THURSDAY, NOVEMBER 8, 1888.

THE PREVENTION OF SMOKE.

THE people of London have lately experienced much inconvenience and discomfort from the dismal fogs which so often make their appearance at this season of the year. Considerable interest, therefore, attaches to the excellent lecture, by Mr. Rollo Russell, on "Smoke in Relation to Fogs in London," of which we to-day print an abstract. The importance of the subject no one will dispute, yet the questions connected with it have hitherto received very inadequate attention. That much might be done to purify the atmosphere, not only of London, but of all our great towns, is certain; what is needed is simply that the matter shall be taken in hand in earnest by the Legislature. The existing Acts of Parliament to abate the nuisance arising from the smoke of furnaces in the capital are efficient so far as they go. Inventors have produced mechanical stokers and other means of feeding furnaces, which have resulted not only in the prevention of smoke from such furnaces, but also in commercial advantages to their users, by reason of the increased efficiency and reduced consumption of the furnaces. Police-inspectors appointed to watch the chimneys of manufacturers' premises have done most useful work in preventing the emission of smoke, and London is to be congratulated upon the freedom from smoke from such sources. Legislation, however, has not gone far enough even in controlling the emission of smoke from furnaces, for in the provinces there is very great negligence. In some places by-laws exist, in other places there are none; but wherever they are enforced it is invariably the case that the fines imposed are too small, and that the real offenders, the manufacturers and users of the furnaces, do not adequately feel the effect of the penalties in which they are mulcted.

The careful observer in London will find that the nuisance from which we suffer does not arise from factory or other industrial chimneys, but from the millions of domestic chimneys. Why should legislation apply only to the comparatively small number of industrial furnaces in London, and leave the multitude of hotel and private fire-places to emit dense volumes of smoke? In a letter addressed some time ago to the *Times*, Mr. Alfred E. Fletcher clearly demonstrated the practicability of having open fire-places in well-warmed and thoroughly ventilated houses without smoke, but there is no law to enforce the application of such a system. To those who have not read Mr. Fletcher's letter, the apparatus may be briefly described. It consists of a coke stove in the basement, a flue to discharge products of combustion, an air-pipe drawing in air around the stove and discharging it when warmed through a grating on the ground-floor. The effect of this simple apparatus is such that warm, but not scorched, pure air ascends up the staircases, into the rooms, passes up the chimneys, and out at the windows, without creating draughts of any kind. The open fire-places in all the rooms may be maintained, but, to insure their smokelessness, they should either have one or other of the systems of under-feeding coal grates, or have incandescent blocks heated by gas. The duty of the fire-place is reduced to practically nothing, as the whole house is warmed by pure air from the heating chamber of the coke stove, and the bright open fire need only be maintained to satisfy English prejudice and custom.

This is one system which has come under our notice, and others might be mentioned. But one fact is enough—viz. that ordinary London houses can be thoroughly well warmed with pure air, well ventilated by known appliances, and with this knowledge the public ought to demand immediate legislative action. There is evidence that the necessity of legislation is beginning to be understood, for the House of Lords was some time ago approached by Lord Stratheden and Campbell with a Bill "to amend the Acts for abating the nuisance arising from the smoke of furnaces and *fire-places* within the metropolis;" and, although this Bill did not pass into law, its importance was such that a Select Committee was appointed to consider its terms and to report to the House of Lords. Mr. Ernest Hart gave many thoroughly practical suggestions for the prevention of smoke from domestic fire-places in his evidence before the Select Committee; and other evidence from scientific, legal, and police authorities was adduced. But at the time the public interest in the question was insufficient to secure the passing of the measure.

If members of the Houses of Lords and Commons would seriously consider the dangers to life, the inconvenience, the loss, the injury to household effects, and other disadvantages which the presence of smoke and other impurities in the air occasion, and would turn their attention to the very deficient legislative measures now existing, a speedy remedy would no doubt be effected. The necessity for the universal adoption of smoke-preventing appliances would probably bring out much latent inventive talent from the public. By reference to the Report of the Council of the National Smoke Abatement Institution, we find that inventors and manufacturers are continually introducing better means of consuming fuel. The greatest improvement is in apparatus for industrial furnaces, because it is with these appliances only that Acts of Parliament deal. As compared with some tests made by the Smoke Abatement Institution in 1881–82, tests made in 1886–87 show an apparent economy of 31 per cent. in consumption of fuel combined with complete smoke prevention. In the Transactions of the Sanitary Institute of Great Britain—in a paper on smoke abatement, read by Mr. Russell Duncan at the Bolton Congress—we find that inventors are working in the right direction, and that during the last ten years over 4200 patents have been taken out for various appliances having for their object the prevention of smoke and the more complete combustion of fuel.

