards the height of auroras; nor do I know whether he is making this specially a subject for investigation; nor whether he has enlisted the services of many observers in Britain. Surely J. E. C. is in error in saying that a height of 100 miles is far greater than is now usually supposed. In works on auroras, far greater heights are given, and I am not aware that these have ever been disproved. It is obvious that the curious spindle-shaped beam seen on the 17th must have been at an enormous height.

Sunderland, December 4 THOS. WM. BACKHOUSE

The past week has been one of remarkable electrical disturbances. Auroras were visible Tuesday evening, November 14, all Friday night, Saturday evening, Sunday night, Monday morning, and Monday evening. It was cloudy in this vicinity between the 15th and 16th, and if there were auroræ they were not visible. The aurora of Friday evening, following an intense magnetic storm, was remarkably brilliant, and lasted all night.

During the earlier part of the evening all the visible northern hemisphere was covered by it, but later, about midnight, all the visible heavens, to within 20° of the southern horizon, was covered by straight streamers extending from all points of the horizon to the zenith, where they formed a boreal crown of blood-red colour. The streamers were pulsating towards the zenith, making the sight a peculiarly magnificent one. Early in the evening the arc to the north was about 10° in elevation, and then gradually raised, showing the rich folds bordered by a dark fringe of a magnificent waving curtain, until it reached nearly to the altitude of Polaris. The southern boundary, also bordered on the south by the dark band, seemed to be nearly at right angles to the circle of the northern arc. Monday evening, the 20th, all manifestation was confined to the south. In a point in the south-east, near where Foucalhaut then was, rays shot northward past the zenith, but instead of converging, the rays diverged like the fingers of one's hand. The horizon, too, in the south, seemed much lighter than in any other direction. Though moonlight, the rays could be plainly seen to within 5° of the moon. It may be remarked that of the spots on the sun during this period of disturbance, one has been visible to the naked eye.

L. G. CARPENTER

Agricultural College, Michigan, Lansing, Mich, U.S.A.
November 21

The electrical storm seems to have been as violent in America as it was in Europe, as will be seen from Prof. G. L. Carpenter's letter above. The American papers of November 18 contain long accounts of the phenomenon. The *New York Times* says :—

"Yesterday's storm was accompanied by a more serious electrical disturbance than has been known for years. It very seriously affected the workings of the telegraph lines both on the land and in the sea, and for three hours—from 9 a.m. until noon—telegraph business east of the Mississippi and north of Washington was at a stand-still. An aurora borealis was the first evidence of the overcharging of the atmosphere with electric fluid. This appeared at about five o'clock yesterday morning, and was brilliant in the extreme. At the same hour trouble began to be experienced in the action of the telegraph wires. The circuits were broken, and the usual annoyances accompanying such disturbances were manifested. These increased in intensity until nine o'clock, at which hour it became impossible to transmit messages over the wires having an earth circuit—that is, where the ends of the line were grounded. Such lines as had a metallic circuit worked all right throughout the day, however, and so some little business was transacted over isolated lines. The disturbance continued until 1·50 p.m., when the electric storm seemed to have ceased. During the electric storm Mr. Brown, the chief operator, stated it was impossible to work the cables at all, except by cutting off the ground wires and making a metallic circuit by connecting the land ends of two cables. This was done, but even then the cables worked in a very unsatisfactory manner From all the central offices complaints came to the general office of the failure of the lines to work. People who attempted to use the telephones heard a buzzing, ringing noise, rather than any well-defined sound while attempting communication, and occasional words only could be distinguished. A singular fact in connection with the storm was that the wires of the Law Telephone Company did not seem to be affected. Engineer Shaw stated that they had had no more trouble during the day than usual, and attributed this to the fact their lines are all short ones, and therefore less liable to be affected than the longer lines. Their wires are ground circuits, and their freedom from annoyance is a mystery that he can solve in no other way than the one suggested.

From Chicago, under date November 17, the following details of the disturbance were sent to the *New York Times* :—"Officers of the Western Union Telegraph Company there say the electrical disturbance was the most pronounced and wide-spread experienced for years, if indeed it has been paralleled at any time. An electric storm of the greatest violence raged in all the territory from New York to points beyond Omaha, and from Kansas City north to the terminus of telegraphic communication, practically putting a stop to the telegraphic service over the entire area. It first began to be felt about 4 o'clock this morning and increased in intensity till 9.45, when communication from every direction was cut off. This electric storm seemed to go in successive negative and positive waves, alternately neutralising the currents on the wires or increasing their intensity to such a degree as to burn everything up. The switch-board here was on fire a dozen times during the forenoon, and half a dozen keys of the instruments were melted by the current which continued to pass through. The screws burned up and the points parted to their furthest limits. The duplex and quadruplex wires were rendered entirely useless, and at noon only a single wire out of fifteen between this city and New york was in operation, and it was frequently interrupted. Word was received from Milwaukee that the atmospheric electricity coming in on one of its wires from the country had such dynamic power as to keep an electric lamp burning."

