THURSDAY, FEBRUARY 12, 1885

IRON AND STEEL

Principles of the Manufacture of Iron and Steel. By Lowthian Bell, F.R.S.

THE work before us, as its title indicates, does not attempt to describe the plant or the manipulation involved in the successful conduct of the several processes pursued in the manufacture of iron, but is confined to a scientific discourse upon the reactions and economics of the production of iron, and more especially upon the question of the economical consumption of fuel in the blast furnace, as based upon the author's long practical experience as a Cleveland ironmaster, fortified by the results of, and deductions drawn from, the numerous and carefully-conducted experiments which he has made upon the chemistry and physics of iron-making. These results have been previously largely published at different periods in the *Transactions* of the Iron and Steel Institute; but, as the author says in his introductory chapter, they "were described in the language of the laboratory," and it is his desire in the present volume to present the general results at which he had "arrived in a more consecutive and less attractive form than that necessarily adopted under such circumstances, and to correct any opinion therein stated which further observation had shown to require modification." The book also contains some valuable considerations of a more commercial character than those usually found in scientific or technical works.

After an introductory chapter, Mr. Bell devotes a section to an interesting historical sketch, arranged in chronological order, of the progress and improvements effected in the iron manufacture, commencing with the primitive forge found in the interior of Africa and closing with the introduction of the basic process for the manufacture of steel. Then follows a chapter upon the direct processes for making malleable iron, in which the economic results of these processes, as against the indirect methods (where the blast and puddling furnaces are conjointly employed), are discussed adversely to the direct processes. Mr. Bell considers that, owing to their simplicity and the partially oxidising tendency of the operations of direct smelting, whereby the phosphorus in the ores is largely left in the slags, these processes have received during the past thirty years more attention than they merit. The author's ideal is a well-appointed blast furnace which expels oxygen from the ore, intercepts the escaping heat, and raises the product to the desired temperature in one apparatus. Owing to an erroneous assumption, viz. that the cost for melting steel in the open hearth furnace is the same whether pig iron and iron ore, or pig iron and scrap, are the materials employed, the author is led to compare somewhat unfairly, on p. 39, the cost for fuel and labour of the product of the Siemens rotary furnace with pig iron produced in the blast furnace. The comparison is made as though the two products were the same, whereas the rotator-blooms are used in the open-hearth steel process in lieu of malleable iron, and not as a substitute for "iron in the form of pig," and hence the comparison should fairly be made as between rotator-balls or blooms and balls or blooms of suitable quality as made by the indirect process of puddling the product of the blast furnace.

Section IV. is devoted to a brief consideration of the preliminary treatment of materials for the blast furnace, such as coking, charcoal-burning, and the calcination of ores; and with Section V., at page 61, the author commences his discussion of blast furnace phenomena, which he continues through Sections VI., VII., VIII., IX., X., and XI., devoting altogether a space of 282 pages to this division of the subject; whilst Chapters XII. and XIII., occupying only forty-eight pages, suffice for the discussion of the phenomena and economic results attending the production of malleable iron from pig iron in low hearths, together with considerations upon the action of the refinery, and of the various forms of puddling furnace, from that of Cort to the Danks, and other mechanical puddling appliances.

Section IX. gives much information of a speculative character, bearing upon the causes of the observed alterations in the relative proportion of carbon, oxygen, and nitrogen to each other in the gases withdrawn at different levels below the furnace throat. A like remark applies to the theories propounded to account for the origin and behaviour of cyanogen compounds in the blast furnace, and likewise to the explanations offered for the appearance of bodies, such as silica, lime, alumina, magnesia, oxide of zinc, and oxide of lead in varying relative proportions in the fume withdrawn with the gases taken at different depths in the furnace.

In Section X. the author maintains the conclusion previously arrived at in his "Chemical Phenomena of the Blast Furnace," viz. that in practice, when smelting Cleveland stone in well-appointed and well-managed blast furnaces of 80 feet in height and from 11,000 to 25,000 cubic feet capacity, driven by a blast heated in pipe-stoves to a temperature of from 500° C. to 600° C., that a ton of pig iron can be produced with the consumption of 20·4 cwt. of coke, which the author calculates is within 1·26 cwt. of the minimum consumption of coke required by theory to smelt a ton of pig iron from the ore in question. He maintains that such furnaces are, and must be as economical in fuel as larger furnaces driven by blast heated in brick stoves to a temperature of 800° C.; but he does not directly venture to dispute the advantage of an increased make per 1000 cubic feet of capacity effected by the larger furnaces and the higher temperatures of blast employed in them.

Mr. Bell dismisses, in the sixty pages of Chapter XIV., the consideration of the manufacture of steel by the Bessemer, the dephosphorisation or basic process, the open-hearth processes, known as the Siemens-Martin, and the ore process. The manufacture of steel in the Pernot furnace, by the cementation and the puddling process, are here also discussed, and in the same chapter are also described the reactions and investigations which resulted in the author's purifying or pig-washing process for the dephosphorisation of pig iron by means of molten oxide of iron added to the charge of phosphoric pig iron contained in a rotating furnace. Further, there is in Chapter XIV. an important sheet of six diagrams, graphically

representing respectively the order and rate of removal of silicon, phosphorus, and carbon from pig iron in the author's purifying process, in the Bessemer converter, with both acid and basic linings, during the process of mechanical puddling, in the refinery, and during the process of puddling by hand labour.

The thirty-four pages of Section XV. of the volume are devoted to the consideration of facts and figures better calculated to interest the trader and economist, than the manufacturer or scientist; it contains extracts from the statistical returns of the condition of the trade, and make of iron in Great Britain, Germany, France, Belgium, and the United States. Then there follow two sections full of interesting and valuable information upon the labour question, and the effects of free trade principles upon the iron industries. In these sections comparisons are made of the relative cost and efficiency of the British workman as compared with his continental competitor and his American cousin. Commencing with the agricultural labourer, the coal and ironstone miner, the labour employed at the blast furnace, the puddling furnace, in the Bessemer and other methods of steel production, and finally in the engineering and shipbuilding industries, the author shows that throughout, although wages are considerably higher in Great Britain than in any Continental iron-producing district, yet that the English workman, being better fed, does more work per day than his competitor; or, in other words, fewer hands are required in Great Britain than are necessary for the performance of the same work where foreigners are employed. The comparison with the labour of the United States stands, however, differently, the American workman, as a rule (not without exception), receiving a higher rate of wages than the corresponding class in England; such examples being conspicuous amongst the various classes of mechanics, while the individual labourer at the blast furnace is paid at about the same rate in the two countries; but from various causes Mr. Bell states that "the labour on a ton of metal in America amounts to nearly double, and often more than double, its cost in England," and similar results apply to the production of malleable iron by hand-puddling, or to steel ingots from the Bessemer converter.

The last chapter of the volume compares with one another the chief iron-producing countries of the world, their national resources, their competition with Great Britain in English and foreign markets, and the effects of improvements, more especially of the basic process, upon the German steel industries. Mr. Bell concludes the volume with a brief discourse upon the present prospects of the iron trade of the world, and draws the conclusion that the cost of production of pig iron and of steel cannot be materially reduced, except by the reduction of royalties, railway charges, and wages; whilst the puddling furnace is doomed to extinction by its more powerful rivals the Bessemer converter and the open-hearth steel-melting furnace; so that there is little inducement for ironmasters to incur any expense in experiments aiming at the improvement of mechanical puddling appliances. The last-mentioned conclusion is pretty generally accepted, but that the cost of producing pig iron and steel cannot be materially reduced may well be questioned when the immense developments of the last twenty years are considered; and there are many who still hope to see some continuance of this progress, possibly in the direction of a still more economical production of steel from phosphoric and other inferior ores, either by direct processes or by improvements in the existing types of procedure.

The statistical portion of the work is often very indefinite as to the date to which the figures apply to different localities, and the six sections comprised between pp. 61 and 342, treating as they do of the reactions in the blast furnace, the use and theory of the hot-blast, the quantity and quality of fuel required in the blast furnace using air at different temperatures, of the solid products and of the chemical changes as they take place in the blast furnace, on the equivalents of heat evolved by the fuel in the blast furnace, on hydrogen and certain hydrogen compounds in the blast furnace. Each of these sections contains, as might be expected, much valuable information upon the theoretical considerations affecting the combustion of fuel, the effects of increasing the height and capacity of the furnace, and the limits to which the temperature of the blast may be raised with economical results; but the sections might be advantageously condensed, and much repetition avoided, by a more systematic arrangement of the facts and data.

The chemical analyses, results of experiments, the various facts and data, statistical and otherwise, with the discussions thereon as contained in Mr. Bell's volume, make it a most important and invaluable contribution to the literature bearing upon the scientific and economic considerations of our great iron industry, and this notwithstanding that the theoretical deductions which the author propounds may fail to secure universal acceptation.

W. H. G.

PHILLIPS'S "MANUAL OF GEOLOGY"

Manual of Geology, Theoretical and Practical. By John Phillips, LL.D., F.R.S. Edited by R. Etheridge, F.R.S., and H. G. Seeley, F.R.S. Pp. 546. (London: Chas. Griffin and Co., 1885.)

THERE are two ends which a Manual of Geology, or for the matter of that of any science, may be intended to compass. It may be meant for beginners, or it may be designed for the use of advanced students. And the ways in which the subject must be handled in order to meet the needs of the two classes are essentially distinct; for it is no less true in intellectual than in physical development that the infant and the adult require different modes of treatment and different kinds of nourishment.

At the very opening of the work before us we find, on a fly-leaf by itself, evidently placed in a conspicuous position for the purpose of calling special attention to it, the aphorism, "Knowledge should be practical from the first," and directions follow as to the way in which the reader can best obtain the specimens by the aid of which alone his knowledge can be rendered practical. Such instructions would be superfluous in the case of advanced students, and we must conclude that the book is intended for beginners. We are warned in the preface that "of things good and beautiful the gods give nothing to men without great toil"; this is a truth which the real teacher never fails to impress on those whom he aspires to guide along the rugged roads that lead to the heights of learning, but at the same time he finds his first and best joy

in rolling aside as far as he can the obstacles that lie so thick on the path, and, when he cannot clear them away, in helping the novice with tender, loving hand to surmount them, and the wish that lies nearest to his heart is to make the journey as smooth and easy as is compatible with thoroughness. It can scarcely admit of a doubt that the way to do this is to begin with the simple, the known, and the certain, and gradually lead on to the complicated, the doubtful, and the hypothetical. And it is not only because it smooths the beginner's path that this is the more excellent way, it is even more than that, because it engenders from the outset a habit of clearly distinguishing between what we may fairly look upon as established truths and the things which are still matter of speculation. If hypotheses are forced on the student's attention in the early part of his career, and still more if these hypotheses are spoken of as if they were universally-accepted doctrines, the learner soon ceases to distinguish between fact and theory, and his scientific studies lead only to confusion of thought and a habit of jumping to conclusions from imperfect data.

It is for these reasons that I cannot help doubting the wisdom of introducing so early as the second chapter questions about which so very little is known for certain as the composition and condition of the earth's interior, the origin of the earth's figure, and the nebular or meteoric origin of the earth itself. The author is, however, countenanced in this by the practice of many eminent geologists, and I will not therefore press the objection; but I feel little doubt that he has not acted in the best way for the interests of those for whom he seems to have written when, only two chapters further on, he plunges into the vexed question of the origin of the crystalline schists. Chapter IV., which deals with this matter, begins, "The newest water-formed rocks are similar in appearance to deposits which are now being deposited." Not a word has yet been said about the class of rocks described as water-formed, nor any reason given why they are believed to have been formed in water. Why should this be taken for granted when it is a matter so easy to understand and about which there is so little difference of opinion? Surely it would have been safer for a beginner to make the demonstration of a proposition so simple as this his introduction to the study of geology, than to launch him at the outset on a sea of speculation when he is tossed to and fro by conflicting theories and bewildered by the opposite opinions which different authorities hold. Our author, it is true, evades this danger, but he does it in a way that is distinctly unfair to his readers. He shows that it is not impossible that crystalline schists may be produced by the metamorphism of sedimentary deposits, and then lays it down, without any further reason, that *all* rocks of this class have been produced in this way, but he says nothing to lead us to suspect that this is at best an hypothesis, still less that it is an hypothesis which many geologists decline to accept. This looks very much like one of those sweet and easy ways which are so severely denounced in the preface. Nor is his further development of the subject any less unsatisfactory. He gives one of the many reasons that have been alleged in favour of the view that granite is also a product of metamorphism; goes on to the further step that granitic rocks are the deep-seated forms of lavas, and so leads up to the conclusion that all crystalline rocks are metamorphic products. There are many geologists, myself for one, who look favourably on this speculation, who are even sanguine enough to believe that the day will come when it will be placed among established facts, but I could hardly have thought it possible that any scientific writer could have stated it in the present day as a thing about which there was no question; and it scarcely seems prudent, when geology offers us so much that is sure and certain on which to base our teaching, to choose one of the most speculative of its tenets as the foundation for a scheme of instruction.

A chapter follows on the "Nature, Composition, and Origin of the Water-formed Rocks," which illustrates under a typical form the defects and excellences of the greater part of the book. There is much admirable matter and the illustrations are well chosen, but it would be very hard to teach from this chapter. The facts are all strung together in a continuous narrative, somewhat scattered, too, so that if we wished to make out all the steps in the formation of a certain rock, say an organic limestone, we should have to pick out a clause here and a sentence there and piece these fragments together. In fact, this and many other parts of the book remind us of a formation rich in organic remains, but requiring much labour to unravel because the fossils are embedded in rock, are mixed confusedly together, and are, many of them, fragmentary. We do not put a beginner in palæontology to work on such a deposit, but let him first get systematic knowledge in a museum where the fossils have been extracted and set up in order. And it is just such orderly arrangement of the facts and the deductions that follow from them which is wanted in a scientific manual intended for a beginner; they ought not to be embedded in the text, where they have to be hunted for, but they want picking out and placing each by itself in a strong light so that they may catch the eye of the student. Again, if we remember that the materials out of which the water-formed rocks are built up were furnished by denudation, it would seem that an account of the origin of these rocks must necessarily begin with a description of the mode of action and products of denuding agents, but for this we have to wait till we reach Chapter XI. That chapter and Chapter X. furnish one of the most perfect instances of the "cart before the horse" to be met with anywhere. Chapter X. is headed "The General Features of the Scenery in their Relation to Geological Phenomena"; in it, while due weight is given to the influence of upheaval in determining the shape of surface, the large share which denudation has played in forming hill and valley is fully recognised; but it is not till we come to the following chapter that we are told what denudation is and how it works.

The author may say, however, that all this is very much matter of opinion, that I have my notions as to the way in which geology is to be taught and the order in which its subject-matter is to be presented, and that he has his. It may be so, but there are in the book slips and errors about which there can be no difference of opinion, and to which I feel sure the author himself will be glad to have his attention called. We do not generally describe charcoal as uncrystallised diamond, but this would be nearly as bad as "calcite in an uncrystallised condition" (p. 47);

we can hardly agree with the statement that "clay is identical in composition with felspar" (p. 46), when we remember that the one contains about 47 and the other about 65 per cent. of silica; it is somewhat a surprise to find the old time-honoured section of a mountain chain, given in Fig. 34, p. 80, still surviving; if one wished to select a section of what a mountain-chain is not like, here we have it. What would Mr. Huggins say to the statement on p. 17, that "the nebulæ are now known to be in no respect nebulous"? On p. 22 we are told that, "when a typical felspar contains potash, it is recognised by fracturing at right angles to the side (*sic*) of the prism." This is hardly calculated to convey a notion that potash felspar has two cleavages, and certainly gives no definite idea of the direction of either.

The treatment of the subject of joints is bewildering; it reminds me of the advice given to a youthful and diffident teacher, "If you are asked to explain any thing you don't understand, look solemn and talk of polar forces." We have vague hints that the crystallisation of monoclinic augite and triclinic plagioclase may in some mysterious and unexplained way have determined the direction of the cracks on the hexagonal jointing of basalt, and that the structure is essentially crystalline (p. 43); then, on p. 82, our mind is unsettled by the statement that tension in successively different directions is more probably the true cause of the phenomena of jointing in slaty rocks; then heat and electricity, it is surmised, may have had something to do with it. Surely in the place of these guesses, or at least in addition to them, it would have been well to mention some of the facts that throw light on the solution of the problem; that the columnar structure of basalt is closely mimicked by the hexagonal columns of starch and dried clay in the formation of which crystallisation took no share; and that Daubrée has produced, by torsional strain, cracks, the directions of which follow the same law as governs the trend of master-joints in rocks. It is this preference of shadowy surmise to solid substantial fact which constitutes one main fault of the book. The notice of "reversed faults" on p. 77 is incomplete; Rogers and Heim have taught us that these are the rule in violently contorted districts, and the latter has given a beautiful explanation of how they have been produced. The formation of coal is dismissed in ten lines, at least this is the only reference to coal given in the index, and I have not found anything on the subject elsewhere in the book. When I think what an admirable instance of inductive reasoning the discovery of the terrestrial origin of coal supplies, and how the study of sound inferences like this is one of the best ways of developing the logical faculty in the student, I cannot help regretting that some of the questionable speculations with which the book abounds have not been left out to make room for an account of the way in which this truth was arrived at. I fear very much that the directions given on p. 253 will not help the student much to identify minerals under the microscope. One would gather from them that colour was the one important point to attend to, for this is almost the only thing noticed; and it is strange that in the case of olivine, where the extreme vividness of the colours is of some little use as a distinctive test, no notice is taken of the fact. Amphibole, it would seem, is to be distinguished from pyroxene by giving brighter colours, but the widely different cleavages of the two minerals, and the dichroism of the one and its absence in the other are passed over. Nor is a word said about the dichroism of tourmaline and magnesian mica. Of the many points to be attended to only one is mentioned, and the most important facts under that head are omitted.

For such reasons as I have given I cannot help feeling that this work is unsuited for teaching purposes; indeed, on account of the way in which it mixes up theory and fact, I should say it would be positively dangerous to put it into the hands of a beginner.

But it will be by no means without its use to those who have made some progress in the study of geology. It is an admirable geological gazetteer. The long lists of localities where typical examples of the various classes of rocks may be studied and the condensed descriptions of the geological structure and history of the various districts cited, will be of great value. References to original memoirs are frequently given, but they might be largely increased with great advantage; it would be scarcely possible to make them too numerous. There is much, too, in the speculative portion of the book, which, even if it be in places hazy and but slightly supported either by observation or experiment, is still very acceptable. Even the guesses of an acute and original thinker are welcome.