An examination of the work done by the National Smoke Abatement Institution will show that if legislative measures could be carried it would not be necessary to restrict the use of one kind of fuel in favour of another, but that by means of suitable appliances houses might be heated by ordinary fuels—coal (bituminous and non-bituminous), coke, oil, and gas, or by improved systems of circulating warmed air and heated water.

SOME RECENT MATHEMATICAL BOOKS.

Euclid. Part 1, Books I. and II. By H. S. Hall and F. H. Stephens. (Macmillan, 1887.)

Algebraical Exercises. By H. S. Hall and S. R. Knight. (Macmillan, 1887.)

Key to Todhunter's Mensuration By Rev. L. McCarthy. (Macmillan, 1886.)

Explanatory Arithmetic. By G. E. Spickernell. Third Edition. (Simpkin, 1887.)

Plane and Spherical Trigonometry. By H. B. Goodwin. (Longmans, 1886.)

Spherical Trigonometry. Part 2. By W. J. McClelland and T. Preston. (Macmillan, 1886.)

Solid Geometry: Solutions. By P. Frost. (Macmillan, 1887.)

Elementary Statics. By J. Greaves. (Macmillan, 1886.)

Differential Calculus. By B. Williamson. Sixth Edition. (Longmans, 1887.)

Differential Calculus. By J. Edwards. (Macmillan, 1886.)

Algebra. By Oliver, Wait, and Jones. (Ithaca: Finch, 1887.)

Practical Solid Geometry. By W. G. Ross. (Cassell, 1887.)

IF former periods of the world's history were characterized as the "Stone," "Bronze," and "Iron" Ages, the present epoch might well be entitled the "Book" Age. Amidst the flood of literature of all sorts which daily pours out of the jaws of our printing leviathans, didactic mathematics certainly claims its due proportion. The number of Algebras, Euclids, Arithmetics, and Trigonometries which appear, with the "rough ways made smooth and the crooked ways straight," make us regard the modern student with a mixture of envy and pity—envy at the possession of such broad highways to knowledge as we never dreamt of, and pity at the difficulty he must experience in choosing out of such a multitude. We cannot, moreover, help fancying that this plethora of books is not entirely without compensating disadvantages, for the very ease and tranquillity which which the student glides through the cleared forest, make him careless and inattentive of the land-marks and salient features that were so carefully noted by his more self-reliant, if less luxuriously-equipped, predecessor.

Of the twelve books on our table, we shall begin by noticing the most elementary. Among these is an instalment comprising Books I. and II. of "Euclid," by Messrs. Hall and Stevens, of Clifton College. For these revolutionary days it is remarkably orthodox; but certain changes have been introduced, very wisely as we think, where Euclid's enunciations were confusing, or the proofs were not sufficiently comprehensive, as in Propositions 8 and 26, where the identical equality of the two triangles is not usually emphasized. The authors, in their preface, enter very fully into the reasons which decided them to avoid the use of symbols at first, and also to preserve "the formal, if somewhat cumbrous, methods of Euclid," and with these reasons we in the main agree. If, however, for "a large majority of students 'Euclid' is intended to serve, not so much as a first lesson in mathematical reasoning, as the model of formal and rigid argument which most conduces to accurate and orderly thought in any field of study," we should welcome a book of geometry brought out for the use of those whose natural mathematical growth is stunted, and taste warped, by a too strict adherence to the cumbersome and often involved style of the ordinary text.

We admit the dilemma for those who wish to make "Euclid" serve the double purpose of an introduction to logic as well as geometry, but, at the same time, we are unable to see why, even for the logicians, *some* at least of the advantages of the German method cannot be introduced, such as the use of a, b, c for the sides, and α, β, γ for the angles of a triangle. A great deal of confusion arises from the use of *three* letters for an angle and *two* for a side, and the change to the simpler method would not only clear the student's mental vision, but leave the logic unimpaired.