Somewhat similar observations were made at Washington. On the Chicago and Cincinnati circuits it was found impossible to work the quadruplex instruments, and they were taken out. The chief operator said that the magnetic interference was greatest on the east and west lines. The officer in charge at the office of the Signal Service, said that great trouble had been experienced in collecting the weather reports on account of the general demoralisation of telegraphic circuits.

Similar reports were sent from Cleveland, Indianopolis, Cincinnati, Milwaukee, Nashville, Bangor, Toronto, and other places. At Cleveland the disturbance was first observed at 4 or 5 o'clock in the morning. From Milwaukee it was reported that "Strong currents of electricity pervaded the atmosphere and actually suspended all telegraphic communication from 9 o'clock in the morning until afternoon. An electric lamp attached to a St. Paul wire produced a brilliant illumination without the use of a battery. Business on 'Change was virtually suspended on account of the lack of telegraphic facilities. At 2 p.m. all the telegraph offices resumed work."

The *Detroit Evening News* states that "telephone communication all over the country was greatly improved, the pronunciation being distinct and much louder than usual, which fact may suggest to electricians an improvement in telephonic communication. Another unusual thing was that the electrical storm prevailed during a cloudy sky and murky atmosphere ; heretofore such storms have occurred during a clear atmosphere. With the approach of night and the clearing away of the clouds came a most beautiful spectacle of the electrical agitation of the atmosphere. A more magnificent display of aurora borealis was never seen. It became slightly visible just at dusk, and increased in brilliancy and variety of form, movement, and colour, until midnight, when the whole vast heavens was one grand canopy of dancing flames of every conceivable hue and shape moving in all directions."

At Omaha the aurora was very brilliant, the illumination rendering the night almost as bright as day. At St. Paul the sky was of blood red colour, the display being grand and fearful. Cheyenne reports the illumination at that point as bright as day. At Denver the display in the northern heavens was most brilliant and dazzling. In California the aurora was visible from the northern part of the State as far south as San Diego, and was most brilliant. At Olympia, Washington Territory, the aurora was magnificent, the heavens north and east being brilliantly illuminated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

LONDON.—At a meeting of the Council of University College on Saturday last : 1. Mr. H. F. Morley was authorised to give a course of advanced lectures on Organic Chemistry. 2. It was resolved to invite Mr. T. W. Rhys Davids to accept the Professorship of Pali and Buddhist Literature, once held by the late Prof. R. C. Childers. 3. It was resolved to ask Mr. R. H. Gunion to take the office of Lecturer on Sanskrit. 4. The resignation of the Chair of Physiology by Prof. Burdon Sanderson was accepted.

MANCHESTER.—A public meeting was held last week to inaugurate a movement for the extension of Owens College by the addition of a museum, which is expected to cost between 50,000*l.* and 60,000*l.* It was stated that there were a few thousand pounds in hand available for the purpose, and it was resolved to ask the public for 50,000*l.* to erect and equip the museum. Fourteen subscriptions of 1000*l.* each and a number of others ranging from 100*l.* to 500*l.* each were announced in the room. Lord Derby, the Duke of Devonshire, Mr. Hugh Mason, M.P., and Mr. Grafton, M.P., each offered 1000*l.*

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 12.—On the volume-changes of water containing salts on heating, and the resulting chemical transpositions, by E. Wiedemann.—On the molecular refraction of sulpho-carbonic ether, with some remarks on molecular refraction in general, by the same.—On the dispersion of colourless transparent media, by A. Wüllner.—Some remarks on the papers of Herren Hasselberg and Goldstein, by the same.—On galvanic elements supposed to consist only of elements, and the electromotive useful effect of chemical processes, by F. Braun.—The electric conductivity of chloride, oromide, and iodide of silver, by W. Kohlrausch.—On methods of multiplication and rejection, by E. Dorn.—Contributions to a knowledge of the relations between fluidity and galvanic conductivity, by C. Stephan.—On the joint action of traction and torsion in metallic wires, by F. Himstedt.—On the connection between the units of magnetism and of electricity, by R. Clausius.—On the theory of Fresnel's integrals, by A. Lindstedt.—On the theory of elastic reaction, by E. J. Michælis.