In the section devoted to palæontology the puzzles and uncertainties of that branch of geology are stated without reserve, and the lines on which the palæontologist must work are clearly marked out. The chapter on the "Succession of Life in Classes and Orders of Animals" is too crowded with detail for beginners, but I fancy that the advanced student will often turn to it for reference and thank the author for having furnished him with such a concise index to the subject. The brief indications given under each head will serve as starting points, and as he develops and expands his knowledge by the aid of special treatises and original memoirs, the student will find out for himself where the author is propounding his own peculiar views, and where he is in accord with his fellow-palæontologists.

A. H. GREEN

OUR BOOK SHELF

Transit Tables for 1885. By Latimer Clark, M.I.C.E., &c. (London: E. and F. N. Spon, 1885.)

AT a period when the question of universal time is in every one's thoughts, more or less, these tables should possess more than ordinary interest. By the production of a simple, efficient, and inexpensive transit instrument Mr. Clark first demonstrated that transit observations were within the power of others than the professional astronomer or the wealthy amateur, and that by these observations timekeepers could be regulated to the fraction of a second. The next step was to simplify the calculations involved in the reduction of these observations, by the yearly publication of tables giving in Greenwich mean time, instead of sidereal time, the transits of the sun and a few of the principal stars conveniently situated for observations for every day in the year. This is chiefly what is accomplished in these tables, now in their fourth year of publication. In addition to the fundamental stars, the transits of five of which are given for every

day in the year, there are tables by which the transits of about twenty others can be computed by the simple addition of their R.A. converted into mean time from that of one of the fundamental stars. The transits of the major planets and of certain bright stars suitable for daylight observations are also given, and the tables show the declination and meridian altitude of sun, stars, and planets. There is a monthly ephemeris, and in additional tables will be found the time of sunrise and sunset, daybreak and nightfall, the sidereal time at a certain epoch of mean time (9 p.m.), and the sun's semi-diameter for every alternate day. In the preface are clearly-written instructions for fixing and adjusting the instrument, and for obtaining local or Greenwich time at any place in England or abroad. The times are given to the nearest tenth of a second, and the tables are clearly printed in bold type.

Reise nach der Insel Sachalin in den Jahren 1881-1882. Von J. S. Poljakow. Aus dem Russischen übersetzt von Dr. A. Arzruni. (Berlin: Asher and Co. 1884.)

THE author of this volume is a zoologist who filled for a considerable period the office of Conservator of the Zoological Museum of the Russian Academy of Sciences. He has also travelled widely on scientific missions in outlying parts of the Russian empire, and has already studied a portion of the zoological collections sent home by Col. Prejevalski from his Central Asian journeys. The importance which the large island of Saghalin, off the mouth of the Amour, is believed to possess for Russia, led the Geographical Society of St. Petersburg to despatch Mr. Poljakow to study the island and to report upon it from a scientific and economic point of view. He took passage from Odessa accordingly, in a ship conveying convicts, and arrived at the mouth of the Djuka, in Saghalin, in June, 1881. During the succeeding fourteen months he travelled all over the island, along the water-ways—which are the only ways there—when travelling was possible, and arranged his collections when the weather and the season rendered advance impossible. This volume is composed of the letters addressed to the secretary of the Geographical Society, detailing his movements when travelling. For the most part they are such as the most unscientific traveller might address to a friend: they describe the incidents of his various journeys, the superficial customs of the natives he met, the difficulties of travel, his views of the island as a penal colony, its agricultural and mining prospects, and much else of a general and chatty kind. Here and there in the course of the narrative it is apparent that behind these ordinary incidents of travel there is a scientific purpose, which only comes out casually and by chance. Not that there is any concealment about the work; but the real results of the exploration will probably need more examination and arrangement than he has yet been able to give to them. Towards the end he summarises his work in the island, and the summary is worth giving, as showing us what we may expect from him now that he has time for study and arrangement. His collections on leaving the island were, he tells us, enormous. He possessed all the most important representatives of the mammals, birds, fishes, and amphibia, as well as numerous examples of the lower animal world—insects, crustacea, mollusks, &c. One of the most important places in his collection is occupied by ethnographical and anthropological objects. He has ample material to investigate and characterise the original population of the island, which has now disappeared, viz. that of the Stone Age, as well as the race which dwelt around Patience Bay, and which knew the use of metals. It is highly probable, he thinks, that aborigines who belonged to the Aino stem were so numerous a century and a half or two centuries ago at the mouth of the Poronai River that their settlements on a limited space then contained a larger population than the whole of the island does to-day. The present inhabitants, the Gilyaks and the Orokos, have retained many of the characteristic features of the culture of their predecessors. The present inhabitants of Saghalin, like the former, concentrate all their activity in hunting and fishing, and they seek their sustenance on the land as well as in the seas and rivers. He notices that the natives, and especially those of the southern part of the island, have been largely influenced by the Japanese, who go there in the summer to catch fish, and that this influence has lasted for centuries. It is only a few years since the Russians commenced to settle Saghalin, in order to introduce European agriculture and industry. Their first task was to work the coal-measures and to develop agriculture and stock-raising. But there are great difficulties to be overcome. Coal-mining, Mr. Poljakow thinks, will be successful when the methods are completed, the prices lowered, and the delivery of the coal on board ship rendered easier. The rough and cold climate must always be an obstacle to farming; marshes cover a large part of the island, and the larger rivers are subject to frequent alteration of their beds. In fact, the climate and topography of Saghalin offer no natural advantages that would lead one to prophesy smooth things of its agricultural future. The development of the fisheries would form an undoubted source of income, as salmon and herrings are numerous and can easily find neighbouring markets. "I left the island of Saghalin," concludes Mr. Poljakow, "persuaded that it was possible—nay, advantageous—for the State to cultivate, even if forced labour has to be employed. On the other hand, it was clear to me that the results obtained so far by no means correspond with the means and efforts directed to that object." The absence of a map, however small, to accompany the book is a serious inconvenience.

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 insure the appearance even of communications containing interesting and novel facts.*]

Gardiner's Researches on the Continuity of Vegetable Protoplasm

DR. JULES SCHAARSCHMIDT, in a paper (NATURE, January 29, p. 290) on "Continuity between the Protoplasmic Contents of Adjacent Cells in Plants," gives what he calls "the history of this subject." But he makes no reference to the elaborate memoir by Mr. Walter Gardiner which I communicated on behalf of that gentleman to the Royal Society. This was read on April 26, 1883, and is published in the third part of the *Philosophical Transactions* for that year.

Dr. Schaarschmidt states in his communication that in 1884 he "claimed the universality of the communication (at least in tissues)." I do not myself feel that the establishment of individual claims to unoccupied territory is as important in the scientific as it appears to be in the political world. Still I think it is only due to Mr. Gardiner to quote in reference to this statement of Dr. Schaarschmidt's, the following passage (the italics are mine) from the conclusion (p. 858) of Mr. Gardiner's memoir:—

"Although I am aware of the danger of rushing to conclusions, I cannot but remark that when these results—which were foreshadowed by Sachs and Hanstein when they discovered the perforation of the sieve-plate—are taken in connection with those of Russow, it appears extremely probable that, not only in the parenchymatous cells of pulvini, in phlœm parenchyma, in endosperm cells, and in the prosenchymatous bast-fibres, is

continuity established from cell to cell, but that *the phenomenon is of much wider, if not of universal occurrence.*"

Kew, September 7 W. T. THISELTON DYER

A Plea for the Experimental Investigation of some Geological Problems

THE subject of terrestrial physics involves the study of such a large number of phenomena that it is quite comprehensible that any one investigator must devote himself to only one or two branches of it at the most. The consequence of this is that from time to time some section of this extensive field of research is for a period neglected. Such is really the present state of experimental geology, and especially that branch relating to movements of the earth's surface.

Disturbances perceptible at the terrestrial surface may be looked upon as made up of three very distinct groups: first we have actual upheaval or depression of comparatively large tracts of land. Secondly, we have true earthquakes, which probably are dependent upon a variety of circumstances, as, for instance, the snapping of a rock stratum brought to the limit of its flexibility in consequence of the first group of movements; or the formation and injection of fissures by igneous matter. Lastly, there exists a series of small disturbances imperceptible to our senses and even to ordinary instruments of earthquake measurement, and only discoverable by special delicately constructed apparatus. They seem to be dependent upon a variety of causes, amongst which are those of the two former groups, together with changes dependent upon or in relation with barometric pressure, tidal action, temperature of the air, rainfall, &c.

The upheaval or depression of our earth's surface is the very basis of geological science, for it is in consequence of this that rocks have been brought within the reach of investigation, and that our globe has some dry ground upon which we can live, instead of one continuous expanse of ocean. The changes of level were supposed by the cataclysmic school of geologists to occur suddenly, bringing about entirely new distributions of land and water in a short period of time. Lyell, as the leader of the uniformists, laboured all his life to prove that these upheavals were in the main a slow and gradual process, extending over long periods of time. One of this author's examples which he brought forward in the argument with as much skill and force as an accomplished counsel would have done in pleading a cause, was the renowned (so-called) temple of Serapis at Pozzuoli. This building was for half a century the subject of almost innumerable books and pamphlets, some of which show a vast amount of ingenuity. None perhaps were more elaborately worked out than the volume of researches on the phenomena of this building and the neighbouring coast from Gaeta, around the whole gulf of that name, together with the Gulf of Naples, to the Punta Campanella. The author there brings forward a large amount of genuine evidence to show that during the last 2000 years the whole coast has been in a state of oscillation, so that the relative change of level of the land and sea has been as much as 12 m. So far as Niccolini's investigations were capable of being carried out, abundant evidence showed that about the second or third century B.C. the coast line commenced to descend, and continued to do so gradually until the 10th or 11th centuries, when elevation took place for nearly 6 m., till in the sixteenth century, when depression again set in. This depression is now going on in a remarkably rapid manner. I have in my possession an engraving of the temple of Serapis, in which the base of the three columns stands on the upper antique pavement of the building, which is perfectly dry. This is dated 1810. In Niccolini's work is another drawing, made in 1845, in which water had commenced to collect, so that it was necessary to wade about. In 1879 a layer of earth of over a metre had been spread over the floor to make access convenient, the standing column being surrounded by brickwork cylinders, and standing in water of over a metre in depth. The ground was then dry, but from time to time when I visited the building I found puddles commenced to collect, which at last grew so large and deep that lately an additional layer of sea-sand has been added to further raise the level. Similar variations have been observed in other parts of both of the Mediterranean and Adriatic coasts of Italy, which all seem to indicate that this geologically speaking young peninsula has not yet stopped growing.

But if the coast-lines are altering, are we not justified in supposing that the axial ridges of the Apennines are not doing so also, even in all probability to a far greater extent, though from the want of a fixed datum-line, such as the sea may afford, we are unable to appreciate the amount of disturbance? It is not likely that this change of levels exceeds 50 m. in historic times in Italy.

If we even accept the recent reports from Spain as gross exaggerations, we cannot well believe them to be pure inventions when changes of 400 m. are spoken of, which could hardly be asserted without some foundation of truth.

Now, are we not bound in some way to investigate these phenomena, which involve the very principles of geological science? It is strange, but true, that around the Gulfs of Naples and Gaeta no instrument exists for registering the relative level of the sea, nor do there exist any marks on rocks that are officially looked after. During the earthquake of Ischia of 1883 it is not known whether any disturbance of the sea took place, and we are perfectly ignorant of the rate and other characters in the change of the relative levels of the land and sea.

But putting aside this gradual elevation or subsidence, are we not permitting to slip by one of the most remarkable examples of quick elevation and depression which from the accounts that now reach us are taking place in Spain? Were the reports as to changes of three and four hundred metres true, we should be compelled, to a certain extent, to accept in part the teachings of the cataclysmists.

It seems regrettable that England, which is the mother country of geology, should allow such an opportunity as the Spanish peninsula now presents for the investigation of important terrestrial disturbances to slip by. Even if the earthquakes themselves are not studied, little expense of time or money would be necessary to chronicle at least the principal phenomena now in progress, which the Royal or some other Society might well take up.

H. J. JOHNSTON-LAVIS

Iridescent Clouds

THE letters of Prof. Piazzi-Smyth and Mr. J. Edmund Clark (vol. xxxi. p. 148) on iridescent clouds, while interesting, do not, if I mistake not, record any new phenomena. The descriptions given agree very well with that of a phenomenon which I have observed here several times, and which is described in Herschel's "Meteorology," p. 225. Here the phenomenon is usually seen before the approach of the monsoon, and is looked upon as a sign of its being near at hand. Under these circumstances it can hardly be admitted that they have any connection with the cloud glows of which so much have been written, and which, as observed from the top of Dodabetta (8600 feet), are as brilliant as ever when the atmosphere is sufficiently dry.

It may perhaps still be of interest to some to know that observations made on the spectrum of the sun when seen through mists from the same hill-top, showed that the spectrum of the "green sun" can be completely reproduced by superposing the spectra of sunlight passing through a mist and through a thick layer of moist air; and it is probable that all cases in which the sun has been seen green can be thus explained.

C. MICHIE SMITH

The Christian College, Madras, January 1

Science Teaching in Schools

IN the discussion as to the teaching of science I have failed to find any distinct expression of an element in the subject which has for years seemed to me of the highest importance, and to which I should like with your permission to call attention. In those of our schools where science is taught it is almost always taken up late in the boy's career, often when he is passing from the lower to the upper school. This I feel sure is a mistake. Think for a moment of the process of evolution of that phenomenon—the English schoolboy. In too many cases he passes through the first, second, and third forms of a school, learning little more than the habit of diligent plodding, and developing little more than the art of storing away an unheard-of quantity of dry facts. He learns, for instance, page after page of grammar rules; he learns rules for making numerical transformations; he even learns in the same fashion answers to questions that examiners are known to set for the purpose of finding out whether the pupil has been *intelligently* taught! The habits so acquired are valuable, but they are acquired at the risk of sacrificing the boy's freshness, and with the subjugation of his habit of independent reasoning. After several years of such training the herald of science comes forward with such a

scheme as Prof. Armstrong very properly suggests. The would-be disciple of science is thunderstruck (as probably not a few teachers of science were when they first saw the scheme), but the novelty of the situation, the sight of new appliances and strange results, enable him to pull himself together, and his interest for a time keeps up. Presently he is asked to conduct for himself some simple steps of deductive reasoning; he fails, the whole business is a new world to him, and in the misery of his wishfulness to do something, he beseechingly asks for more dry facts to devour. What is the ultimate result? If science is to be taught effectually *it must begin with the earliest years of the educational career*, and there is surely no subject that lends itself more appropriately to the youthful mind. Children delight to talk of flowers, of insects, of the wonders of nature; they are ever asking suggestive questions; they are indefatigable collectors of objects of beauty; the Kindergarten system has acknowledged that the child is an orderly being delighting in symmetry and colour. Yet we increase his vocabulary by the word "star" and fail to tell him anything of the wonders of stardom. Why, our very fairy tales are based on just such fabric! To effect this early introduction of science the very best and most considerate teaching is required, as indeed it is a much more difficult task to guide the young student's thoughts than to guide the veteran student's reading. We want, further, a well thought-out progressive scheme of simple general science which shall be suggestive to the teacher of the course to be pursued. To draw up such a scheme is, I am quite aware, not a matter of moments: it would require the association of many minds and many sympathies.

Something in this direction has been done in France, and good text-books are to be found in the English science primers and in Paul Bert's Book of General Science for the Young; text-books, however, are not an immediate want—for the matter of that, the pupil may make his own—we do, however, want that which will help the conscientious teacher to see how he may make the teaching of science interesting, intelligent, and above all progressive. We cannot afford to wait for unintelligent teaching to die a natural death, remembering that there is in England no criterion that the teacher in the middle-class school can *teach*, that teaching does not pay in examinations, that the dry-bones method lends itself most readily to school discipline, and finally, that the subjects chiefly taught are of such a nature as almost to preclude any other method with the young. Under the present *régime* science is not a growth, it is a graft, and a graft, it is to be feared, of a most unfortunate nature; the sooner it develops roots of its own the better. It is, under the circumstances, no cause for wonder that the more advanced student flounders over common general principles. I have confined my remarks, for the sake of definiteness, to middle-class schools, but they are, I believe, with unessential variation, applicable to the general question of the teaching of science. G. H. BAILEY

Heidelberg, February 3

Barrenness of the Pampas

I AM anxious to add a few further remarks on this interesting subject. It was during its investigation that I was so deeply impressed with the desperate struggle for existence which characterises the bordering fertile zones. I could there watch the contest on the very battle-field itself, and for that purpose I established myself for some months in the north of Uruguay, away from all other habitation, among the wooded banks and lagunes of the River Arapey. This river, though normally a quiet stream, is subject to tropical floods, during which the water rose often thirty feet in eight hours. The "monte," or fertile wooded belt on each side, is intersected with ravines and lagunes teeming with animal and vegetable life of singular interest. The alligator, carpincho, myopotamus, nutria and other and numberless snakes thrive in the marshy swamps, while in the woods we met with the puma, the jaguar, the great lizard, the Podinama, the *Nasua socialis*, and numerous other singular animals and birds described in my little book. But it was among the flora that the principle of natural selection was most prominently displayed. In such a district, overrun with rodents and escaped cattle, subject to floods that carried away whole islands of botany, and especially to droughts that dried up the lakes, and almost the river itself, no ordinary plant could live, even on this rich and watered alluvial *débris*. The only plants that escaped the cattle were such as were either poisonous, or thorny, or resinous, or indestructibly tough. Hence we had only a great development of solanums, talas, acacias, euphorbias, and laurels. The buttercup is replaced by the little poisonous yellow oxalis with its viviparous buds, the passion-flowers, asclepiads, bignonias, convovuluses, and climbing leguminous plants escape both floods and cattle by climbing the highest trees and towering over head in floods of bloom. The ground-plants are the portulacas, turneras, and œnotheras, bitter and ephemeral on the arid rock, and almost independent of any other moisture than the heavy dews. The pontederias, alismas, and plantago, with grasses and sedges, derive protection from the deep and brilliant pools; and though at first sight the "monte" doubtless impresses the traveller as a scene of the wildest confusion and ruin, yet, on closer examination, we found it far more remarkable as a manifestation of harmony and law and a striking example of the marvellous power which plants, like animals, possess of adapting themselves to the local peculiarities of their habitat, whether in the fertile shades of the luxurious "monte" or on the arid, parched-up plains of the treeless Pampas. EDWIN CLARK

Great Marlow

Recent Earthquakes

WITH reference to the statement in NATURE, vol. xxxi. p. 262, that the earthquake of December 25, 1884, was registered by the magnetic variation instruments in London, permit me to inform you that an effect was also noticed on a curve of the magnetograph at the Imperial Marine Observatory, Wilhelmshaven. But while at London declination and bifilar were specially affected, here only the Lloyd's magnetic balance, the instrument for vertical intensity, was set in oscillation, first at 9h. 52m. p.m. local time. Full details will be published in the *Zeitschrift* of German Meteorology. Dr. M. ESCHENHAGEN

Wilhelmshaven, February 6

MR. W. A. SANFORD, in NATURE of January 29, p. 289, says on the above subject:—"It would be interesting to know whether anything of the same kind [as described in his letter] had been observed elsewhere at the same time." I have been collecting observations on this subject for a continuation of my paper on earthquakes in Devon, published in the *Transactions* of the Devonshire Association. The Vicar of Bampton has very kindly given me his experience of the earthquake, as the wave appeared to have passed very near, if not directly under, his house. Bampton is seven miles north of Tiverton, and about a mile inside the junction of the Carboniferous and the Devonian systems, situate on a rather large patch of limestone. The time the earthquake occurred there was 8.42 p.m. In the drawing-room at the vicarage it appeared as if a heavy traction-engine was passing close to the window; the window faces eastward. In the kitchen the servants were greatly alarmed by a rumbling noise and a shaking under the floor. Some of the Vicar's neighbours say they heard a report, and houses with cellars under them and higher felt the shaking more; some persons who were up stairs, thinking that it was some explosion, rushed down stairs and out of doors. The effects were also felt at Shillingford, two miles distant, and also at Combehead, one and a half mile distant. The porters at the station describe it as like a heavily-laden mineral train passing. The only damage done at Bampton was a piece of wall was thrown down. This was undoubtedly the same shock or seismic wave as mentioned by Mr. Sanford as occurring on the night of Thursday, January 22, and would appear to have travelled from east to west.