One of the best examples of the defects arising from a rigid adhesion to the formal text is in Book I., Proposition 13. We have found many to whom this proposition in its existing form is one of the most repulsive in the book, and it has been almost touching to witness the joy evinced by a dullard on his first realizing that the obtuse angle was just as much in excess, as the acute angle was in defect of a right angle—a fact which the ordinary proof completely disguises. We do not think the alternative proof to Proposition 47 is likely to meet with much favour, and since the authors do not altogether discard alternative proofs, we should have preferred, instead, the neat alternative to Proposition 48 given in Casey.

For the purpose for which it is designed we do not hesitate to recommend the book. It is excellently printed, the construction lines being very properly faint, and the figures in all cases clearly drawn. The exercises, additional theorems, and hints to solution are also unusually well arranged, and will be truly welcome to the student who intends to go in for mathematics, as well as train his mind into logical habits.

"Algebraical Exercises," by Messrs. Hall and Knight, is, we presume, intended to be a companion and supplement to their excellent little "Elementary Algebra," which has met with such a generally good reception. While these exercises will, no doubt, be of considerable use, we think they might be improved, and rendered more widely serviceable, (1) if Part 1, devoted to the earliest rules, were extended beyond a meagre six pages—a range altogether out of proportion to what follows; and (2) if the exercises were more *gently* graduated in Part 2. For example, linear equations in three unknowns are introduced *per saltum* as early as p. 10, and all the papers after p. 6 strike us as being a good deal harder than those encountered by the Army Preliminary candidate, types of which are given on pp. 146–47. We also regret to find in the first ninety-seven pages an almost entire absence of book-work questions—a defect which is only partially made up for in the capital selection of typical public examination papers which follow. Example-grinding is no doubt an essential art, but in algebra, especially, the early parts tend to become purely mechanical, unless *real thinking* is encouraged and stimulated by rational questions on the processes employed. In a subsequent edition a few more recent University and Army papers would form a welcome addition.

Mensuration is represented by a key to Todhunter's small treatise, by the Rev. Lawrence McCarthy, of St. Peter's College, Agra. As a rule we have no great liking for keys, but if there is any country where such a key might be used with advantage, it is India. Possibly this is what prompted Prof. McCarthy to perform a labour which might fitly be termed an intellectual treadmill. We have always looked upon the "Mensuration" itself as Todhunter's least valuable work. It is full of long-winded rules which are never learnt, and the use of algebraic symbols by which all such rules could at once be rendered visible to the eye, is most curiously, and, as we think, unreasonably, avoided. The same spirit characterizes the key. Everything is worked out at full length with needless repetitions of figures, especially the oft-recurring 3·1416, which we have counted no less than twenty-nine and thirty-four times respectively on two pages chosen at random. Surely the symbol π might have been substituted with advantage here. Barring such defects, the work appears to have been well done, and will doubtless be of use, more especially to those who are unable to get tutorial assistance.

An "Explanatory Arithmetic," by Mr. G. E. Spickernell, which has reached a third edition, does not strike us as any improvement on existing treatises. Brevity, which is one of the points aimed at, is certainly secured, but at the expense of both elegance and lucidity. The rules read like excised telegrams, and are liable to be misconstrued in much the same way. Thus, to take an example of the telegram purporting to explain compound subtraction: "Take *like from like;* and whenever it is necessary, in order to make subtraction possible"; and a longer one for the subtraction of fractions runs thus: "Reduce minuend and subtrahend to equivalent fractions having their least common denominator; and then, having like parts of integers, take less number from greater, and write in figures, under remaining parts, their name." Similar highly cacophonous and ambiguous paragraphs are to be found scattered through the book, and give one the impression that they will frequently necessitate as much explanation as the principles they are intended to embody. Occasionally the author employs a definition which is palpably partial, thus: "When an integer or whole thing is divided into a number of *equal* parts, those parts are called fractions."

The entire book strikes us as being of the empirical cramming style, as opposed to the rational and scientific style so well exemplified in Brook Smith's treatise and the smaller one by Lock, in which rules are avoided as much as possible. On the other hand, it contains copious and very well assorted collections of examples and examination papers, with answers which can be readily removed from it if desired. These might be used with advantage, and the teacher, if a good one, could translate and expand the telegrams into a more rational and elegant form, or, still better, do without them.