Journal de Physique, November.—On the methods to employ for determining the ohm, by L. Lorenz.—On the electro-chemical figuration of equipotential systems, by A. Guébhard.—On the liquefaction of ozone, by P. Hautefeuille and J. Chappuis.—On the absorption spectra of ozone and pernitric acid, by J. Chappuis.—Application of instantaneous photography to the study of animal locomotion, by G. Demeny.

Journal of the Russian Chemical and Physical Society, vol. xiv. fascicule 7.—On the action of the cyanide of ammonium on glyoxal, by M. N. Lubavin.—On the decomposition of the acetate of tertiary amyl by heat, by Prof. Menshutkin.—Analysis of the water which accompanies naphtha in wells, and ejected by mud-volcanoes, by M. A. Potilitzin.—On new beds of mineral manure, by M. P. Grigorieff.—Analysis of naphtha coke, by M. A. Lidoff.—Residual elasticity and analogous physical phenomena, by M. N. Hesehus.—Review of Russian chemical literature for the year 1881, by M. N. Lubavin.

Archives des Sciences Physiques et Naturelles, October 15.—On cometary refraction, by G. Cellerier.—On the duration of excitability of nerves after the separation of their nutritive centres, by O. Gorlinsky.—Researches on lodes, by F. Sandberger.—The grain of the glacier, by E. Hagenbach-Bischoff.

November 15.—Sixty-fifth session of the Helvetic Society of Natural Sciences, held at Linthhal on September 11, 12, 13, 1882.—The prehistoric antiquity of man, by G. de Mortillet.—The origin of cultivated plants, by A. de Candolle.—New researches on the appearances of Jupiter, by E. W. Hough.

Journal of the Franklin Institute, November.—An improved feed-water heater and purifier, by G. E. Strong.—Economical steam power, by W. B. Le Van.—Note on the pendulum, by J. R. French.—Vision by the light of the electric spark, by W. Le Conte Stevens.—Notes on water analysis, by R. Haines.—Report on European sewerage systems, &c., by R. Hering.—Examination of water and air for sanitary purposes, with remarks on disinfection, by R. Hitchcock.—Report of Committee on the Rappleye rheometric governor burner.—The silver and gas dynanometers, by L. H. Sargent.—The American iron trade in 1881.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 8.—"Note on the Discovery of Bacilli in the Condensed Aqueous Vapour of the Breath of Persons affected with Phthisis." By Arthur Ransome. Communicated by Dr. W. Roberts, F.R.S.

In the year 1869 the author had examined the aqueous vapour of the breath in health and disease. This vapour was condensed in a glass globe surrounded by ice and salt, and, in condensing, it was found to carry down all the organic matter contained in the breath. It appeared probable that the breath of persons in advanced stages of phthisis would contain the bacillus of tubercle, and that this organism could be rendered visible by Dr. Heneage Gibbes' method of staining.

The aqueous vapour of the breath of several advanced cases of phthisis was accordingly condensed by the above-mentioned method, and each specimen was separately examined.

In order to carry down the organic matter, and to afford a basis to attach the material to the microscopic cover glasses, fresh white of egg, or a little mucus, free from bacilli, was added to the fluid.

No attempt was made to sterilise the fluids, as the ordinary bacteria of putrefaction are not stained by the process used.

In the aqueous vapour obtained from two of the cases, specimens of bacillus were found which took the staining in the same manner as the bacillus found in phthisical sputa and in tubercle.

The organism was not found in several other cases, nor yet in the aqueous vapour condensed in the waiting-room of the Manchester Consumption Hospital.