EDWARD PARFITT

Devon and Exeter Institution, Exeter

Loligopsis ellipsoptera

COULD you allow me space to ask whether any of your readers can give me a clue to the present locality of the type-specimen of *Loligopsis ellipsoptera*, Adams and Reeve, obtained during the voyage of the *Samarang;* and also to state how grateful I should be to any one who can lend me specimens of that genus or of others allied to it? WM. E. HOYLE

Challenger Expedition Office, 32, Queen Street, Edinburgh, February 9

L. WRAY, JUN.—Your supposed dragon-fly belongs to the family *Ascalaphidæ*, allied to the ant-lions.

CIVILISATION AND EYESIGHT

IN his interesting paper on "The Influence of Civilisation upon Eyesight," read recently before the Society of Arts, Mr. Brudenell Carter supports the commonly received view that the vision of savages is far more acute than that of civilised men. In some sense this is doubtless true; but that the eyes of savages, considered merely as optical instruments, are greatly superior to our own appears to be inconsistent with optical laws and facts long since established by the labours of Airy, Helmholtz, and other investigators. It is known to physicists that the resolving power of an optical instrument is limited by its *aperture*. With a given aperture no perfection of execution will carry the power to resolve double stars, or stripes alternately dark and bright, beyond a certain point, calculable by the laws of optics from the wave-length of light. With sufficient approximation we may say that a double star cannot be fairly resolved unless its components subtend an angle exceeding that subtended by the wave-length of light at a distance equal to the aperture. If we take the aperture of the eye as 1-5th inch, and the wave-length of light as 1-40,000th inch, this angle is found to be about 2 minutes; and we are forced to the conclusion that there is no room for the eye of the savage to be much superior in resolving power to those of civilised physicists, whose powers approach at no great distance the theoretical limit as determined by the aperture.

It has always appeared to me that the superiority of the savage is a question of attention and practice in the *interpretation* of minute indications, and that it is comparable with the acuteness of the blind in drawing conclusions from slender acoustical premises. It would be an interesting subject for investigation, but I should not expect to find that when put to a direct test blind people were able to hear sounds wholly inaudible to others.

The increasing prevalence of short sight is a very important matter, worthy of all attention. There is one fact in connection with it which I avail myself of this opportunity of mentioning, in the hope of inducing scientific oculists to give it further examination. I find that, though not at all short-sighted under ordinary circumstances, I become decidedly so in a nearly dark room, seeing much better with spectacles of 36 inches negative focus. In a moderately good light I see rather better without the glasses than with them. From the few observations that I have made I have reason to believe that this peculiarity of vision is not uncommon. With the aid of a set of concave glasses it is easy to try the experiment in a room lighted with gas. The flame should be gradually turned lower and lower, so as to give full time for the pupil to dilate, and for the eye to acquire its maximum sensitiveness. In my own case the most marked indication of better definition is the augmentation of binocular relief.

RAYLEIGH

THE INTERNATIONAL INVENTIONS EXHIBITION

THERE seems now little reason to doubt of the success of the South Kensington Exhibition of next summer—success, that is, from an educational and scientific point of view. What its financial result may be depends upon a variety of circumstances, and perhaps, since it is very improbable that there can be any serious deficit, while, if there is a large surplus, its disposal will, as usual, form a problem difficult of solution, this part of the question does not really very much matter. That Londoners will have a pleasant outdoor lounging place, that there will be abundance of music, that the fountains will be as pretty as last year and the gardens prettier, all this may be taken for granted; but there now seems every reasonable expectation that we shall have more than this, and that the Exhibition will be what it professes to be—a complete illustration of the progress made in the application of science to industry during the past twenty years. At all events if it is not it will be the fault of the promoters, since they have had so large a range of choice that it has only been possible to find space for some third of the applicants, and an enormous number of exhibits have been rejected, not because they were unsuitable or uninteresting, but simply because, when there was not room for all, some must of necessity be excluded.

To begin with, it was thought best to exclude, not only the actual articles which were shown last year, but inventions of the same class, and consequently there will be found at South Kensington this year few, if any, exhibits relating to food, clothing, or sanitation. It appears that this rule has given rise to a certain amount of heart-burning, since reference is found to all these heads in the official classification; but it must be remembered that the announcement was duly made at the beginning that the space to be allotted to these and certain other classes would be strictly limited, and then again it was impossible to foresee how large would be the response to the invitations issued. The task of selection has been a difficult, and indeed an invidious, one; but we think it will be found, when the show is opened in May next, that this thankless task has been performed with great judgment, and with a just consideration of the claims of exhibitors on the one hand, and the interest of the public on the other.

We are glad to have heard that in none of the thirty-one groups into which the inventions' half (we are not now considering the musical part) of the Exhibition is divided, have the applications been deficient; in some they are naturally better than others, but in every one there is enough to provide a fair representation of the condition of its particular industry, and of the improvements which have been made in it during the limits of time with which the Exhibition is concerned. Even this will doubtless be a cause of complaint to those who believe that injury will be done to our manufacturers by the opportunity given to foreigners of imitating our wares and the methods by which they are produced. This is a specious but a somewhat narrow-minded notion; the early history of invention is full of stories of the efforts of inventors to keep their inventions secret, and the constant failure of such efforts may be taken as one of the principal causes which produced the modern Patent system, under which an inventor is protected, so far as law can protect him, in the enjoyment of the property he has created. There are, of course, many instances of processes worked, and successfully worked, in secret; but these are the exception, and on the whole it is found that inventors individually, and industry generally, gain far more by a system of publicity than by one of concealment. So it is with exhibitions. It may be taken as tolerably certain that manufacturers who have any special process which they desire to keep to themselves will not select that particular process for exhibition, and that on the whole manufacturers find exhibitions profitable or they would not be so anxious to engage in them. The suggestion that was made by some wiseacre that the Exhibition should be confined to untried inventions, so that manufacturers (who of course have no other means of hearing of novelties in their own trades) might have the benefit of seeing them, does not, perhaps, call for serious refutation. If the curious collection of rubbish which fills the big building at Washington, devoted to the United States Patent Office, were carted across the Atlantic, and placed in the Kensington Galleries, it is a question whether the public would be more bored, or the manufacturers less instructed.

As would naturally be expected, in an exhibition of this character, machinery will occupy a far larger proportion of the space than on previous occasions; we understand that it has therefore been necessary to make considerable additions to the motive power provided for the

use of exhibitors. Besides the engine which supplied power in the machinery gallery last year, an engine is being erected in the new gallery which is being put up along the north side of the old South Gallery, as described in the *Journal* of the Society of Arts for January 30. A third engine will also be provided, which will drive machinery in one of the Foreign Courts. It will thus be seen that those visitors who have mechanical tastes will be amply provided for.

As regards the prospects of applied chemistry, we are not able to speak so confidently. Probably the completeness of this portion of the show will almost entirely depend on the success of the efforts which are being made by the Society of Chemical Industry to secure a collective exhibit. The announcement made by the executive at the outset, that it was desired to show processes rather than products, is believed to have kept back many manufacturers from seeking to show specimens, while it is obvious that but few chemical processes could conveniently be carried on in an exhibition gallery. Possibly this rule might have been abrogated as regards the chemical section, and we believe that no attempt will be made to enforce it with reference to the collection of the Society of Chemical Industry, in which it is proposed that the information required shall be given by means of a collection of pictorial diagrams, exemplifying some of the more interesting or more important chemical operations.

As our readers are aware, a similar work is being undertaken by the Physical Society in the class devoted to "Philosophical Instruments and Apparatus," though in this case there will be less left for the society to do, since the principal makers of apparatus have come forward in sufficient numbers to ensure a good representative collection. The object, however, of the Society in exhibiting has been not so much to supply deficiencies, as to show the work which has been done by its own members. We believe that the Kew Observatory and the Meteorological Society will also be among the exhibitors, the latter in their old place in the grounds. Besides this, a very interesting exhibit is promised—namely, a fully fitted observatory, which we understand one of our best known makers had offered to fit up.

In the class devoted to Photography, which comes next both in the classification and in actual position in the galleries to the philosophical instruments, the Photographic Society has undertaken to form a collection of apparatus and specimens not likely to be shown by makers. It appears that the Society intend to go a little beyond the precise limits of the Exhibition, and to show a collection of examples illustrating the entire progress of photography from the inventions of Niepce and Daguerre, and it may doubtless be assumed that in so special a case no objection will be raised, especially as but a very small space indeed, and that only on the walls, will be required for what cannot fail to prove a most instructive and interesting collection.

The progress which has been made in electric lighting has indeed been sufficiently illustrated in the exhibitions of last and of the preceding year; in fact, the Health Exhibition offered almost the only public example of any progress at all in England. Doubtless the lesson will be repeated this year, and on a more extended scale, for we learn that considerable additions are being made to the arrangements for electric lighting of the buildings, while it is intended to use the light also for the garden illuminations, an improvement due to the energy of Sir Francis Bolton. If this idea is carried out on the plan which we understand is intended, the instantaneous lighting up of the myriad incandescent lamps by which the gardens are to be illuminated will certainly be one of the most popular, and one of the most wonderful, sights in London next summer.

The above remarks refer only to the English portion of the Exhibition. How much will be contributed by foreign countries it is not yet possible to ascertain. Thanks doubtless to the efforts which were made by certain of the members of the British Association who were in the States last year, the American Court promises to be well filled, and it must be admitted that in the present Exhibition, if we get American ingenuity well represented, we shall not very greatly miss the contributions of other countries, though we hope, all the same, that these will not be lacking.

THE RETINA OF INSECTS

IT might have been thought impossible for any one who has studied the eyes of Arthropods to doubt that the so-called retinulæ are really the nerve-end cells of the eye, and correspond with the rods and cones of the vertebrate eye. The evidence in favour of this view accumulated by the researches of almost every observer, including such eminent authorities as Johannes Müller, Leydig, and Grenacher is so overwhelming that of late years no one has thought fit to dispute it.

Mr. Lowne has, however, at last attempted to overthrow this theory, and in a paper just published in the *Transactions* of the Linnean Society, vol. ii. part ii., on "The Compound Vision and the Morphology of the Eye in Insects," has brought forward certain statements to prove that all the parts of the eye in front of the basilar membrane are dioptric, whilst the true (?) retina is situated behind it.

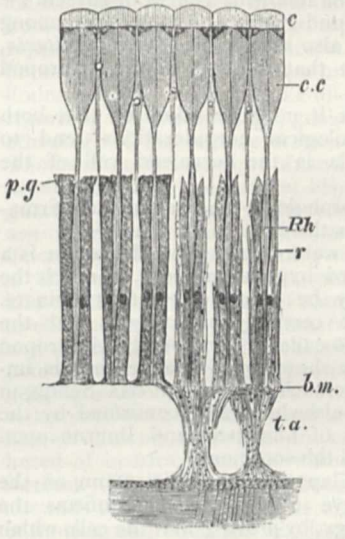

Fig 1.

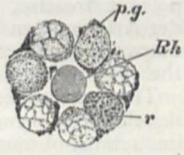

Fig 2.

FIG. 1.—Section through the eye of Squilla, showing the distribution of the ultimate nerve fibrils to the retinulæ. The Ommatidia to the left of the figure are drawn with their accompanying pigment cells (*p.g*) complete; in the three to the right these are omitted in order to show more clearly the distribution of the nerve fibrils; *c*, corneal facets; *c.c*, crystalline cone: *rh*, rhabdom; *r*, retinula; *b.m*, basilar membrane; *t.a*, terminal anastomosis of optic nerve fibrils supplying the retinulæ.

FIG. 2.—Transverse section through the ommatidium of Squilla, showing the seven retinula cells surrounding the central rhabdom. The retinulæ are seen to possess a considerable amount of granular pigment, which is unevenly distributed in the different cells.

To one who has been devoting considerable time and attention to the eye of Arthropoda, this proposition is particularly striking and unexpected, and many points at once occur which show that it is untenable.

In the first place it is untenable because we have ample evidence to show that the original theory is the true one. The nerve-end cells throughout the animal kingdom have certain definite characteristics. They are the cells in which the ultimate fibrils of the optic nerve terminate, and no nerve fibrils have ever been seen to leave them to supply other parts of the eye; and, in the second place,

they are always pigmented either by a diffuse fluid "retinal purple," or by pigment in granules, or both.

In both these particulars the retinulæ of Arthropoda resemble the nerve-end cells of other animals.

It is hardly necessary to point out that Leydig, Max Schultz, Grenacher, and many others, have traced the optic nerve fibrils to the retinulæ. I have in my possession several series of preparations showing this both in insects and Crustacea, and any one can readily see this for himself by making even clumsy sections through the eye of Squilla.

In Fig. 1 I have figured the nerve fibrils of the eye of Squilla perforating the basement membrane and entering the retinulæ, and in Fig. 2 a transverse section through the rhabdom and retinulæ showing their relat ve position and numbers.

A special feature of the retinula is that it is always pigmented. In specimens hardened in spirit a granular pigment may be seen in the retinula cells, which is usually of a light-brownish colour and very unevenly distributed (Fig. 2). But in addition to this granular pigment, the retinulæ contain a true retina purple, which fades upon exposure to the light. This was discovered in 1864 by Leydig[1] in the following genera of Insecta:—Procrustes, Scarabæus, and Pieris, and in Astacus among the Crustacea. I have also seen it in *Musca vomitoria*, and have now no doubt that it exists in the Arthropod eye generally.

So far, then, I think it must be admitted that both anatomical and physiological considerations tend to prove that the retinula is the nerve-end cell of the Arthropod eye.

When we turn to morphology, too, we have confirmatory evidence that this is the case.

In the ocellus of the water-beetle larva the retina is a simple cup of pigmented hypodermis cells, in which the optic nerve fibrils may be readily seen to terminate. These cells are most certainly homologous with the retinula cells of the so-called "compound" Arthropod eye, as has been already shown by Grenacher in his important treatise, "Untersuchungen über das Sehorgan der Arthropoden" and elsewhere, and confirmed by the more recent researches of Lankester and Bourne upon the eyes of Limulus and the scorpions.

The researches of Claparède and Weismann on the development of the eye of Arthropods confirms the deductions of morphology, by proving that the cells which ultimately form the retinulæ are specially modified hypodermis cells, and at an early stage come into connection with optic nerve fibrils. If any further evidence were required to confirm this homology it can be readily obtained by studying the eyes of very young cockroaches, in which the retinulæ at the periphery of the eye are formed from specially modified and deeply pigmented hypodermis cells.

But it is tedious and unnecessary bringing evidence of this kind to confirm a theory which is already fully established in the minds of most naturalists. In fact we have here an instance in which morphology, physiology, comparative anatomy, and development combine to establish an homology, and consequently we must definitely assert that the retinulæ are the nerve-end cells throughout the Arthropoda. But what is the meaning of Lowne's bacillar layer behind the basilar membrane? and does it exist in all Arthropods?

It is perfectly true that behind the basilar in many Diptera, Coleoptera, Lepidoptera, and Hymenoptera there is a layer composed of a number of small cylindrical masses which has a superficial resemblance to the rods of the Vertebrate eye, but Mr. Lowne did not *discover* this layer in any sense of the word, for it was perfectly well known to Leydig, who figured it in *Formica rufa*, *Dytiscus marginalis*, and *Sphinx ligustri* (*vide* Leydig's Tafeln, viii. ix. x.). The little cylindrical masses cannot be regarded as cells, nor rods, nor bacilli, for each one of them is composed of a very fine reticulum of nerve fibrillæ which is in direct communication with the optic nerve fibrils behind, and the terminal anastomosis of the optic nerve fibres in front. In fact, these "bacilli" of Lowne are connected with nerve fibrils on both sides, and thus differ from "nerve-end cells" in one of their two fundamental characters.

Very often, too, this layer is quite devoid of any pigment (Apis, Eristalis, Bombyx, Squilla, &c.), and no one has ever yet been able to demonstrate the presence of retina purple in this region.