Trigonometry, plane and spherical, is represented by two books—one, comprising the elements of both subjects, chiefly for the use of junior naval officers, by H. B. Goodwin, Naval Instructor; while the other is Part 2 of a "Treatise on Higher Spherical Trigonometry and Geometry," by Messrs. McClelland and Preston, of Dublin. Mr. Goodwin's work is intended to give, in one volume, the course usually required for an acting sub-lieutenant—which heretofore he has had to pick out of a variety of elementary works—and appears to admirably fulfil its author's intention. It is marked by simplicity of treatment, the avoidance of cumbrous rules, those bugbears of our ancient text-books, and a separation of the subject into distinct parts, each of which is complete in itself.

Messrs. McClelland and Preston's book is a new departure, in so far as, with the exception of the well-known treatise of Mulcahy, it is the first time that spherical geometry, as distinct from trigonometry, has been seriously put into text-book form. The authors are to be congratulated on their bold, clear, and systematic treatment of this too-much-neglected and really useful branch of mathematics. The work throughout is characterized by lucidity and originality of treatment, and is subdivided into complete chapters. Spherical and stereographic projection are also carefully explained, and their power as methods amply exhibited.

We cannot help thinking that both spherical trigonometry and geometry are far too much neglected in our educational curricula. In consequence, it is astonishing what errors are committed when even the simplest properties of a spherical surface are in question. The curvature of the earth is realized by few, and some who ought to know better have not yet grasped the fact that the latitude of Cairo approximately bisects the area of the northern hemisphere. Nothing but polar projections, or, better still, globes themselves, will ever correct the false impressions which we get from that terrible flat-ruled distortion entitled "Mercator's projection," from which all approach to curvature has been so carefully extracted.

The theory of the trade-winds, moreover, which has survived up to date in some of the text-books, takes no account of the shortening of the radius in considering the gain in eastward motion by the transference of the air at relative rest on the equator to higher latitudes. Thus, according to Loomis's "Meteorology," the gain is simply found by subtracting the linear velocity at the higher latitude from that at the equator; whereas when the shortened radius is considered, it amounts, in latitude 60°, to 1554 instead of 518 miles per hour, and at the Pole itself to ∞ instead of 1036 miles per hour. These are only a few of the most patent errors which arise from a neglect of spherical principles, and might be multiplied almost indefinitely.

"Hints for the Solution of Problems in Solid Geometry," by Dr. Percival Frost, is a book which cannot fail to be of great value to the student of this difficult but important branch of mathematics. Mathematical solutions have little analogy to, and, except in elementary works, none of the disadvantages of, classical cribs. In the present case, the execution of Dr. Frost's truly laborious work has been attended by an unexpected advantage, in leading to the discovery of certain errors and omissions in the statement of the problems themselves, which might otherwise have escaped notice. We heartily welcome Dr. Frost's hints, and trust they may receive the attention they so fully deserve.

While some branches of elementary mathematics are already in danger of being congested by a plethora of text-books, statics and dynamics seem to us to still present an open field for the writers of really able didactic treatises. For those who have reached the Elysian fields of the calculus, no better book can be recommended than Prof. Minchin's admirable work; while for those who have not yet reached that stage, and perhaps never intend to, the "Elementary Statics" by Mr. John Greaves, which is written much on the same lines, can be unreservedly recommended. The science of statics, like everything else, has been obliged to *move* with the times, and Mr. Greaves, following the modern views, prefers to consider it as merely a particular case of the science of dynamics, and to base it upon the laws of motion. Thus, instead of the familiar proof of the parallelogram of forces on the principle of transmissibility of force, he deduces it solely by the aid of the parallelogram of velocities, from which, together with the third law of motion, the conditions of equilibrium are obtained more readily, and, in the author's opinion, more clearly, than usual. This expectation can only be tested by actual experience. Meanwhile we would recommend that, in a reprint of the book, the more salient propositions and results should be rendered more emphatic and conspicuous by being placed either in italics or large type. In their present form and position the plums are too disguised to be readily picked out. The work is characterized by thoroughness, and by a large number of worked-out examples illustrated by excellent figures, the material lines being very properly distinguished from the geometrical and force lines by thicker type. The free use made by the author of the purely geometrical method for solving some statical problems is elegant, but occasionally leads to a neglect of the statical or primary limitations under which they are stated. An example of this occurs on p. 86, where it is required to find the greatest inclination to the horizon at which a uniform rod can rest partly within and *partly without* a fixed smooth hemispherical bowl. The condition assumed for the maximum inclination leaves *no part* of the rod outside the bowl, which clearly violates the latter part of the question.