Physical Society, November 25.—Prof. Clifton, president, in the chair.—A paper by Mr. William Ackroyd, on rainbows produced by light reflected before entering the rain-drops, was read by the Secretary. The author investigated mathematically the rare phenomenon of three bows, and inferred that it would generally take place about sunrise or sunset. Mr. Lecky thought the effect had a simple explanation. It might be said to be due to two suns, one (reflected) appearing to be below the horizon.—Mr. Shellford Bidwell gave an account of some experiments he had made to test the theory of Dr. James Moser, that the action of a selenium cell under light was due to the heat rays making a closer microphonic contact between the selenium and the metal electrode, by expanding the material. He submitted selenium cells to dark heat rays, and found their resistance to *rise*. Under light rays, however, their resistance fell. He therefore concluded that Mr. Moser's theory was erroneous, and that the fall in resistance due to the light rays is the differential result of the rise due to heat and the fall due to light. He also explained the "fatigue" of a selenium cell by use, as caused by its increase of temperature. When the cell cooled again the fatigue disappeared. Dr. Moser and Prof. G. C. Foster made remarks on the paper, the former suggesting experiments to test the reversability of the effects observed by Mr. Bidwell, and the latter seeking to reconcile Mr. Moser's theory with the new data.—Dr. James Moser then read a paper on a general method of strengthening telephonic currents. This consists in forming a primary circuit of the telephone transmitter or derived circuit, a set of induction bobbins in derived circuit, and a changed secondary battery, the whole circuit having a very low resistance. Each primary bobbin has a secondary wound over it, and these secondaries are connected in quantity to the telephone line, which has at its remote end a set of telephones in derived circuit to the earth or return wire. In this way one line wire serves to supply a large number of separate telephones, a hundred being employed by Dr. Moser to transmit music from the Hippodrome in Paris to the Place Vendôme. The system is applicable to long lines; and the induction noises are reduced by subdivision among the separate telephones.

Victoria (Philosophical) Institute, December 4.—A paper by Dr. Miller was read on the references to the Antediluvian period in the cuneiform texts.

Institution of Civil Engineers, November 28.—Sir F. J. Bramwell, vice-president, in the chair.—The paper read was on "American Practice in Warming Buildings by Steam," by the late Mr. Robert Briggs, M. Inst. C.E., of Philadelphia, U.S.

CAMBRIDGE

Philosophical Society, November 27.—On complex multiplication of elliptic functions, by Mr. A. G. Greenhill.—On certain points in the function of the cardiac muscle, by Dr. W. H. Gaskell.—On the development of the Pollinium of Asclepias, by Mr. T. H. Corry.—On some micro-organisms and their relations to disease, by Mr. G. F. Dowdeswell.

BERLIN

Physical Society, November 17.—Prof. Helmholtz in the chair.—Herr Hagen has sought to determine the physical properties, and especially the coefficients of expansion, of metallic sodium and potassium, and he reported on the methods and results of this investigation. Both metals, which, in petroleum, in which they are commonly kept, always present a dull surface of hydrated oxide, Herr Hagen succeeded in keeping, with bright metallic surface, without petroleum, any length of time, in evacuated tubes, after the small amount of oxygen in the residual air had been fixed by a part of the metal in an antechamber. By melting the metal, drops could be formed, from whose heights the capillary constants of the two metals were

found, viz. 34·23 for sodium, and 14·17 for potassium. The two metals, mixed in the ratio of their equivalents, gave an alloy which is liquid at ordinary temperature, and which, on account of its brilliant metallic surface, might be easily taken for mercury; only its greater specific gravity distinguishes the latter at once from the potassium-sodium alloy. This solidifies at about 4°·5 C., and its capillary constant is 17·86. Very careful experiments were made for determination of the coefficients of expansion, and their relation to the temperature, in suitable dilatometers. The linear expansions, deduced from the volume-expansions, were, for sodium, 0·000853, and for potassium, 0·000721; pretty similar values were had in direct measurement of longitudinal expansion in a metal block. This coefficient of linear expansion exceeds that of all other metals, and is about three times the linear expansion of lead.—Prof. Helmholtz then gave a report of this year's International Congress in Paris, from which he had just returned. The Congress having last year come to an understanding on the units occurring in electrical science and "technic," and their designations, the point now was to determine those units exactly, so that practical normal units might be prepared. Attention was first given to the determination of the unit of resistance,—the "ohm" (as most easily practicable); that is, the exact measurement in metres of the column of pure mercury of one square milimetre cross-section at 0° C., the resistance of which is the "ohm." There were already quite a number of measurements by methods which Herr Helmholtz specified in his lecture. The values obtained are: Herr Kohlrausch, 1·0593; Lord Rayleigh, by the British Association method, 1·0624; Lord Rayleigh, by Lorenz's method, 1·0620; Mr. Glazebrook, in Cambridge, 1·0624; Herr H. Weber, in Brunswick, 1·0611; Herren W. Weber and Zöllner, 1·0552; Mr. Rowland, in America, 1·0572; Herr Dohrn, 1·0546. Against these pretty concordant values, however, stood the mean value obtained by Herr F. Weber, of Zürich, by reliable methods, and from experiments agreeing well together, viz. 1·0471, which came so near the older ohm of the British Association, that the Congress, on the motion of Sir William Thomson, refrained meanwhile from forming a definite conclusion. It was rather agreed to recommend the experimenters (1) to compare their resistances with the standard of resistance which the French Government will produce; (2) to compare the induction coils by the method adopted by Herr Kohlrausch with the wire-circuit; (3) in their measurements to avail themselves of the modified and still further to be improved method of Lorenz. The respective governments should finally be urged to support, as much as possible, the national experiments for determination of the "ohm."