Another important difficulty in the way of accepting this theory, too, is the fact that this layer is not always present (Periplaneta, Nepa), and in all Crustacea and many insects it cannot be divided into separate bacilli.

I have lately paid considerable attention to this part of the optic tract, but must defer a fuller explanation of the meaning of it until I am able to publish my paper in the *Quarterly Journal of Microscopical Science*, when I shall be able to illustrate my researches by several figures. To summarise, however, the evidence against this layer being composed of nerve-end cells: We find that it is certainly not homologous with the retina of other animals; optic nerve fibrils both enter and leave it; it is devoid of retina purple or of any other form of pigment in many Arthropods, and finally it is absent as a bacillar layer in many insects and in all Crustacea. In fact we can bring as much evidence to prove that this is not the retina as we can to prove that the retinulæ are the true nerve-end cells.

At the conclusion of his paper Mr. Lowne says, in referring to a recent memoir of Justus Carrière of Strassburg, "He remains, however, a disciple of established views, and has not given the retinal layer nearly so much attention as it deserves." I have given the retinal layer as "much attention as it deserves," and must also claim to remain a "disciple of *established* views."

SYDNEY J. HICKSON

[1] Leydig, "Das Auge der Gliederthiere." Tübingen, 1864.

RORAIMA

A TELEGRAM has been received at Kew giving the welcome news that Mr. Everard F. im Thurn has at last ascended Roraima. This has been the cherished object of botanical exploration in South America for the last quarter of a century. The expenses of Mr. im Thurn's expedition have been borne in equal shares by the Government grant of the Royal Society and the Royal Geographical Society.

The latest news from Mr. im Thurn was in a letter dated December 6 from the south side of the mountain, and the following passage describes the position immediately before the final attack:—

"Before we came to Roraima itself we had four days walking through a purely savannah, but most glorious country, and over splendid mountain passes, guided by an Arecoona who said, villain that he is, that he knew the way to Roraima. But at a village marked on the map as Ipelemonta, on the Aroopa River, and with a considerable mountain pass still between us and Roraima, our villain guide at last admitted that the road for some distance had been quite new to him, and that he now knew not how to proceed further. However, at last we procured a guide, and came, in some four hours, out of our difficulties at Ipelemonta (its real name, by the way, is Toorarking), into this inconceivably magnificent valley, and are installed in a village on the actual southern slopes of Roraima itself.

Yesterday Perkins and I ascended the slope of Roraima to a height of 5600 feet to a most beautiful spot—a very garden of orchids and most beautiful and strange plants. To-morrow, after despatching the bearer of this scrawl, we

go up to the same place with a lot of Arecoonas, who are to build us a house, in which we intend to stop for a week or as much longer as we may find desirable. I may mention that we have already seen, close to where our house is to be, a place where the mountain *seems* accessible; but it looks so easy that I am convinced that it is impossible at that point."

BENJAMIN SILLIMAN

DURING the American War of Independence many men were called on to leave peaceful pursuits and adopt the profession of arms. Among these men was a well-known lawyer of New Haven in Connecticut, Gold Selleck Silliman by name. Lawyer Silliman became Brigadier-General Silliman. As the British troops advanced in the direction of New Haven the family of the General left their native place and settled in North Stratford, now called Trumbull. In this town Benjamin Silliman, the father of him whose death was recently recorded in these columns, was born in 1779.

Benjamin Silliman, sen., was a central figure in the group of pioneers of natural science in the United States. In 1818 he commenced the *American Journal of Science and Arts*, which continues to the present day to hold a leading position among the scientific journals of America. Two years before this date—that is, in 1816—Benjamin Silliman, jun., was born, at New Haven, where the Silliman family had so long had their home. The younger Silliman graduated at Yale College in 1837; and in the following year he began to teach chemistry, mineralogy, and geology. In 1846 he was appointed Professor of Applied Chemistry in the Sheffield Scientific School in connection with Yale College. The scientific work of Benjamin Silliman seems to have fairly begun about this time; according to the Royal Society's Catalogue, his first paper, "On the Use of Carbon in Grove's Battery," was published in 1842. From that time until his death he was an active worker in the advancement of science. During the years 1849-54 Silliman was Professor of Toxicology in the University of Louisville, Kentucky; in the latter year he returned to Yale College, to succeed his father as Professor of Chemistry. Here he remained until January 13 last, when he "went over to the majority."

Prof. Silliman did not publish any original memoirs, involving experimental work, of first-rate importance; like his father, he was distinguished rather as an organiser and teacher than as an investigator. For many years he acted as Secretary and Editor of the *Proceedings* to the American Association for the Advancement of Science. In 1838 he became associated with his father as joint editor of the *American Journal of Science;* in this capacity he exercised a great and beneficial influence in all matters connected with natural science in his own country.

The journal of which Sillimann was an editor contains about seventy papers from his pen; the greater number deal with mineralogical or chemico-mineralogical subjects, but he also wrote on such topics as glacier-motion, Australian wines, petroleum, temperature of flames, &c. He likewise furnished the *Journal* with many reviews of books and reports on the progress of various branches of natural science.

He published a book on the "First Principles of Chemistry," and another on the "Principles of Physics."

In his capacity as a public lecturer on scientific subjects, Silliman helped to guide the general opinion of his fellow-citizens in these matters in the right direction. It may indeed be said that his life-work was to form a connecting link between those who had devoted themselves to original investigation in natural science and the general outside world, which, while interested in science, requires a judicious and trustworthy middleman to interpret the meaning of the work that is being done for humanity by the students of nature in the inner shrine.

M. M. P. M.

MASAI LAND[1]

MR. THOMSON has not kept us waiting long for the story of his journey through a region of Africa which, so far as is known, had not previously been visited by any white man. Kilimanjaro itself was seen for the first time by Rebmann. After him Krapf, New, Von der Decken, Hildebrandt, and Wakefield, penetrated to the borders of the region which has been explored by Mr. Thomson, New alone being able to reach the snow-line on Kilimanjaro. Kenia, though doubtfully sighted by Krapf from afar, had never been approached. Mr. Thomson had thus a virgin field before him when he arrived at Zanzibar in the beginning of 1883, and the enterprise intrusted to him by the Royal Geographical Society he carried out in a manner and with results that will add much to the reputation which he achieved on his first expedition to Tanganyika. Mr. Thomson's instructions were to ascertain if a practicable direct route for European travellers exists through the Masai country from any one of the East African ports to Victoria Nyanza, and to examine Mount Kenia; to gather data for constructing as complete a map as possible in a preliminary survey; and to make all practicable observations regarding the meteorology, geology, natural history, and ethnology of the regions traversed. These objects Mr. Thomson never lost sight of, and, considering the means at his command, the time at his disposal, and the blackguardly crew he had to be content with as followers, are even more than might have been expected. Mr. Thomson is first of all a geologist, and no region in Africa is of more interest from a geological standpoint. He knows, moreover, enough of natural history to enable him to observe the flora and fauna of a country intelligently, and the value of his botanical collections has already been pointed out in our pages by Sir Joseph Hooker. For geographical observations he was even better fitted than in his previous expedition, and as for ethnology he found himself among a people unlike anything he had ever heard of in Africa, and in whom he took the intensest interest. Thus for the scientific reader the volume abounds with interest, and, as Mr. Thomson has no end of hunting and other stories of adventure to tell, his book is sure to be popular, especially as he is a skilful story-teller, abounding with a strong feeling of humour, or at least for the ludicrous, which does not spare even himself.

Mr. Thomson's route lay westwards from Mombassa to Kilimanjaro, which he traversed on nearly every side. Here he stayed for some time, ascending a considerable distance towards the Kimawenzi summit. For this magnificent mountain is really double-peaked, the highest summit, Kibo, reaching a height of over 18,610 feet, and Kimawenzi only about 2000 feet lower. The scenic features of the mountain were described in some detail in our columns recently in the paper read by Mr. Johnston at the Geographical Society, in which also its botanical and zoological characteristics were well brought out. Kilimanjaro, Mr. Thomson tells us, may be described as a great irregular, pear-shaped mass, with its major axis in a line running north-west and south-east, the tapering point running into the heart of the Masai country. On this line it is nearly sixty miles long. Its minor axis, running at right angles, reaches only to some thirty miles. The mountain is divided into the great central mass of Kibo and the lower conical peak of Kimawenzi. Towards the north-west it shades away into a long ridge, which gradually tapers horizontally and vertically till it becomes

[1] "Through Masai Land; a Journey of Exploration among the Snowclad Volcanic Mountains and Strange Tribes of Eastern Equatorial Africa." By Joseph Thomson, F.R.G.S. (London: Sampson Low and Co., 1885)

merged in the Masai plain. As to the geological story of the mountain, Mr. Thomson works it out thus:—

"Let me try to trace the sequence of events which have produced Kilimanjaro. An examination tells us that in the serrated peak and rugged sides of Kimawenzi we see the original volcano, which, without doubt, existed long before there was a trace of its neighbour Kibo. Kimawenzi, after the imprisoned earth-forces found vent, rose in size and grandeur, added layer after layer to its height and circumference by a continual alternation of lava sheets and beds of agglomerate and tuff. It appears probable that it welled or belched out its contents without any of those terrific outbursts by which whole mountains are blown into the air or enormous areas submerged under a molten flood; for, curiously enough, we find no evidence that any of its lava-flows ever extended beyond the base of the mountain, or ashes accumulated to any depth in the surrounding country. At the present day the metamorphic rocks are seen to crop out at its very base on the east and south-east, and we have no reason to suppose that they ever were covered by lava rocks. As this—for a volcano—gentle accumulation went on, the hypogene agents would have more and difficulty in forcing the lava up the now elongated vent or orifice, and a time would come when the weight of the column would, in the end, balance the strength of the forces below. We can now imagine the terrible struggle that would ensue as the pent-up gases laboured mightily to relieve the pressure. Doubtless for a time they would succeed occasionally in clearing off the incubus and getting temporary outlet. At last even that would fail, and the volcano was doomed either to become extinct or find another vent. After some grand convulsions the latter was effected, and a new volcano began its existence to

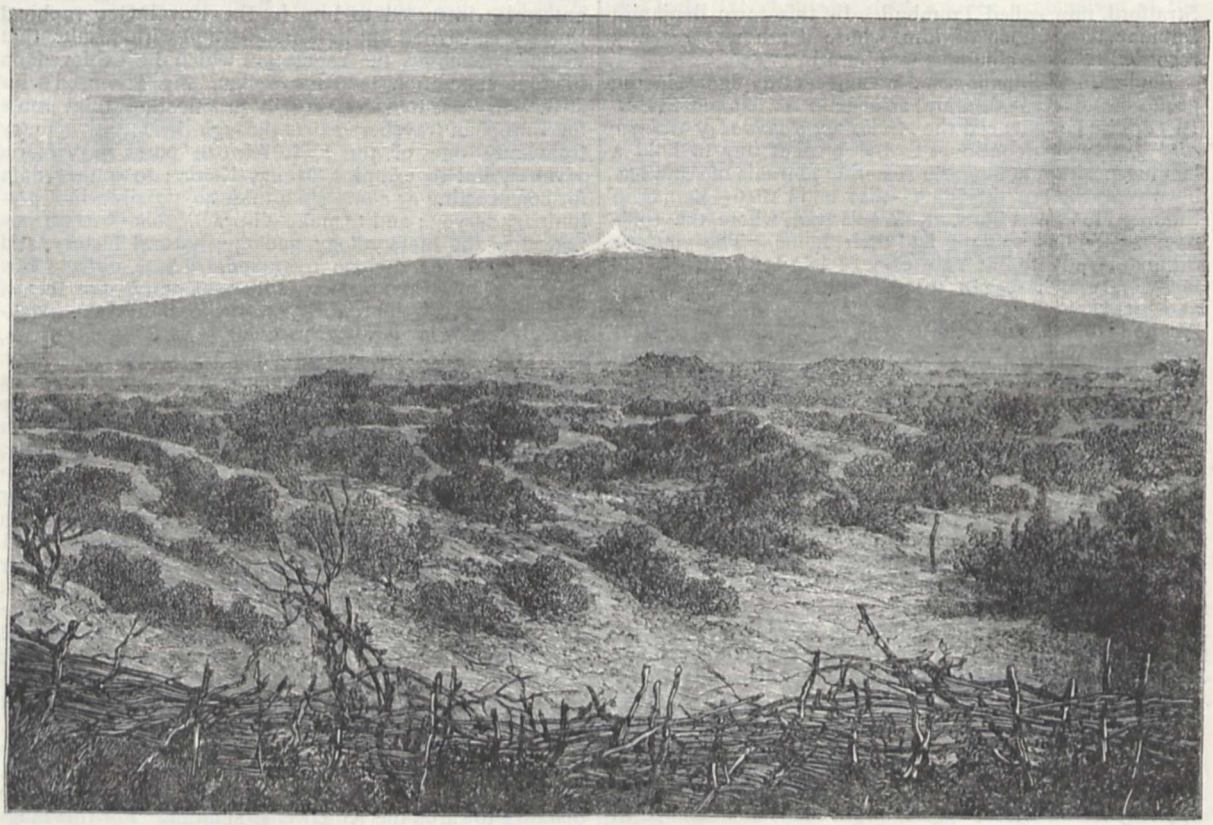

Fig. 1.—Mount Kenia from the West.

the west of Kimawenzi. In process of time it soon rivalled its neighbour in size, and finally towered above it, battering Kimawenzi's hoary head—probably then snow-capped—with showers of stones, and even threatening to obliterate it under the volcanic ejections. Meanwhile Kimawenzi, now no longer under a reign of fire, with its volcanic life-work finished, began, like all things earthly, to crumble away before the slow-boring influence of apparently puny agents. Rain, snow, and frost worked on insidiously but steadily, and soon told their usual tale of denudation as they gradually loosened and washed away the loose ashes which formed the crater, undermined the more compact lavas, and hurled them to the bottom of the mountain; until finally the solid core which had originally choked the orifice stood out a shattered, weather-beaten pinnacle with only a slight indentation to mark the line of the original crater The beautiful concave curve, so characteristic of large volcanoes, is still to be seen from the east, and speaks of the once handsome proportions of Kimawenzi.

"The fate which befell Kimawenzi soon came upon Kibo. A height was reached which baffled all the attempts of Vulcan to raise the lava to the surface, and, like the other, it became extinct. Evidently, however, the imprisoned forces had either spent their original strength, or they frittered away their terrible energies in the production of numerous parasitic or secondary cones, instead of uniting in another grand effort and producing a third great volcano.

"These cones were spread in great numbers all along the southern side of Kibo and Kimawenzi, and set themselves to the task of strengthening or buttressing them up. An enormous mass of lavas and agglomerates was belched forth, resulting eventually in the formation of what I have called the Chaga terrace or platform, and the long ridge which penetrates far into the Masai country.

These manifestations of volcanic energy were continued far into what, geologically speaking, are recent times, and the geologists may view the small cones in many instances as perfectly preserved as when they were at work.

"The most interesting relic of the reign of fire is presented by the beautiful crater lake of Chala, which lies a short distance to the east of the base of Kimawenzi, and only a few miles north of Taveta. It represents probably the latest manifestation of energy, extending indeed into historical times, as the natives have a tradition that at one time a great Masai village stood on its site and was blown into the air, and they will now tell you that at times you may still hear from its liquid depths the lowing of cattle and the bleating of sheep, as well as other village sounds. The shape of the lake is that of an irregular polygon, about two miles in diameter and little short of six miles in circumference. It occupies the centre of a small hill with very irregular rim, 400 feet

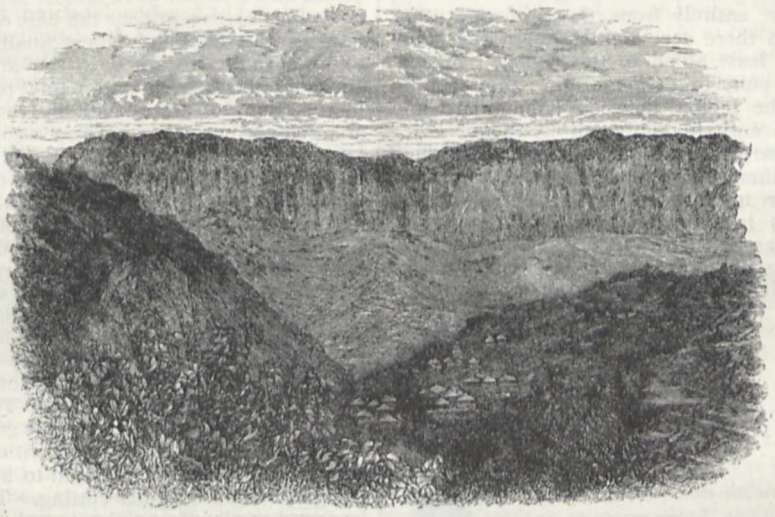

FIG. 2.—Lava Cap,' Elgeyo Escarpment.

above the eastern plain at its lowest point, and quite 800 at its highest, where it runs up into a peak. The outer slopes are formed by beds of lapilli and tuff, which incline away all around at the same angle as the hill itself. Internally the lake is bounded by perfectly perpendicular cliffs without a break at any point, at least as far as I could discover, though the natives of Taveta say there is a place where the descent can be made; indeed, its discoverer, New, declares that he reached the water, and drank of it. I went all around it, and though I am not deficient in enterprise or nerve, I saw no place where I dare descend, not even though I could have swung from creeper to creeper like a monkey."

From Kilimanjaro Mr. Thomson proceeded in a northerly direction, through the heart of the Masai country, to Lake Baringo, making a detour eastwards to

FIG. 3.—Glen of the Guaso Kamnyé.