Machines are deferred to the last chapter in the book, presumably because some of the principles, such as virtual work, are dealt with in preceding chapters; but we think they might be advantageously introduced, at all events in a preliminary way, much earlier, since their consideration not only enlivens the otherwise dry discussion of abstract principles, but gives concrete expression to their reception. We are glad to see that the merits of this excellent little book are recognized by the authorities of the Mason Science College, who recommend it for one of their courses.

At the threshold of the higher mathematics we find two books on "Differential Calculus," which, though rivals, will, we trust, often be found in company, since each possesses certain merits and characteristics which distinguish it from the other. One is the well-known and excellent treatise by Prof. Benjamin Williamson, F.R.S., which has now reached a sixth edition. In this edition, besides careful revision, a short discussion is added on the elementary properties of solid and spherical harmonics, which are so frequently employed in the higher developments of electrical and optical theories. As a former edition of the book has been fully noticed in NATURE, we need only indorse the opinion then put forward, that it is one of the best treatises on the subject in our language. The other work, by Mr. J. Edwards, formerly Fellow of Sidney-Sussex College, Cambridge, is very different in style, and more elementary, in so far as it is, according to the author's design, "unencumbered by such parts of the subject as are not usually read in Colleges and schools." Compared with Prof. Williamson's treatise, it is distinctly more geometrical in method, and in this and some other points, such as large type, beautifully-drawn figures, an unusually full and systematic account of curve-tracing and the properties of curves, which, contrary to the usual custom, *precede* maxima and minima, it is more suited to the wants of the average student as a preliminary course of reading. Some of the geometrical illustrations, such as those of the compressed form of Taylor's theorem, $\phi(x + h) = \phi(x) + h\phi'(x + \theta h)$, and $Dz = \frac{dz}{dx}dx + \frac{dz}{dy}dy$, are very elegant, and help to keep alive the real meaning of differential symbols, which a too exclusive attention to algebraic analysis tends to annihilate. Symmetry and brevity have both been evidently studied, and a good example of this may be seen on p. 271, where the radius of curvature for an implicit function of x and y is deduced. If this be compared with the analogous method on p. 290 of Williamson's book, the difference in the style will be manifest. Regarding the two books together, we should advise a student to begin with Edwards, and then proceed with Williamson. Nothing in the former work need be omitted at a first reading, after which he may plunge fearlessly into the more complete and analytical treatise of the Dublin Professor.

Two books remain to be noticed, which lie somewhat outside the ordinary run of didactic works. One is an Algebra by Profs. Oliver, Wait, and Jones, of Cornell University, U.S. This, though originally intended as a text-book for their own students, seems, in the course of construction, to have developed into a work which, while it might be found really useful as a book of reference to teachers and the rare youth who *cultivates* mathematics, is quite unsuited to the ordinary student.

In some respects it appears to be an effort to regard algebra from the modern point of view as the science of finite operations, and to present it in the form of "a stepping-stone to the higher analysis," and there is much that is commendable from this point of view in the exposition of incommensurables, limits, imaginaries, derivatives, and graphic representation of equations, as also in the introduction of some fresh symbols, such as the Gaussian sign of congruence, $\equiv$, and $\ngtr$ $\nless$ for smaller than and greater than in the sense of size only. The use of the signs + − as left-hand indices to indicate absolutely positive and negative quantities is also an improvement, and renders it easier to deal with negative and directional quantities. For English didactic purposes, however, this book will be chiefly useful as one of reference for the teacher.

In conclusion, we must not omit to draw attention to a very handy little manual of "Practical Solid Geometry," by Major Gordon Ross, of the Royal Military Academy, Woolwich, which is particularly adapted to military students. The method of orthographic projection by "vertical indices" receives special attention, and a section on defilade—a subject not much studied in this country—cannot fail to be of use and interest to those who study the science of war. E. D. A.

OUR BOOK SHELF.

Examples in Physics. By D. E. Jones, B.Sc., Lecturer in Physics at the University College of Wales, Aberystwyth. (London and New York: Macmillan and Co., 1888.)