PARIS

Academy of Sciences, November 27.—M. Jamin in the chair.—The following papers were read:—Observations of small planets with the great meridian instrument of Paris Observatory during the third quarter of 1882, by M. Mouchez.—Note on the verification and the use of the magnetic maps of Col. Al. de Tillo, by M. Lalanne. He compares magnetic observations (of declination) made by him in 1837, in four localities of the region north of the Sea of Azof, with Col. de Tillo's two maps (for Russia), and notes some defects of the latter (the longitudes of the two do not refer to the same meridian, &c.).—Reply to the objections of M. Decharme to my rational conception of the nature of electricity; proofs of the validity of hypotheses serving as the basis of this conception, by M. Ledieu.—General law of congelation of solvents, by M. Raoult. Every substance, dissolved in a definite liquid compound capable of solidifying, lowers its freezing-point. In all liquids, the molecular lowerings of congelation with different compounds, approach two values invariable for each liquid, and one of which is double, the other (the greater being normal). The normal lowering varies with the nature of the solvent. A molecule of any compound, dissolving in 100 mol. of any liquid, of different nature, lowers the freezing-point of the latter a quantity nearly constant, and near 0°·62.—Chemical study on maize at different epochs of its vegetation, by M. Leplay. Sugar is found in the leaves, and accumulates in the stem till the moment of formation of starch in the grains. It then migrates into the spike, first into the support of the grains, then into the grains themselves, where it is replaced by starch. This migration continues to be fed by the leaves till they disappear, then in great part by the stem—diminishing, however, as the starch is developed. The function of the sugar, then, is to furnish to the grain the elements of starch.—On the conservation of solar energy; reply to M. Hirn's note, by Dr. C. W. Siemens. He estimates the temperature of the photosphere as 3000°, not too high to satisfy the conditions of combustion (M. Hirn's estimate is 20,000°). The theory of diminution of light intensity as the square of the distance seems to be not applicable to the whole of the light of stars. Some wave-lengths less favourable to decomposition, may on this account reach further. As to mechanical resistance of gaseous matter to the planets, he shows reason for thinking it much less than hitherto supposed.—On a theorem of M. Tisserand, by M. Stieltjes.—Extension of the problem of Remann to hyper-geometric functions of two variables, by M. Goursat.—On a new integrometer, by M. Abdank-Abkanowicz. Increased accuracy is obtained by means of a disc which rolls on a cylinder without slipping.—On a mode of transformation of figures in space, by M. Vaneeck.—Equilibrium of elasticity of a solid limited by a plane, by M. Boussinesq.—Theoretic interpretation of the calming effect produced by a thin layer of oil spread on the surface of the sea, by M. Van der Mensbrugghe.—On electric motors, by M. Deprez. He describes an experiment proving that the two laws—that of independence of the current's mechanical action, of the state of rest or motion of the ring, and that of proportionality of the electromotive forces to the velocities (supposing, of course, the intensity of the current constant)—hold good within very wide practical limits.—General expressions of the absolute temperature, and of Carnot's function, by M. Lippmann.—Range of sounds in air, by M. Allard. Experiments with different instruments yielded the result that the intensity of sound in air decreases much more rapidly than according to the law of the square of the distance. The second cause of enfeeblement is considered to lie in the non-homogeneous character of the air. A given sound may have, apart from the influence of wind, very different ranges, varying, *e.g.* from two to twenty nautical miles. For small augmentations of range the work required increases very rapidly. The differences of range for different pitches within the octave are little sensible.—On the reform of some processes of analysis used in laboratories of agricultural stations and observatories of chemical meteorology (fourth memoir); volumetric determination of alkalino-earthy carbonates in waters, by M. Houzeau.—Modifications of structure of nerve tubes in passing from the spinal roots into the spinal cord, by M. Ranvier.—On the present flood of the Seine, by MM. Lemoine and de Préaudeau.—Magnetic perturbations from November 11 to 21, 1882, by M. Renou.—A letter from M. Tarry on the aurora showed that while the magnetic currents of earth lines render possible a pre-vision of aurora several hours in advance, those on submarine lines give a pre-vision of *several days* in advance.

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