Mount Kenia, which in some respects is even more interesting than Kilimanjaro. From Lake Baringo he proceeded as far westwards as the north-east shore of Victoria Nyanza, not many miles from the outlet of the Nile; then north to some strange artificial caves on the south face of Mount Elgon or Ligonyi (14,000 feet), and by Mount Chibcharagnani (12,000 feet), back to Baringo, and so south-eastwards to the coast, following a more northerly route after passing Lake Naivasha, which is just about half-way between Kilimanjaro and Lake Baringo, Of course this excellent piece of work was not accomplished without many trials and sufferings. The fierce and warlike Masai threatened many a time to eat Mr. Thomson and his men up, and it was only by the most wonderful tact and patience that the expedition succeeded in accomplishing its work without loss of life. The Masai

are notorious cattle-lifters and great breeders, but their herds were dying by thousands of some mysterious disease, and it was only when at its last gasp that an animal could be bought, its carcase when cut up being loathsome. It was no wonder, then, that Mr. Thomson suffered dreadfully from dysentery, and a less determined man might have succumbed entirely. Yet Mr. Thomson cannot sufficiently express his admiration for a people whom he regards as the Apollos of Africa. Their physique, their language, their habits, their bearing, differ entirely from those of any other African race, though there seems little doubt that they are, by language at least, allied to the Gallas. Indeed, their own traditions point to a Galla origin ; they seem to be intruders into the region between Kilimanjaro and Kenia, which is now entirely dominated by them. They are certainly not a pure race, and scattered among them are remnants of a different people, who are the pariahs of the country. Their intelligence is above that of the average African, as is indicated by the dimensions of their skulls as well as by their organisation and general bearing. Their social habits are much what we find among other races of their stage of civilisation; "morality"

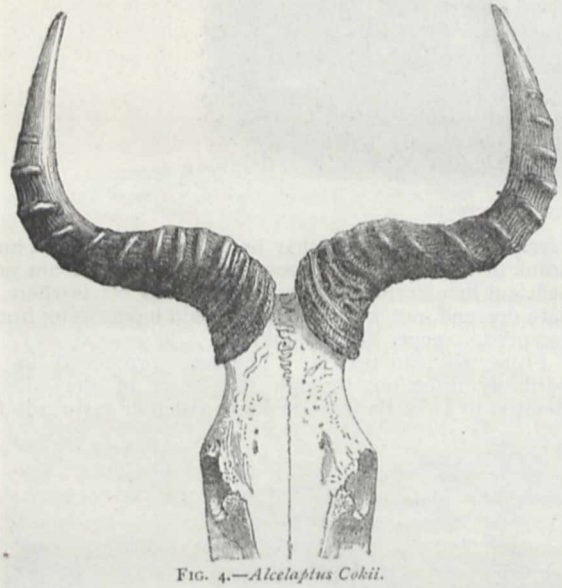

FIG. 4.—*Alcelaptus Cokii.*

begins only after marriage. All the unmarried men belong to the warrior class, and are permitted to use none other than animal food. Their spears, of native make, are of enormous dimensions, and their war costume is elaborately ludicrous. One strange custom is that spitting is the greatest mark of distinction you can bestow upon a Masai, and Mr. Thomson was often sorely exercised when he desired to be particularly conciliating and gracious in his intentions. This custom is, however, not without parallel : the natives of part of the southern coast of New Guinea, indeed, improve upon it by squirting mouthfuls of water on those to whom they wish to give a specially friendly welcome. What is the particular significance of the custom perhaps those who have investigated the subject of salutations may be able to explain.

As to the country itself through which Mr. Thomson passed, while part of it is desert, simply from want of water, much of it is rich in grass and forest, abundantly watered, and with a wealth of varied scenery scarcely surpassed in some of the favourite tourist resorts of Europe. Besides the two prominent mountain summits, there are several ranges of varying height, one of the loftiest and most attractive being to the south-west of Mount Kenia, and to which Mr. Thomson loyally gave the name of Lord Aberdare. "The Masai country," Mr. Thomson tells us, "is very markedly divided into two quite distinct regions, the southerly or lower desert area, and the northerly or plateau region. The southerly is comparatively low in altitude, that is to say, from 3000 to nearly 4000 feet. It is sterile and unproductive in the extreme. This is owing, not to a barren soil, but to the scantiness of the rainfall, which for about three months in the year barely gives sufficient sustenance to scattered tufts of grass. The acacia and mimosa have almost sole possession of those dreary plains, except near the base of some isolated mountain or other highland, where small rivulets trickle down, to be speedily absorbed in the arid sands. No river traverses this region, and many parts are covered with incrustations of natron, left by the evaporation of salt-charged springs. We have seen something of this lower region in the flat reach of Njiri, and the forbidding desert of Dogilani. It is not, however, to be conceived as a monotonous level. Far from it. The colossal Kilimanjaro and the conical Mount Meru belong to it. The hills of Geléi and the Guaso N'Ebor circle round in the form of an amphitheatre, to meet the metamorphic masses of Ndapduk and Donyo Erok. Further to the west and north are the volcanic masses of Donyo Engăi, Donyo la Nyuki, and Donyo Logonot, with the hills of Nguru-ma-ni. Except in the immediate vicinity of the higher mountains, such as Mount Meru and Donyo Engăi, the country is to a large extent uninhabited. To summarise this tract we may say that it is triangular in general shape, the apex towards the north reaching to within thirty miles of the equator, and extending beyond to Baringo as a species of trough or deep irregular cutting. The Masai are only to be found at all seasons about such favourable situations as the base of Kilimanjaro, Mount Meru, Ndapduk, Geléi, Kisongo, to the west of Meru, Donyo Engăi, and along the edge of the plain at the bases of the bordering highlands Maũ and Kaptè. The country is sufficiently characterised when the fact is stated that it is a region of later volcanic activity, which in a very recent geological period has produced the cones and craters already referred to. These results of volcanic energy may, to some extent, be accounted for—though the statement may seem to savour of reasoning in a circle—by the lower region as an area of depression having subsided or sunk from the higher level of the flanking table-lands. The northerly or higher plateau region of Masai Land may be described as rising from an elevation of nearly 5000 feet on either side, and culminating in the centre at an elevation of little short of 9000 feet—although through this very line of highest elevation runs from the Dogilani plain the remarkable meridional trough which incloses the charming chain of isolated lakes, Naivasha, Elmeteita, Nakuro, and Baringo ; and which, at the last-named place, begins to widen out till it assumes the characteristics of the southerly plain of Masai Land. On the eastern half of this divided plateau rises, as we have seen, the snow-clad peak of Kenia—and the picturesque range of the Aberdare Mountains, which runs almost parallel with the central line of depression. A more charming region is probably not to be found in all Africa, probably not even in Abyssinia. Though lying at a general elevation of 6000 feet it is not mountainous, but extends out in billowy, swelling reaches, and is characterised by everything that makes a pleasing landscape. Here are dense patches of flowering shrubs ; there noble forests. Now you traverse a park-like country enlivened by groups of game ; anon, great herds of cattle, or flocks of sheep and goats are seen wandering knee-deep in the splendid pasture. There is little in the aspect of the country to suggest the popular idea of the tropics. The eye rests upon coniferous trees, forming pine-like woods, and you can gather sprigs of heath, sweet scented clover, anemone, and other familiar forms. In vain you look for the graceful palm—ever present in the mental pictures of the untravelled traveller. The country is a

very network of babbling brooks and streams—those of Lykipia forming the mysterious Guaso Nyiro; those of Kikuyu the Tana, which flows to the Indian Ocean through the Galla country; while further, south, in Kaptè the streams converge to form the Athi River, which flows through U-kambani to the Sabaki River."

Here is Mr. Thomson's account of his observations on Mount Kenia:—"We were now at an altitude of 5700 feet, which may be taken as the general level of the plain from which Mount Kenia rises. Kenia itself is clearly of volcanic origin, and may be considered to be a counterpart of the Kimawenzi peak of Kilimanjaro. Unlike Kilimanjaro, its volcanic forces have not changed their focus of activity, and hence it now stands as a simple undivided cone. Up to a height of 15,000 feet (9000 feet above the plain) the angle of slope is extremely low, being in fact only between 10° and 12°, a fact which would seem to show that the lavas ejected must have been in a much more liquid condition than those of Kilimanjaro. The angle in the latter is much higher, indicating that the ejections were more viscid, and consequently did not flow so far from the orifice. At an elevation of over 15,000 feet the mountain suddenly springs at a high angle into a sugar-loaf peak, which adds a further height of about 3400 feet. At the base of the peak two small excrescences are noticeable, and some distance to the north there rises a humpy mass. This peak, as in the case of Kimawenzi, without a doubt represents the column of lava which closed the volcanic life of the mountain, plugging or sealing up the troubled spirits of the earth. The crater has been gradually washed away—having been composed, doubtless, of loose ashes and beds of lava, and now the plug stands forth, a fitting pinnacle to the majestic mass below. As at Kilimanjaro, nature has appropriately woven for its grim head a soft crown of eternal snow, the cool, calm shining of which is at once a wonderful contrast and a strange close to the mountain's fiery history. The sides of this upper peak are so steep and precipitous that on many places the snow is quite unable to lie, and in consequence the rocks appear here and there as black spots in the white mantle. Hence its Masai name of Donyo Egèrè (the speckled or gray mountain). The snow covers the whole of the upper peak, and extends some distance on either side, reaching, and indeed including, the humpy mass on the north. The peak is strikingly suggestive of an enormous white crystal or stalagmite, set upon a sooty basement, which falls away gradually into the dark emerald green of the forest region round the base."

On the north side of Mount Kenia very few streams have their origin, though on the south side they are said to be abundant. It is still more unaccountable that, except on the south side of Mount Kilimanjaro, not a stream trickles down the snow-capped mountain, a phenomenon which only actual exploration can account for. One of our illustrations (Fig. 2) shows a great lava-cap in the Elgeyo Mountains to the west of Lake Baringo. In a running survey such as Mr. Thomson made, minute observation is of course impossible; but with his experience as a field geologist and his general caution, we may accept his geological map of the region lying between Victoria Nyanza and the coast as in a general way representative of the facts. Along the coast at Mombassa we find a strip of Tertiary rocks, succeeded westwards by a broad band of Carboniferous. West and north west of this is a great area of metamorphic rocks, having their counterpart further westwards on the east side of Victoria Nyanza. Between them, in three irregular strips, lie the earlier and later volcanic series, the mass of Kilimanjaro winding its way into the metamorphic, and Kenia lying on the northern edge of the latter. That volcanic activity is not quite extinct is shown by the fact that in the Kenia region hot springs and pools are met with, and the natives have a tradition that on the site of Lake Chala, on the east side of Kilimanjaro, once stood a large and populous town.

Thus Mr. Thomson has been able to fill up in a very satisfactory manner a considerable blank on the map of Africa. He has moreover established the fact that Baringo is a distinct lake, and that the east shore of Victoria Nyanza trends much more to the north-west than we find it on Mr. Stanley's map. The combined observations of Mr. Thomson and Mr. Johnston are a valuable addition to a scientific knowledge of one of the most interesting regions of Africa.

NOTES

MANY of our readers will be pleased to learn that M. Charles Feil has, after some years' absence, returned to the active management of his celebrated manufactory of optical glass in Paris, the new firm being "Feil père et Mautois." M. Charles Feil, who is well known both for his scientific and business abilities, is grandson to M. Guinaud, who, some sixty years since, in a mode of working almost identical with that adopted by the celebrated potter Palissy, overcame the serious obstacles which occur in securing the perfect homogeneity of both crown and flint glass, and whose secrets have descended to his grandson.

IT is with great regret we announce the death, on the 7th inst., of Mr. Edward Caldwell Rye, Librarian to the Royal Geographical Society, after a very short illness, from small-pox, aged about fifty-two years. In natural history he specially made his mark as an entomologist, and for a long time was the chief authority on British beetles, on which subject he was the author of a volume in Lovell Reeve and Co.'s series of popular works on British Natural History. For several years he contributed the article "Coleoptera" to the *Entomologists' Annual*, and he was one of the editors of the *Entomologists' Monthly Magazine* from its commencement in 1864. Furthermore he was for some years on the staff of the *Zoological Record* as a contributor, and since the 10th volume of that useful publication he had been sole editor. Nowhere will his nearly sudden death be more felt than at the Royal Geographical Society, for, in addition to his ordinary duties as Librarian, that of editing the bibliographical portion of the *Proceedings* devolved upon him. Mr. Rye married a daughter of Mr. G. R. Waterhouse, of the British Museum, who, with four children, all young, survives him; and, if report be true, they are left almost unprovided for. He was a Fellow of the Zoological Society, a member of the Entomological Society of London, and the Recording Secretary of Section E at the meetings of the British Association.

WE regret to announce the death, at Paris, on February 1, at the early age of thirty-four, of Mr. Sidney Gilchrist Thomas, to whom is mainly due the basic Bessemer process. Born in 1850, he entered the Civil Service, but from his youth showed a taste for science, and especially metallurgy. The project of eliminating phosphorus by the Bessemer converter soon occupied all his attention, and, after numerous experiments at Blænavon, in 1877 he took out his first patent, and communicated his invention to the Iron and Steel Institute in a paper read at the Paris meeting in 1878.

THE Minister of Agriculture in Canada has just declared the Bell telephone patent void in the Dominion, the occasion being a double infraction of the Canadian law by the Canadian Telephone Company. It appears that the Company imported telephones after the expiry of two years from the date of the patent, and that it also refused to sell instruments to the public, demanding annual rentals for the lease, as in this country and in the States. Both these acts contravene the Dominion law.

UNDER the title of "The Cost of a Fog," Mr. W. T. Makins, Governor of the Gas Light and Coke Company, writes to the *Times* under date of January 24:—"Perhaps your readers may be interested to read the experience of the Gas Light and Coke Company on the occasion of last Tuesday's fog. Ninety-six million cubic feet of gas were sent out during the twenty-four hours ending at midnight on Tuesday. This quantity was an increase on that of the corresponding day in 1884, which may be taken to have been an ordinary January day, of 37 per cent., or over 35,000,000 feet. The price being 3*s.* per 1000 feet, the public had to pay this one company 5250*l.* extra on account of the fog. Nine thousand five hundred tons of coal were carbonised during the twenty-four hours to produce the 96,000,000 feet, the largest quantity we have ever sent out in one day."

THE *Times* Alexandria correspondent, in reference to the Egyptian Sanitary Board, takes occasion to mention the immense services which might be rendered to that country and to science by the appointment of a scientific microscopist and analyst to the uncontrolled charge of the Health Department. An eminent physician assures him that half the population are mentally and physically incapacitated for work, owing to the existence of certain diseases, which sanitary study might remedy.

FOLLOWING the example of the United States Geological Survey, that of Canada has lately enlarged the sphere of its operations, so as to include ethnological work in its publications. The first result of this wise measure is a volume containing copious comparative vocabularies of the chief Indian languages still current in British Columbia, for which the authors, W. Fraser Tolmie and George M. Dawson, have been collecting materials since the year 1875. In this collection, which was issued in 1884 by Dawson Brothers of Montreal, the list of words proposed by Mr. Gibbs in his "Instructions for Research Relative to the Ethnology and Philology of America," has been adopted as a basis, and his orthographic system has also been largely adhered to. The vocabularies thus comprise over 200 words of one or more dialects of every stock language spoken on the Pacific slope of the Rocky Mountains from Alaska southwards to the Columbia River. Appendices are added containing comparative tables of other native languages from vocabularies already printed, and from these tables it appears evident that, contrary to the hitherto prevalent impression, the widespread Tinné (Athabascan) family is represented on the Pacific slope in the Tshimsian group about the Nasse and Skeena rivers over against the Queen Charlotte Islands. Nevertheless on the accompanying linguistic map, which is on a large scale, this group is still coloured separately as if it were a stock language, and not a branch of the Athabascan, as is now for the first time made evident. The other stock languages of this region—Haida (Queen Charlotte Islands), Thlinkit (from Alaska to the Nasse River), Kwakiool, Aht, and Kawitshin (Vancouver Island), Niskwalli (Puget Sound), Cheheili (Washington Territory), Tshinook (Lower Columbia River), Bilhoola (Bentinck and Dean Inlets), Selish (Fraser River), Sahaptin (Right Bank Columbia River), and Kootenuha (Kootenay and Upper Columbia Rivers)—all are represented in one or more of their branches. Altogether valuable materials are here collected and conveniently arranged for the comparative study of nearly thirty languages or distinct dialects current in one of the most intricate linguistic domains on the American Continent.

THE African Association will shortly send to the Congo the apparatus required for establishing telephonic communications between certain stations on the lower river.

ACCORDING to the report of Capt. E. Backhaus, of the German ship *Carl* (published in *Hansa*), that vessel, while on her voyage from New York to Trieste, experienced an earthquake at sea on the night of December 21–22 last. For about five minutes the ship was violently shaken. The lamp shades were thrown to the ground, and the upper layers of the tins of petroleum between decks were pitched up against the deck. She was then at 36° 34′ N. lat. and 22° 26′ E. of Greenwich, that is, near Cape Matapan in the south of Greece. Those on board thought the ship had struck on a rock, and the pumps were rigged and set working. The sea was still, but had a whitish colour; the wind was east and light, and the rate was about three nautical miles per hour. When examination was made subsequently, no trace of injury was found on the wood or copper outside. The captain was led to make a report of the occurrence at Trieste by hearing of the Spanish earthquake, as well as from another shipmaster, who had experienced the same phenomenon also to the south of Greece.

THE last four years have been a period of unusual activity in railway construction in Japan. How much has been done in that period, and is now being done, is not generally understood in Europe. The following statement on the subject is summarised from a paper communicated to the Geographical Society of Toulouse by Capt. Fouqué, Professor of Mathematics in Tokio. The line between Tokio and Yokohama, eighteen miles in length, was opened in June, 1872; that between Hiogo and Osaka in March, 1874, its extension to Kioto in 1876, and a further extension to Otsu, making the total length from Hiogo about sixty miles, in 1879. At Otsu it reached the shores of Lake Biwa. What may be regarded, therefore, as a prolongation of this line is that from Nagahama, at the head of the lake, to Tsuruga, an important harbour on the sea of Japan, a distance of over twenty-five miles. There is thus a direct steam connection (as there is a fleet of steamers on the lake) between Hiogo on the Inland Sea, and the Sea of Japan on the west. On May 25 last a line was finished between the same—Nagahama and Sekigahara—with a continuation to Ôgaki, a total distance of about fifty-five miles, through the centre of the province of Mino, one of the most productive in Japan. The last line finished is that between Tokio and Tagasaki, which was opened by the Emperor on June 25, 1884. The length is about sixty-two miles, and it taps the rich provinces of Joshin, Shinshin, and Boshin, the great centres of silk, tea, and tobacco cultivation. There were no serious engineering difficulties on this line, perhaps the most important of any yet constructed in Japan, for it traversed large and fertile plains. Thus the total length of the railways actually constructed in Japan is about twenty-three miles. Two short lines in course of construction are those between Shinagawa, near Tokio, and Kawaguchi, and one from Tagasaki to Mayebashi, the capital of the silk trade. The latter is only about eight miles long, and may be regarded as complete. Of projected lines the construction of the following have been decided on, and the work should be commenced by this time: (1) one from Tokio due north through the centre of the main island to Awomori, opposite Hakodate, in the Island of Jezo. This would be one of the main trunk lines of Japan, and its length will be about 450 English miles. (2) From Takasaki to Ôgatchi, the first part of a line which will ultimately reach Yokkaichi, an important seaport on Owari Gulf, on the east coast. The length of this will be about 200 miles. (3) From Nyeda, in Shinano province (in the centre of the main island) to Niigata, the principal part of the west coast, 150 miles, and two shorter lines intended to connect important towns with neighbouring ports. It has been decided recently to construct tramways between some of the principal towns omitted in the railway scheme, the first being between Tokio and Kofu, a distance of about 700 miles. The amount of money available for public works of this description is necessarily limited, and the progress is therefore, everything considered, exceedingly rapid.

ACCORDING to a Russian journal, quoted in *Globus*, the Russian law, especially as regards murders, is now to be enforced amongst all natives under Russian rule. Hitherto the murder of a Kirghiz was punished by their own customs in the following manner:—When in an aul or in the steppe a murder has been committed, the relatives and friends of the dead man commence the search for the murderer. Sometimes he is not found until after a long interval, especially if the body is not soon found. Frequently the latter is hidden, then the flight of birds of prey is watched, and other indications are utilised by the extraordinary acuteness of the nomads. When the murderer is discovered the relations have the right to levy from him a so-called *kun*. This fine, which washes away bloodguiltiness, consists of a number of camels, horses, sheep, and clothes, a special *kun* being due to those who took part in the search for the murderer, to the person who actually discovered him, and to the judge. The fine, or *wergild*, for a woman is less than that for a man, and in the latter case it varies with the descent. Thus there would be a greater fine for killing a pure Kirghiz than for killing one whose descent was unknown. If the murderer cannot pay the *kun*, his kinsfolk must do it for him, and the payment and receipt of this fine is accompanied by a number of different customs. The occasion is a kind of festival in the aul in which the relatives of the murdered man live. Among the animals paid as *kun*, the murderer's horse must always be one. The family of the person killed have, however, the right to refuse all payment, and to demand a duel with the slayer. The latter appears in the aul of the others armed from head to foot, and mounted on his best steed; a certain distance off the avengers are stationed, and a wild race ensues. If the accused can get away from his pursuers, he is safe from all punishment; he can, however, only be pursued to the going down of the sun, and directly the latter sinks behind the horizon he is free. If he is caught he is generally put to death at once. It is remarkable that a murder rarely remains undiscovered. The Kirghiz hardly ever commit that crime for the sake of robbery; the murder generally takes place after a quarrel, or for revenge.

AMONG the various contrivances for indicating 24 hours on watch dials, one by Sturrock and Meek, mentioned in the February number of the *Horological Journal*, seems to be neat and ingenious. The dial is made with twelve holes in place of the usual figures. During the first half of the day, midnight to noon, the figures 1 to 12, placed on a disk at the back, show through; at noon the disk becomes automatically shifted so that the figures 1 to 12 are replaced by figures 13 to 24 (0); at midnight the figures 1 to 12 are again brought into view. Thus, whilst retaining the ordinary and familiar and convenient 12 hour spaces, the advantage of the 24-hour system is obtained without the necessity of keeping a double set of hourly figures constantly in view.

TO the *Boletin de la Institucion libre de Enseñanza* for January 15, D. Augusto Arcimis sends an account of the meteorological branch of the observatory recently attached to that institution. The building is situated in the Paseo del Obelisco in the north of the city, where it is surrounded only by low buildings and removed as far as possible from disturbing influences. Pending the acquisition of improved instruments a mercurial barometer connected with two thermometers, and with a diameter of 4 mm., has been set up, and since last December its readings have been systematically compared with those of the barometer in the Medical Observatory. With another instrument, specially constructed by Salleron of Paris, records are taken of the atmospheric temperature in the shade, as well as of the moisture, certain modifications having converted it for practical purposes into a hygrometer similar in principle to that of Mason. The thermometer of maxima is modelled on the system introduced by Negretti and Zambra of London, while that of minima adopts the Rutherford system, both being manufactured by Secretan of Paris. To avoid as far as possible the disturbing influences to which all meteorological stations are exposed in large cities, the instruments are placed in wooden boxes, which, while exposed to the free circulation of the air, are still thoroughly protected from bad weather and from the direct rays of the sun. The Institution has also been supplied with other instruments for determining the amount of evaporation, the loss of heat by radiation, the force, pressure, and direction of the winds prevalent throughout the year. This meteorological station is thus one of the best equipped in Europe, and in fitting it up advantage has been taken of the experience already acquired from the working of similar establishments elsewhere.

THE first railway in Cochin-China was opened on December 21 last. It runs from Saigon to Mytho, the journey taking about four hours.

IN connection with the Parkes Museum a meeting will be held at the Mansion House on Friday at 3 p.m. to obtain more extended support for the Parkes Museum, so that it may be firmly established on a permanent basis. The Right Hon. the Lord Mayor will preside, and the Council hope to have the support of all those interested in promoting public health and a knowledge of the laws of hygiene.

AT the Meeting of the Council of the National Smoke Abatement Institution, preliminary to the recent annual meeting, a letter was read from the secretary of the Duke of Westminster stating that in his Grace's town house nothing had been burnt but coke, with the most satisfactory results. The Draft Report to the Annual Meeting was presented by the Secretary, to which, at the chairman's suggestion, it was decided to add a paragraph calling attention to the obsolete character of the boundaries within which the present Metropolitan Smoke Act is operative, and pointing out the necessity for a short amendment Act aiming at a rectification of the boundaries, and the necessity for a firmer and fuller application of the provisions of the Act to certain industries in which smoke abatement is now much easier than it was at the time when the present Act was passed. It was resolved to communicate with the Home Secretary, calling his attention to the documents which had been already forwarded to him, and to the paragraphs in the Report relating to the nominal nature of the fines imposed by the magistrates in cases of infringement of the Act, and ask him whether, under the circumstances, he would be willing to issue a circular calling the attention of the police magistrates to the evils which result from the difficulty of obtaining a due enforcement of the law. It was further resolved to issue a separate memorandum, in the form of a leaflet, putting forward some information as to the conditions to be considered in the choice of grates, in the burning of fuel, and in the general treatment of a coal fire.

PROF. SIDNEY COLVIN, Slade Professor of Fine Art in the University of Cambridge, will give two lectures at the Royal Institution, on Tuesdays, February 17 and 24, on "Museums and National Education."

SOME of the fish in the Salmonidæ tank at the South Kensington Aquarium have recently been spawned, the species operated upon being the *S. levenensis*, *S. fontinalis*, and the *Gilleroo* trout of Ireland. The eggs have been deposited in suitable hatching boxes, where they afford satisfactory evidence of ultimate success. It will be particularly interesting and edifying to note the result on account of the prolonged captivity of the fishes from which the eggs were spawned.

THE fine aquarium on view during the Health Exhibition will naturally be in existence during the forthcoming Inventions Exhibition. In addition thereto will be shown a very large collec

tion of fish culture appliances showing the process of hatching, the mode of dealing with the fry after losing their umbilical sac, and the best means of artificially feeding them until they have reached that stage in their existence when they are able to provide for themselves. A special building is to be erected for this purpose in proximity to the aquarium, which is now in course of construction. This section of the Exhibition, which will be under the entire direction of the National Fish Culture Association, promises to be a source of much attraction and interest to the ichthyological world.

AN experiment has lately been tried by the Secretary of the National Fish Culture Association at South Kensington to test the highest temperature endurable by various species of fish. To this end several specimens of the following fish were selected for the trial, viz. the carp, gudgeon, dace, roach, perch, minnow, golden tench, common tench, trout, and salmon, all of which were deposited in cold water registering 53°. The temperature was then gradually increased by the infusion of hot water through a tube which caused the temperature to rise steadily. None of the fish, however, exhibited signs of fading vitality until the thermometer recorded 82°, when a perch became prostrated; and shortly afterwards its congeners followed its example in rapid succession in the following order:—Roach, 82½°; salmon, 83°; minnow, 85°; gudgeon, 85½°; dace, 86°; common tench, 88°; golden tench, 88°; carp, 91°.

So as to further test the efficacy of brandy as a fish restorer, about which much has lately been said, each fish on showing signs of exhaustion was removed from the water, dosed with a small quantity of brandy, and replaced in the tanks from whence it was taken. The operation proved highly successful, for on inspection the following day all the objects of the experiment were found swimming about as usual, and thoroughly restored to their normal exuberance, with the exception of the dace, which succumbed to the severe ordeal through which it had passed.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. F. W. Robinson; a Royal Python (*Python regius*) from West Africa, presented by Mr. A. H. Berthoud; a Long-eared Owl (*Asio otus*), British, presented by Mr. R. Farren; two Kagus (*Rhinochetus jubatus*) from New Caledonia, purchased.

GEOGRAPHICAL NOTES

IN a special article communicated to the *New York Tribune*, Lieut. Greely unfolds his views upon future Arctic exploration. Of the five well-known routes to the Pole, he advocates the Franz Josef route as the only probable one. Lieut. Greely shows by all the experiences of Arctic travellers, from Sir Edward Parry downwards, that continuity of land, with northern trend and western aspect, and a secure harbour easy of access, together with good ice for sledging operations, are necessary desiderata for Arctic exploration. He maintains that all these conditions are fulfilled in the fifth route—viz. that by Franz Josef Land. "This route," continues Lieut. Greely, "presents unusual chances of success with the minimum of danger. It is more than possible that an English expedition will enter these waters. Chief Engineer Melville, U.S.N., has in view an expedition by this route, and his varied Arctic experiences and indefatigable energy mark him as a man peculiarly fitted for this work. It is therefore to be hoped that he will be given the desired opportunity. Two ships with about sixty men and officers would be needed. One vessel should winter in Eira Harbour or some secure point near by, while the second should be pushed as far northward as possible, preferably by Austria and Rawlinson's Sounds, but, if that is not possible, along the west coast of Franz Josef Land beyond Cape Ludlow. The vessels should be provisioned for three years, and the crews should be quartered in temporary houses to be erected on shore. August and September there, as in Smith Sound, are undoubtedly the most favourable months for ice navigation. In case of a bad year for ice the vessels should rather return, to renew the expedition the year following, than adventure the experiences of the *Tegethoff*. After full suggestions and recommendations as to the command and outfit of the expedition, covering every branch of the subject, the writer expresses a doubt whether the United States Government will extend any aid to Arctic exploration for years to come, but none the less does he believe in the propriety and certainty of future Arctic work. In concluding his article Lieut. Greely says:—"The expedition suggested by Lieut. Ray, United States Army, at the meeting of the British Association at Montreal, should receive the attention and support of scientific men. The magnetic pole of Boothia Felix Land, located by Ross in 1831, has probably changed its position in the past fifty years. Its re-location would be an important contribution to science. With a home station at Repulse Bay or in Wager River, I believe this work could be done without great expense or serious danger. The benefits to be derived from such an expedition would not be confined to terrestrial magnetism. As regards ethnology, botany, and natural history, the country around King William Land is substantially a blank."

AN interesting account of recent Norwegian explorations in the Spitzbergen Seas will be found in yesterday's *Times*. Several new islands have been discovered to the east of King Karl or Wiche Land. These explorations show that the year 1884 was a very remarkable ice-year. The west side of Spitzbergen was blocked by a belt of land-ice the whole summer through, while the east side, which is nearly always blocked with ice, was more open than it has been for many years. These conditions, there seems little doubt, depend on the prevailing direction of the winds.

ACCORDING to the *American Naturalist* three expeditions have been despatched during the last summer to explore the lake region reported to exist in the north-eastern part of the provinces of Quebec and in Labrador. One went by way of Lake St. John, another by the River Betsiamits, and a third from Newfoundland. The last has orders to land scientific observers at various points upon the coast of Labrador, where they will spend the winter. Little that is definite appears to be as yet known respecting the actual dimensions of Lake Mistassini and other bodies of water in this region. A French missionary, writing in 1672, says that this lake is "believed to be so large that it took twenty days to walk around it." Mr. Burgess affirms that it is 150 miles in length, and abounds in deep bogs. An old trader of the "Compagnie des Postes du Roi," who was stationed on it for several years, estimated its least width at ninety miles. The account of 1672 mentions another lake, "ten days' round, and surrounded by lofty mountains." These lakes appear to occupy a depression similar to that occupied by Lakes St. John, Temiscaming, and many smaller lakes to the southward, and Silurian limestone has been observed in Lake Mistassini as well as at Lake St. John. The former lake is supposed to be about 1300 feet above the sea, and the land between it and Lake St. John to the south is only 300 feet above the sea. The plain around it is said to be very fertile, and attention has recently been called to the magnificent forests and fertile soil of the country around Hudson's Bay to the north of it. The explorations now in progress will doubtless open up extensive areas for colonisation, besides adding largely to our geographical knowledge.

La Gazette Géographique announces the death, in Tonquin, of M. Stocker, who perished recently in an expedition against the Muongs on the Red River. M. Stocker, who was a native of Alsace, travelled for thirty years in the United States, having explored specially the Rocky Mountains and the territory of Alaska. He returned recently from California to France, and was despatched by the Government to investigate the mineral wealth of Tonquin, where he discovered the auriferous deposits of Myduc. His reports on the subject were not encouraging for the development of mining enterprise there, as he declared that the value of the mines had been greatly exaggerated. He was shot dead during one of the skirmishes in the Muong expedition.

SIXTEEN "*brigades topographiques*" embarked at Marseilles on January 31, fourteen for service in Algeria and two in Tunis. These brigades are under the command of an officer, of an engineer, and of an official of the geographical department of the War Office in Paris. The whole include seventy-two officers, each accompanied by two soldiers and a native sharpshooter.

The instruments, provisions, and tents for each officer are to be conveyed on a horse and four mules. They will commence their surveying work in the south of each of the three Algerian provinces, and their position, scattered as they will be singly over the whole of Algeria, in the midst of semi-subjugated tribes, will be a delicate and perilous one. They will probably return to Paris about the end of May.

AT the last meeting of the Geographical Society of Paris it was stated that Col. Prejevalski had discovered the sources of the Yang-tsze-kiang.

THE last number of the *Boletin de la Sociedad Geográfica de Madrid* contains a first instalment of Capt. Eduardo O'Connor's official report on his recent exploration of the Upper Limay (Rio Negro) and Lake Nahuel-Hualpi. This report is of considerable geographical interest, as it embodies a detailed account of the first successful attempt to navigate the Rio Negro, from its mouth in the Atlantic to its source in the romantic Lake Nahuel-Hualpi in the heart of the Chilian Andes. As far as the Colluncurá (Catapuliche) confluence the expedition was able to proceed on board the *Rio Negro* steamer, but beyond that point it had to make its way in an open boat, which had in many places to be hauled over the numerous rapids obstructing the navigation of the Upper Limay, or furthest southern head-stream of the Rio Negro. Here the river flowed mainly in a narrow rocky bed, contracting at some points to 120 and even 100 feet, with a current varying from seven to nine, and even eleven miles an hour at the most difficult rapids. But beyond the confluence of the Treful, in 40° 42′ S. lat., the reefs and other obstructions disappeared, the current fell to a mean velocity of five or six miles, and as the stream is very deep it would be accessible to steam launches in this section all the way to the lake. Approached from the Limay this alpine basin presented a charming prospect, winding away to the right in an endless series of rocky inlets or wooded creeks, opening out to the left in broad and slightly undulating grassy savannahs. The hills rise in some places to a height of 700 or 800 feet above the lower wooded slopes, breaking into sharp peaks, crags of fantastic shape, or rocky walls, assuming here and there the appearance of cyclopean fortifications. The horizon was bounded in the distance by an extensive range of lofty sierras covered with snow, and like the lower hills often assuming the most varied and capricious forms. The deep blue waters of the lake are broken only by a solitary island of large size covered with dense vegetation, and intersected by regular ranges of hills from 300 to 400 feet high. The surrounding country appears to be uninhabited, and on calm days, rare in this breezy region, all nature is wrapped in the stillness of death, and the glassy surface of the lake unbroken by a single ripple.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, FEBRUARY 15–21

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on February 15

Sun rises, 7h. 16m. ; souths, 12h. 14m. 20·3s. ; sets, 17h. 13m. ; decl. on meridian, 12° 30′ S. : Sidereal Time at Sunset, 2h. 56m.

Moon (New at 2h.) rises, 7h. 6m. ; souths, 12h. 29m. ; sets, 18h. 0m. ; decl. on meridian, 8° 9′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on Meridian ° ′
Mercury	6 44	11 1	15 17	19 47 S.
Venus	6 36	10 57	15 18	19 5 S.
Mars	7 20	12 12	17 4	13 49 S.
Jupiter	17 28*	0 35	7 42	12 8 N.
Saturn	11 18	19 21	3 25*	21 34 N.

* Indicates that the rising is that of the preceding, and the setting that of the following nominal day.

Occultation of Star by the Moon

Feb.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
20	38 Arietis	5	19 41	20 1	211 246

Phenomena of Jupiter's Satellites

Feb.	h. m.		Feb.	h. m.	
16	6 20	I. ecl. disap.	19	0 25	I. tr. egr.
	19 21	III. ecl. disap.		19 15	I. occ. disap.
	23 9	III. occ. reap.		20 41	IV. ecl. reap.
17	3 40	I. tr. ing.		21 34	I. occ. reap.
	6 0	I. tr. egr.		23 38	II. tr. ing.
18	0 49	I. ecl. disap.	20	2 33	II. tr. egr.
	3 8	I. occ. reap.		18 51	I. tr. egr.
	5 22	II. ecl. disap.	21	18 32	II. occ. disap.
	22 6	I. tr. ing.		21 33	II. ecl. reap.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Feb.	h.	
15	4	Mars in conjunction with and 4° 30′ south of the Moon.
17	1	Saturn stationary.
19	8	Jupiter in opposition to the Sun.

CATALOGUE OF EARTHQUAKES[1]

THE importance of earthquakes as factors in geology tends to be more and more appreciated, and the seemingly increased seismic activity so strongly manifested in different quarters of the globe during the last few years has greatly stimulated the interest in, and the study of, these wonderful phenomena. Amongst many contributions to this branch of geology, have appeared quite recently, this catalogue and map, of which we have given the title, and which have followed other papers by the same author relative to this series of phenomena, published in the *Proceedings* of the Royal Irish Academy.

The earthquake catalogue and map now given by Prof. O'Reilly is based upon a very interesting relation of jointing and fissuring to the physical geography of a country, but more particularly to the coast-line directions. This relation he has shown to be very marked for the east coast of Ireland (see *Proc. Roy. I. Acad.*, 2nd series, vol. iii. ; *Science*, No. 8, May, 1882, and vol. iv. ; *Science*, No. 2, 1884) ; and, considering that much of the fissuring of the earth-surface is mainly due to earthquake action, he looks upon the systems of jointing and fissuring of a country, and consequently their correlated coast-lines, as so many records of past earthquake action ; the only ones, in fact, left us in many cases, and (taking into consideration the poverty and meagreness of historical records in this respect) the most valuable records of these phenomena we have extant. On the other hand, the lists of Mallet, Perrey, Fuchs, &c., present earthquakes in a purely chronological order, are difficult to consult and but little accessible, and in them the events stand out independently, and to a very great extent without apparent connection one with the other, while we know that geological change is the result of a sum of actions taking place continuously in certain localities, and extending through immense durations of time. It has seemed to the author of the present "Catalogue" that it would be useful to present the earthquakes of the three kingdoms in a summarised and connected form, and for that purpose arranged alphabetically, so that it may be possible to ascertain for a given point or locality the sum of earthquake action having occurred therein during historical time. The "Catalogue" thus formed merely gives the years of occurrence for a given place or district, and in this manner indicates frequency of occurrence sufficiently, while serving at the same time as a sort of year and place index for the larger collections. From it he has been able to represent graphically the distribution of earthquakes over the three kingdoms by adopting conventional tints and marks to indicate extent of action and frequency of occurrence, the only factors which it is possible at present to so represent.

From this map it would appear that Great Britain has been much more subject to shocks than Ireland during the period embraced by the records. That as regards Ireland the points of more frequent action lie near the coast or on it ; that in Great Britain the south coast presents a number of points of activity situated approximatively on a same line, in all probability con-

[1] "Catalogue of Earthquakes having occurred in Great Britain and Ireland during Historical Time ; arranged relatively to Localities and Frequency of Occurrence, to serve as a Basis for an Earthquake Map of the three Kingdoms." With Map. By Jos. P. O'Reilly, C.E., Professor of Mining and Mineralogy, Royal College of Science, Dublin. (*Trans. Roy. I. Acad.*, vol. xxviii. ; *Science*, part xvii., September, 1884.)

nected with a system of jointing corresponding to the general direction of the coast; that therefore the observed connection between volcanoes and coast-lines would hold good to a certain extent as regards these and earthquake action, so intimately related to volcanic action; that, as has been lately remarked by Mr. Wm. White in NATURE (December 25, p. 172), Lancashire is apparently a centre of frequent action, and that there may be a further relation to be found between coal-fields and earthquakes than that recognised up to the present.

It is certainly interesting to note that many of the localities affected by the earthquake of 1884 in the south-east of England lie on or quite near a great circle, which Prof. O'Reilly designates "the west coast of Morocco great circle" (that is a great circle of which the starting-point or part is a portion of that coast lying between Cape Blanco and Cape Juby), traced *à priori*, and which was shown on the Earthquake Map of Europe submitted by him at the Swansea meeting of the British Association in 1881. It will be interesting to note to what extent the complete report on that earthquake, which may soon be looked for, will correspond with his theoretical lines.

As a first attempt to graphically represent the earthquakes of a country relatively to their frequency, Prof. O'Reilly's map has much to recommend it, and, more fully developed and more completely worked out, such maps may yet be considered (to use his own words) as "the necessary *pendants* of geological maps."

JAPANESE LEARNED SOCIETIES

WHEN the Japanese Government decided to participate in the Health Exhibition last year, and to devote special attention to the educational portion of their section, they issued a small pamphlet relating to modern Japanese education. This explained in full the national system organised and put in working order in the last ten years; it dealt with the various classes of schools, from Kindergartens to the University, the technical schools, libraries, and educational museums, the history of ancient Japanese education, &c. The pamphlet showed that the Government of Japan was doing its duty so far as education is concerned; but the reader was left to collect for himself how far the people were following in the wake of their rulers. Since the close of the Exhibition the Japanese Commissioner has re-issued the report, with the addition of a statement of the various learned societies formed for purposes connected with science, literature, and education in that country in recent years. These are purely private associations; some of them are confined to localities removed from the large towns, and bespeak a wide and general interest in these subjects amongst the mass of the people themselves. The work of organising these, when the spirit once existed, cannot have been great, for the Japanese have had for ages their associations of men possessing common tastes, or a common love for a particular subject, whether literature, education, fencing, chess, the study of medicine or of Chinese. These organisations are quite familiar to them, and the work of running the new metal into the old moulds was doubtless not a very difficult one. Accordingly, Mr. Tegima's list is a full one, and here and there it might be suggested that two, or even three, of the separate societies could amalgamate with benefit. Amongst these noted we find the educational society of Japan, which has for its object the study, improvement, and advancement of education; various local societies also intended for the improvement of educational methods in their respective districts; the Seismological Society, perhaps the best known of all in Europe. There are two branches of this, the foreign and the native, the former being the parent society. The "Society of Specialities," which has in view the study "of various special branches of science." The Physical Society, devoted exclusively to the study of the higher physics; there appears to be a second Society of Physics, "composed of professional scholars for the purpose of inquiring into the principles [of physics?] and of interchanging knowledge among the members"; the Mathematical Society for the study of the higher mathematics, and also to translate and compile works on that subject. Among the associations for more general objects we find one of French scholars, foreign and native, for the study of that language, and the general interchange of knowledge, one for the study of the moral sciences, another devoted to European and Asiatic philosophy. The French scholars are not allowed to have it all their own way, for a rival devotes its energies to the study of the German language and laws; Hindoo philosophy also has its own special votaries who have formed themselves into an association for the investigation of this misty subject. The Biological Society of the University of Tokio (founded by Prof. Morse) is among the most energetic of young Japanese societies; the Association for the Translation of the Technical Terms of Physics is a most necessary one, and has a difficult and responsible duty under the present system of translating to fulfil. Sooner or later Japanese and Chinese students will have to adopt most of the technical terms of all departments of science employed in the West; the present plan of seeking to translate them in a rough and fanciful way, and thus forcing the student to learn a new language before he can learn a science, is too clumsy and unsatisfactory to last. Why, for example, oxygen should not be called oxygen by the Japanese student, instead of by some Japanese compound term which is not in the least more explanatory to him, is not quite clear. Meantime a society which will exercise a supervision over the translation of technical terms, and thereby secure uniformity, cannot fail to be useful. The Chemical Society, besides devotion to the science of chemistry, has also for one of its objects the establishment of a regular terminology. The Engineering, Law, Agricultural, Fine Arts, Medical, and Pharmaceutical societies speak for themselves. A second medical society seeks to secure the propagation of sound notions of elementary medicine amongst the common people; in this it is assisted by the members of the Society of Hygiene, who diffuse a general knowledge of sanitary matters. It is pleasant to see that old Japan is not forgotten in this crowd of young associations. The members of a Society of Letters study all branches of Chinese and Japanese literature, while the "Society of Japanese Literature" devotes itself wholly to the study of the etymology and syntax of the Japanese language and to the more general employment of the ancient syllabaries, in place of Chinese characters, in writing. A third literary society has for its object "the interpretation of the moral principles. It aims also to encourage good customs, to promote literature, to educate youth, to diffuse knowledge, and to cultivate moral nature"—a tolerably comprehensive programme. Finally, the recent Fisheries Exhibition has given rise to a Japanese Marine Product Society.

Mr. Tegima's statement is an incomplete one. It deals mainly with associations existing in the capital, and makes little reference to any in other large towns in the Empire, such as Osaka, Nagoya, Niigata, Nagasaki, &c. And even as a list of the Tokio societies it is incomplete. No mention, for example, is made of the most numerous, wealthy, and influential of all—the Geographical Society of Japan; nor is the Dendrological Association mentioned; nor is reference made to the new and interesting society called the *Roma-ji-Kwai*, which has for its object the substitution of Roman letters in Japan for the Chinese characters and the native syllabaries. This Spelling Reform Association has set before itself a huge and radical reform, in comparison with which that of our own Spelling Reform Society is trifling and superficial. Its objects, however, appear hardly practicable, if one may venture to use that expression, of any reform in Japan. But enough has been said to show that the seed sown with such care by the Government is producing a rich harvest among the people of Japan.

THE PROPOSED TEACHING UNIVERSITY FOR LONDON

A LARGELY-ATTENDED and influential meeting of the Association for Promoting a Teaching University for London was held last Thursday at the rooms of the Society of Arts, John Street, Adelphi, under the chairmanship of Lord Reay, the President of the Association, whose objects are—(1) the organisation of University teaching in and for London in the form of a Teaching University, with faculties of arts, sciences, medicine, and laws; (2) the association of University examination with University teaching, and direction of both by the same authorities; (3) the conferring of a substantive voice in the government of the University upon those engaged in the work of University teaching and examination; (4) existing institutions in London of University rank not to be abolished or ignored, but to be taken as the bases or component parts of the University, and either partially or completely incorporated, with the minimum of internal change; (5) an alliance to be established between the University and the professional corporations, the Council of Legal Education as representing the

Inns of Court, and the Royal Colleges of Physicians and of Surgeons of London.

The Chairman said since they last met several things had happened, the most important of which was the appointment by the University of London of a Committee to inquire into the possibility of adopting the scheme, or something like the scheme, which was in the hands of members of that association when they formerly assembled together. The sub-committee of the association had carefully considered since how this move in the Convocation of the University of London affected their prospects and actions, and they had arrived at the conclusion that the best course for them to pursue was to ask the association to allow their scheme to be referred to a committee appointed at that meeting, in which committee all the various bodies who had hitherto shown their sympathy for the sub-committee's scheme should be represented, and to which committee any other proposals could be made by members of the association who in any way disagreed with any of the details of the scheme that had been laid before them. The committee to be appointed would no doubt undertake, as soon as they had finally determined upon a scheme—after negotiation and as a result of negotiation—to present it to the general body of members of the association for their consideration. He thought this was a practical way of dealing with a very intricate and complicated problem. That problem since they last met certainly looked much more hopeful, and it had met with much more rapid support in various quarters than the promoters of the movement originally anticipated.

Prof. Williamson said the work before them was one of exceeding difficulty, involving as it did a change in many respects in the conduct of the London University and the placing it upon he footing of other Universities; and this, again, involved a great number of details. The elements of the University of London were so numerous, and many of them were so independently developed in a great degree, that if those various constituent parts—the natural limbs of the University—were to work together it was essential that all should understand what relations they were to hold to each other. The maturing of schemes determining the particular relations of the general University to those various bodies it was sought to connect with it must of necessity require careful, calm, and friendly consideration on the part of representative members, and the committee to be appointed would probably form several sub-committees representing different branches of learning, who might be able to agree upon a general outline of a plan which they would conceive to be most mutually desirable and advantageous. Thus the incorporation of the various limbs of the University, so to speak, might be based upon a distinct understanding of what was contemplated, and they might be induced—as he had no doubt they would be—to vigorously support a scheme which would tend to their mutual benefit and the raising of the standard of education in London.

The resolution was then unanimously adopted.

Lord Justice Bowen moved, and Mr. Erichsen seconded, that the committee consist of the following thirteen gentlemen:—The president of the Association, Mr. J. W. Cunningham (King's College), Prof. Carey Foster (University College), Mr. John Marshall (College of Surgeons), Dr. Norman Moore (St. Bartholomew's Hospital), Dr. W. M. Ord (St. Thomas's Hospital), Mr. F. Pollock (Lincoln's-inn), Mr. R. Stuart Poole (British Museum), Dr. P. W. Pye-Smith (Guy's Hospital), the Rev. Principal Wace (King's College), Prof. Warr (King's College), Prof. Williamson (University College), and Sir George Young, with power to add to their number.

Prof. Bentley expressed a hope that the claims of science to be represented on the committee would not be ignored. Further, he trusted that every effort would be made to ascertain all the information which could possibly be derived with regard to the working of medical degrees and the teaching connected with them.

Sir George Young pointed out that the scheme which the committee would prepare was not intended to be binding upon the members; but it was hoped in the end that a plan might be devised which would not only be acceptable to King's College, but other institutions of inferior rank.

Mr. F. Pollock thought the plan of having two Universities, one of which would be an examining and the other a teaching University, would be very difficult to work, and it was not a scheme which he should contemplate as desirable. His feeling was in favour of the closest possible alliance between the examining University of the present and the teaching University of the future.

The Chairman expressed with how much regret he left that scene of action. He was sure that a very great work remained to be done in the future, and that that work would have to be done with a great deal of tact. Certainly it would have to be achieved by setting aside any notion of establishing in London any kind of ideal University. They had to co-operate with existing corporations, with existing bodies, which had hitherto done exceedingly good work, which were all manned by an extremely distinguished *personnel*—a *personnel* whose ideal it had been to do University work without having a University, and which *personnel* he hoped in the future would have at their disposal the University to which their labours had fully entitled them. He did not say this because he himself was guiltless of having mentioned what he believed to be an ideal University, for he had been guilty of such an escapade in the address which he delivered at St. Andrew's University. There he distinctly laid down what he thought to be the lines on which a University ought to be reformed; and, of course, what he advocated for the Scotch Universities he should in the main—of course there were features applicable to Scotch which were not applicable to the London University—also advocate for London. But in London the problem before them was to unite all the interests, to create a federation of interests, and to recognise the work which had been already achieved with the desire to make that work for the future more efficient, without in any way encroaching on autonomy where autonomy had hitherto proved sufficient, but where autonomy had not before proved altogether sufficient, then, to supplement it by that bond of union by which institutions and empires became great. He resigned his position as President of the Association with the wish—nay, the determined expectation—that they would succeed. He had seen how the work had been thus far done, and how determined had been those with whom he had had the honour to associate to carry the movement to a successful issue.

Sir George Young expressed how greatly they were indebted to the President for the services he had rendered in the past. The services of a very good successor had been secured in Lord Rosebery, whom he (Sir G. Young) proposed as the future president of the association, while thanking Lord Reay for his valuable services.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The second election to the Board of the Faculty of Natural Science was held on February 6. The five retiring members were re-elected, and to make the number of elected members equal to that of the professorial (*ex officio*) members, four new members were elected. After a ballot the following were chosen:—Mr. W. W. Fisher, Aldrichian Demonstrator of Chemistry; Mr. H. B. Dixon, Trinity; Mr. J. Griffiths, Jesus, and Mr. E. H. Hayes, New College.

The Examiners for the Burdett-Coutts Geological Scholarship give notice that the examination will begin on February 23.

An examination will be held at Merton, beginning on June 23, to elect to one Natural Science Scholarship (80*l.*) at Merton, and one at Corpus Christi College. The examination will be in Chemistry and Physics. Candidates must be under nineteen years of age.

On March 17 an examination will be held at Jesus in Physics, Chemistry, and Biology. Candidates must be natives of Wales or Monmouthshire, or born of Welsh parents, and must be under nineteen years of age.

An examination will be held at New College beginning on May 7, to elect to a Natural Science Exhibition (50*l.* value per annum). The examination will be in Chemistry and Piology.

AT a meeting of the Ashmolean Society in the Theatre of the University Museum on Monday, February 16, Prof. Burdon-Sanderson will read a paper "On the Study of Contagion with a view to Practical Measures."

SCIENTIFIC SERIALS

THE last number (13) of the *Journal of the Straits Branch of the Royal Asiatic Society* contains much information on the Malay Archipelago. Mr. de la Croix continues his translation of M.

de Quatrefages's work on the pigmies, the present instalment dealing with the Asiatic pigmies or negritos, and the negrillos or African pigmies. The general conclusion to which the writer comes is that modern science has erred in rejecting all that has been written on this subject by the ancients, for in the midst of many exaggerations and fables there were many facts. He finds it impossible, in the present state of our knowledge, to offer a satisfactory solution of one of the most curious points connected with the geographical distribution of the human race, viz. the narrow resemblance between the Asiatic negritos and the African negrillos, separated as they are by a vast space and by numerous and different races. Are these affinities the result of a common origin? A paper containing a translation of a Dutch account of Malacca, written in 1726, follows this, and is itself succeeded by a long one by Mr. Maxwell, of the Straits Settlement Civil Service, on the laws and customs of the Malays with reference to the tenure of land. The Rev. J. Tenison-Woods prints two lectures on the stream-tin deposits of the protected State of Perak in the Malay peninsula, and the volume concludes with two accounts of travel, one through the State of Remban in the peninsula, the other along the Tawaran and Putalan rivers, which are said to rise in the great mountain Kina Balu, and flow through North Borneo. We observe, also, the prospectus of a very necessary work—an English-Malay dictionary, which, it is suggested, should be translated from Mr. Klinkert's Dutch-Malay dictionary.

Journal de Physique, vol. iv. January.—J. R. Benoit, construction of standard prototypes of the legal ohm. M. Benoit, who was associated with MM. Mascart and de Nerville in the official French researches at the Collège de France, has, at the request of the Minister of Posts and Telegraphs, prepared standards in mercury to represent the legal ohm. This paper gives an account of the methods of calibrating and preparing the tubes for four exact standards. It remains to be seen whether these will prove as permanent as standards constructed in platinum-silver or iridio-platinum alloy.—H. Pellat, on the cause of electrification of storm clouds. Discusses the observations of atmospheric potential at different levels, and concludes that the negative charge of the soil surface is explicable on the hypothesis that it is continually renewed by the falling of negatively charged rain.—E. Bouty, on latent heats of vaporisation. Deduces the approximate law that the latent molecular heats of bodies measured at their normal boiling temperatures are proportional to the squares of these temperatures; tabular evidence is given in support.—E. Bouty, on the specific heat of saturated vapours. Gives a new formula.—Em. Paquet, determination of the ratio of the two specific heats of gases. Describes a modification of Cazin's method, in which the desired change of pressure is brought about by a column of mercury, as in Geissler's mercurial pumps. The deduced value for air is 1·4038.—J. Macé de Lépinay, method of measuring the interior diameter of a barometric tube. Ingenious application of optical laws to deduce internal diameter from the apparent diameter, assuming the refractive index of glass.—G. Quincke, on the measurement of magnetic forces by means of hydrostatic pressure. Abstract of paper in *Philosophical Magazine*, 1884.—W. von Beetz, on normal elements for electromotive measurements. Abstract from *Philosophical Magazine*.—K. Ångström, a new geothermometer. An underground mercury thermometer is read by means of an index attached to a rack and pinion, which is operated from above. When contact is made with the mercury an electric bell rings, and the index is read off.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 5.—"The Relation of Bacteria to Asiatic Cholera." By E. Klein, M.D., F.R.S., Joint Lecturer on General Anatomy and Physiology at the Medical School of St. Bartholomew's Hospital, London.

I propose to bring before the Royal Society the results of an inquiry into the etiology of Asiatic cholera, undertaken, at the instance and expense of the Secretary of State for India, by myself, Dr. Gibbes, and Mr. Alfred Lingard while in India. This investigation will be published *in extenso* by the India Office, but permission has been granted to us to bring to the notice of the Society some of the more important points of our inquiry, particularly those regarding the relation of bacteria to Asiatic cholera. I shall supplement them by giving the results of further observations which I have made since my return from India.

As is now well known, Dr. Robert Koch, in an extensive inquiry into the etiology of cholera in Egypt, Calcutta, and in France, 1883-84, undertaken by him, Drs. Gaffky and Fisher, at the instance of the German Government, has arrived at certain conclusions, which, briefly stated, are these:

1. In all persons suffering from Asiatic cholera there occur in the rice-water stools during the acute stage of the disease certain well-characterised bacteria, which, on account of their curved shape, Koch called "comma bacilli."

2. These comma bacilli are mobile rods, of small size, of about the same thickness as tubercle bacilli, but only of half their length; they are always more or less curved, sometimes as much as to form half a circle; they vary in length according to the state of growth; they occur either singly or in couples, in the latter case arranged like an S.

3. The comma bacilli occur in great numbers in mucus flakes as well as in the fluid of the choleraic evacuations. They occur in the lower part of the ileum of persons dead in the acute stage almost to the exclusion of other bacteria, and in such great numbers that the lower part of the ileum may be considered to contain almost "a pure cultivation of comma bacilli."

4. The mucous membrane of the ileum, particularly that of the lower part, around and in the lymphatic glands located here—the solitary and Peyer's lymph-glands—exhibits in typical and rapidly fatal cases characteristic alterations: loosening and detachment of the epithelium of the surface and of that lining the glands of Lieberkühn; swelling and congestion of the blood-vessels of the mucous membrane, particularly at the peripheral portions of the lymph glands. These alterations are due to the presence, growth, and multiplication of the comma bacilli in these tissues, and the disease cholera is caused by the production on the part of these comma bacilli, and by the absorption on the part of the system of a special chemical ferment.

This state of the presence of the comma bacilli in the tissue is best pronounced in the lower part of ileum; higher up it is more limited, and gradually diminishes, and finally disappears in the upper part of the small intestine.

5. The blood and other tissues are free of any organisms.

6. The comma bacilli grow well outside the body at the ordinary temperature of the room, but better still at higher temperatures up to 38° or 40° C. They divide transversely; after division the two offsprings may remain joined end to end with shape of an S, and by further division they may grow into a spiral-like or wavy form. They grow well in the mucus flakes taken from the intestine, and placed on linen kept in a moist cell; they grow well on potato, in broth, in Agar-Agar jelly, in solid nourishing gelatine mixtures (gelatine, peptone, and beef extract). In this latter substance they exhibit a peculiar and definite mode of growth not seen by Koch on any other bacteria. The comma bacilli require for their growth an alkaline medium; they are killed by acid, by drying, and various antiseptic media.

7. On account of their constant occurrence in the intestines of patients suffering from Asiatic cholera, on account of their absence in all other diseases of the intestine, and on account of their peculiar mode of growth in nourishing gelatine, Koch vindicates for these comma bacilli not only an important diagnostic value, but also considers them as the true cause of cholera.

8. Since his return to Germany, Koch has convinced himself of the correctness of the observations of Nicati and Rietsch, who maintain that cholera can be produced in dogs and guinea-pigs by injecting directly into the small intestine of these animals the comma bacilli taken either directly from the choleraic evacuations, or from artificial cultivations.

Our investigations enable us to say this:

1. Koch's statement as to the constant occurrence of comma bacilli in the rice-water stools of cholera patients is correct; the comma bacilli vary greatly in numbers in different stools and in different cases, in some being exceeding scarce, in others numerous.

2. These comma bacilli vary greatly in length, some being twice and three times as long as others, some well curved as much as to form half a circle, others showing only just a slight bend. The name "comma bacillus" is inappropriate, as in reality they are vibrios.

3. The comma bacilli occur in the mucus flakes of the rice water stools as well as in those taken from the ileum of a person

dead of cholera. The sooner after death the examination is made, the fewer comma bacilli are found in the mucus flakes; even in typical rapidly fatal cases the mucus flakes taken from ileum and examined soon after death (from between fourteen minutes and an hour or an hour and a half) contain the comma bacilli only very sparingly indeed, and not to the exclusion of other bacteria. Our investigations do not bear out Koch's statement as to the lower part of the ileum being in acute typical cases of cholera almost "a pure cultivation of comma bacilli." In not one of the many post-mortem examinations of typical acute cases have we found such a state.

4. The mucous membrane of the ileum of typical rapidly fatal cases, if examined soon after death, does not contain in any part any trace of a comma bacillus or any other bacteria, not even in the superficial loosened epithelium.

If the post-mortem examination is sufficiently delayed, comma bacilla and other bacteria may be found penetrating into the spaces of the mucous membrane.

The theory of Koch's as to the comma bacilli present in the mucous membrane secreting a chemical poison inducing the disease cannot, therefore, be correct.

5. Neither the blood nor any other tissue contains comma bacilli or any other micro-organisms of known character.

6. The behaviour of the comma bacilli in artificial media is not such as to justify their being considered as specific. They grow well in alkaline and neutral media, are not killed by acids, and their mode of growth in gelatine mixtures is not more peculiar than that of other putrefactive bacteria; they show marked differences when grown in different media, but not more so than the ordinary putrefactive bacteria when compared in their growth with one another.

7. Koch overlooked that "comma bacilli" occur in other intestinal diseases, in the mouths of healthy persons, and, as shown recently, even in some common articles of food.

8. The experiments performed by Koch and others on animals do not in the least prove that the comma bacilli are capable of producing cholera or any other disease. The results obtained by them are much easier explained in a manner opposed to that given by Koch and others.

9. There is direct evidence to show that the water contaminated with choleraic evacuations, and containing, of course, the comma bacilli, when used for domestic purposes, including drinking, by a large number of persons, did not produce cholera.

10. The mucus flakes taken from the small intestine of a typical rapidly fatal case of cholera contain numerous mucus corpuscles filled with peculiar minute straight bacilli; in this state they are found when the examination is made very soon after death; soon, however, the mucus corpuscles swell up and disintegrate, and then their bacilli become free.

The small bacilli are never missed in the mucus flakes. They are only one-third or one-fourth the length of the comma bacilli, and about half their thickness. They are non-mobile; they grow well in Agar-Agar jelly, but show in their modes of growth no peculiarity by which they could be considered as specific. When grown on the free surface of the nourishing material they form spores.

11. These small bacilli are not present in the blood, in the mucous membrane of the intestine, or in any other tissue.

12. Experiments made with these small bacilli on animals produced no result.

13. Since my return to London I have ascertained that the comma bacilli of cholera show two distinct modes of division, one the known one of transverse division, and a second one of division in length. When growing in Agar-Agar jelly at the ordinary temperature of the room, after some days the bacilli swell up owing to the appearance in their protoplasm of one or more vacuoles; as these vacuoles increase, so the comma bacilli become gradually changed first into plano-convex, then into oblong bi-convex, and ultimately into circular corpuscles. The longer the original comma bacillus, the larger the final circle. These circular organisms are mobile just as the comma bacilli, and by disintegration of the protoplasm at two opposite points two perfect more or less semicircular comma bacilli are formed. Growing the comma bacilli in Agar-Agar jelly kept at higher temperatures (30-40° C.), the comma bacilli multiply by transverse division only, but transferring these to Agar-Agar jelly and keeping this at the ordinary temperature of the room, they again gradually change into circular organisms, which, by division in the diameter of the circle, form two new comma bacilli.

Linnean Society, February 5.—Mr. Frank Crisp, LL.B., Vice-President and Treasurer, in the chair.—Mr. John Hodgkin was elected a Fellow of the Society.—A paper was read "On the Arbaciadæ, Gray. Part I, the Morphology of the Test in the genera *Cœlopleurus* and *Arbacia*," by Prof. P. Martin Duncan and W. Percy Sladen. The species of recent and fossil *Cœlopleurus* and the recent forms of *Arbacia* examined present some structural details of both primary and secondary classificatory importance, which have hitherto been neglected and not recorded. The ambulacral plates differ from those of all other Echinoidea in the arrangement of the triplets, there being a central primary plate with an adoral and an aboral demi-plate. It is shown that there are no additional plates near the peristome in the species of *Arbacia*. The structure of the sutures, especially of the median inter-radials, is a modification of the dowelling which has been described in *Temnopleurus* by one of the authors. The double-optic pore noticed by Lovén occurs in the fossil species of *Cœlopleurus*, and in *C. Mailliardi*, a recent species. The authors compare the different forms, and exclude *Arbacia nigra* from the genus *Arbacia*. The next part will deal with the classification.—Then followed a paper on Burmese Desmids, by Mr. W. Joshua. The specimens were forwarded by Dr. Romanis, F.L.S., of Rangoon, and got chiefly from the leaves of *Pistia stratiotes* in a tank some twenty-six miles from the mouth of the River Irrawaddy. Of 186 species in sixteen genera hitherto observed, 100 have their representatives in Europe. Altogether some forty supposed new species are described by the author, besides several new varieties and a list of others previously recorded is given.—Mr. W. F. Kirby read a paper on the employment of the names proposed for genera of Orthoptera previously to 1840. In this communication the author shows the application of every name proposed from the time of Linné to the publication of Serville's "Histoire naturelle des Insectes Orthoptères," and there is appended a full bibliography of the subject.

Zoological Society, February 3.—Prof. W. H. Flower, LL.D., F.R.S., President, in the chair.—The Secretary exhibited a specimen of a rare South American Lizard (*Heterodactylus imbricatus*), presented to the Society by Mr. G. Lennon Hunt; and a specimen of a rare Beetle, of the family Buprestidæ, from Beloochistan (*Julodis finchi*).—A letter was read from Dr. George Bennett, F.Z.S., of Sydney, containing remarks on the Tree-Kangaroo of Queensland (*Dendrolagus lumholtzi*), lately described in the Society's *Proceedings*.—A series of specimens of Lepidopterous insects, which had been bred in the insect-house in the Society's Gardens during the past season, was laid on the table.—A communication was read from M. Taczanowski and Count Berlepsch, containing an account of the third collection of birds obtained by M. Stolzmann in Ecuador. The collection contained examples of 289 species, of which ten were new to science.—Lieut.-Col. C. Swinhoe read the first of a series of papers on the Lepidoptera of Bombay and the Deccan. The present communication contained an account of the Rhopalocera, and gave the results of two years' daily collecting.—A communication was read from Mr. Robt. Collett, C.M.Z.S., giving an account of *Echidna acanthion*, a new species of Spiny Ant-eater lately discovered in Northern Queensland.—A communication was read from Mr. Jean Stolzmann, containing the description of a new Rodent, belonging to the genus *Cœlogenys*, from Ecuador, proposed to be called *Cœlogenys taczanowskii*.

PARIS

Academy of Sciences, February 2.—M. Bouley, President, in the chair.—The death of M. Dupuy de Lôme, member of the Section for Geography and Navigation, who died on February 1, was announced by the Secretary.—On the mechanical principles determining the rotation of surfaces on a fixed surface, by M. H. Resal.—Remarks on the cultivation of the phylloxera in tubes, in reply to M. Balbiani's objections to the present practice of destroying the winter eggs of this parasite, by M. P. de Lafitte.—On a plane representation of certain dynamic problems respecting the displacements of a figure of invariable form subjected to four conditions, by M. A. Mannheim.—Description of a selenium actinometer designed for the purpose of measuring the relative intensity of the luminous solar rays at various elevations above the horizon, by M. H. Morize.—On a new preparation of the trifluoride of phosphorus, and on the analysis of this gas, by M. H. Moissan.—Analysis of the green ferrocyanides or glaucoferrocyanides, by MM. A. Étard

and G. Bémont.—On vincetoxine, by M. Ch. Tauret. This term, "vincetoxine" (from Vincetoxicum, the common name of the Asclepias), is applied by the author to a new glucoside, to which is due the remarkable property possessed by the aqueous solution of the hydro-alcoholic extract of the Asclepias root of clouding when the temperature is raised, and becoming limpid when lowered. Vincetoxine has the same centesimal composition as glycyrrhizine, $C_{48}H_{36}O_{18}$.—On the signification of the polarimetric experiments executed with the solution of cotton in the ammonicupric reagent; polarimetric researches on this reagent, by M. A. Béchamp.—On a particular case of catalytic action.—On the composition of the ashes of the Equisetaceæ; its application to the formation of coal, by M. Dieulafait. The author finds that the Equisetaceæ and other typical plants of the Carboniferous epoch contain a much larger proportion of sulphuric acid than those of the present epoch. In this fact we have the natural explanation of the large quantities of sulphur and of sulphate of lime present in all kinds of coal. The sulphur and sulphate entered into the original composition of those plants to whose decomposition are due the carboniferous formations.—On the various cetaceans cast up on the French seaboard during recent years, by M. Georges Pouchet.—Note on the influence of sudden barometric pressure on earthquakes and volcanic activity, by M. F. Laur. Arguing from the fire-damp explosions in mines and other analogous phenomena, the author concludes that all underground disturbances are due to abrupt atmospheric changes communicated even through the medium of the ocean to the crust of the earth. Volcanic eruptions are relatively superficial phenomena due to the expansion of the internal gases when a rupture of equilibrium takes place. Hence they are all the more violent the nearer they are to the surface, and the more closely connected with previously existing terrestrial vacuums.

BERLIN

Physical Society, January 23.—Dr. Kayser laid before the Society a photograph of lightning taken in France and probably under the same minimal atmospheric pressure as that under which he had himself taken his recently-published photograph, the lightnings in France having been photographed three days earlier than those in Berlin. On the small gelatinous membrane sent to Dr. Kayser, still better than on that, on an enlargement of the original prepared by the speaker, there was presented very beautifully to view the extraordinarily manifold ramifications of the lightning. From the lowest part of a dark cloud a broad flash of light was seen to dart forth and throw off many fine branches, which again united multifariously, the junction at one place between one branch and another showing a broader line, while at other places the flashes appeared double.—Dr. Lumner spoke on the interference phenomena produced by two plain parallel glass plates. He briefly adduced the experimental results, already published by him, of an investigation of his own, according to which, at small angles of the glass plates, namely, up to as far as 60°, the interference phenomena represented a circle passing, with increasing angles, into an ellipse, the axis of which at 90° were as 1 : 2, until, on still further enlargement of the angle, the ellipse became transformed into a straight line, which soon in turn, and till the angle of the plates approximated to 180°, changed into a hyperbola. The speaker developed at large the theory of the phenomenon, and deduced the formulæ, which, on inserting the numerical data, were found to coincide remarkably with the experimental results.—A communication from Dr. Müller-Erzbach, designed for the *Verhandlungen*, had been given in and was read. Dr. Müller had sought to determine the sphere of action of the molecular forces by the thickness of the layers arising from the adhesion on solid surfaces of gases and vapours. He chose for his experiments pulverised oxide of iron and carbon disulphide. The latter became, at first very strongly, and then with abating intensity, condensed by the oxide. After four days the quantity of carbon disulphide absorbed in twenty-four hours had sunk to less than 1 mg., without, however, entirely disappearing. By microscopic measurements of the grains of oxide of iron, the author approximately calculated the magnitude of the absorbing surface, and from the quantity of the absorbed carburet of sulphur the thickness of the layer of vapour held fast by adhesion. From the circumstance that the absorption of the vapour very rapidly diminished and after a few days became quite inconsiderable, Dr. Müller-Erzbach concluded that it was not the quantities of vapour at first condensed which drew in those later absorbed, but that the whole absorbed layer of vapour got to be held fast through adhesion by the surface of the iron, and in this way he arrived at values bearing on the sphere of action of molecular forces which far surpassed all that had been hitherto obtained.—Finally, Prof. Neesen directed attention to the disadvantage of having but one term for two different meanings, such, for example, as the word "Gewicht" (gravity, weight), which was employed to signify both a force and a mass, a confusion which often led to inconveniences. Scientifically either the force or the mass should be called Gewicht, the other being denominated by another name. The debate which this question gave rise to was to be continued at a future sitting.

VIENNA

Imperial Academy of Sciences, January 8.—On the fossil flora of Sagor (Carniola), by C. von Ettingshausen.—On pendulum experiments, by P. Czermak and R. Hiecke.—On a new construction of electromagnets for dynamo-machines (sealed packet), by A. von Waltenhofen.

January 15.—On the difference between crystalline and other anisotropic substances, by V. von Ebner.—On a new system of cable-telegraphy for long cable-lines, called the differential recorder (sealed packet), by E. von Taund-Szyll.—On a new method for determining manganese in specular iron ore, ferromanganates, and in the most important ores, by W. Kalmann and A. Smolka.

STOCKHOLM

Society of Natural Sciences, November 15, 1884.—The President, M. Wärn, in the chair.—Prof. Lecke gave an account of a certain fish larvæ which he had studied during a sojourn at Messina. At times the sea was so full of animals, that a vessel immersed in the same would contain as much of the latter as water. He further exhibited a number of rare fish from the Mediterranean, comprising *Trachypterus*, *Peloria*, and *Krohnius*.—Dr. Lindberg explained the working of the Siemens apparatus for registering the quantity and alcoholic contents of spirits. They are now compulsory in all Swedish distilleries, and work very satisfactorily.

CONTENTS