So many books have been written having titles similar to if not identical with that quoted above, the only object of which seems to have been to enable students to pass certain examinations with the minimum of knowledge, that it is a comfort to turn to one against which no such charge can be made. Mr. Jones's "Examples in Physics" has not been written "up to" any Syllabus, but the author has made use of portions of the manuscript in teaching classes of students taking the intermediate science and preliminary scientific courses of the London University, and he believes it will be found useful for students who are preparing for these examinations. There can be no doubt that the book will be of great assistance in this way, owing to the large number of examples and the excellent way in which they have been graduated. In addition to the examples, of which there are more than a thousand, with occasional hints for their solution, there are short explanatory chapters and paragraphs where experience has shown that they are needed. Thus, at the beginning, the C.G.S. units are thoroughly explained, as is the method of passing from one system of units to another by means of dimensional equations. Those approximate relations which are most often made use of are shown to be true, and examples illustrating the advantage of employing them are worked out. The method of using logarithms is explained, and both on pp. 19 and 21 the reader is told that there is a table of four-place logarithms at the end of the book. There is a page on which natural sines and tangents are given to three places, but not a vestige of a logarithm is to be found.

In the chapters on dynamics, hydro-statics, heat, light, sound, electricity, and magnetism, chapters which consist essentially of examples, there are clearly-written paragraphs explaining those points that do not generally seem to be grasped by students. The answers to the questions are given at the end.

The general arrangement of the book is particularly happy; it is clearly the work of a teacher whose object is to increase the real knowledge of his students, and not merely to drive them through the ordeal of an examination.

The Constants of Nature. By Frank W. Clarke. Part I. New Edition. (Washington: Published by the Smithsonian Institution, 1888.)

THIS volume consists of a series of tables of specific gravities of solids and liquids, and differs from the older edition in two respects. In the first place, the tables have been revised and greatly enlarged; and, secondly, melting and boiling points have been omitted, on the ground that they are already supplied by the two volumes by Prof. Carnelley, which are specially devoted to those data. How much the tables have been enlarged may be gathered from the fact that the older edition, with a later supplement, only gave 2963 substances, whereas there are now no less than 5227 distinct substances mentioned, and 14,465 separate determinations. As the author remarks, this increase is a noteworthy indication of chemical activity.

The tables are only intended to be complete as far as artificial substances of definite constitution are concerned, but, in addition to these, many minerals find places. For each substance, the formula, specific gravities, and authorities are stated. The elements take the first place, and these are arranged in order of densities. Then follow inorganic fluorides, chlorides, bromides, iodides, oxides, sulphides, &c., the various groups of organic bodies coming last. There is a very complete index to the names of substances, without which, of course, the book would be far from complete.

The author is to be congratulated on the successful completion of an undertaking entailing such a vast amount of patient labour.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Gresham College.

I TRUST you will allow me space for a short note upon Prof. Lankester's article in last week's issue of NATURE (p. 1), under the above heading. I have no intention of entering into a controversy with Prof. Lankester upon matters of opinion, but I am desirous of correcting statements, made by him in that article, which are inaccurate. In point of fact, the article is based entirely upon a misapprehension as to the purpose and function of the London Society for the Extension of University Teaching, and its position with regard to Gresham College. Prof. Lankester speaks of it as a Lecture Society, and refers to the "innumerable short courses" of lectures given in different halls, Vestry Halls, and others in London. He is evidently here confusing two distinct things. The short courses in large halls are given under the People's Lectures Scheme, which is an entirely different matter, and in connection with which we never use the word "University." The courses of lectures and classes carried on by the London Society and the Universities Joint Board involve a systematic course of work extending over a full term of ten or twelve weeks. It is a part of the same great movement which is carried on by the University of Cambridge (not by a Lecture Society), and more recently also by the University of Oxford, in different parts of the country.

Those who have had an insight into the methods and the result of the working of the University Extension movement have been struck with the excellence and thoroughness of the work done. Sir James Paget, in his annual address to students at the Mansion House, last February, spoke as follows with regard to some of the syllabuses:—

"As I looked through the syllabuses of such subjects as I can estimate, I could see that the amount of teaching in each of them is enough for a good beginning for some who may intend to make that subject a chief study for their lives, and enough to form an important part in the teaching of anyone who wishes to be in the fairest sense generally well educated."

In fact, the principles which underlie the University Extension movement cannot but meet with the approval of all interested in higher education. These principles are, "first, that the amplest facilities for the best kind of higher teaching, such as the Universities provide, should be brought within the reach of the great mass of the people by means of courses of instruction, given locally at convenient times and places; and, secondly, that a teaching system, as opposed to a mere examination system, is required to meet the educational needs of the time."

In his speech at Gresham College, Mr. Goschen made no claim that "Gresham's money should be assigned to the support of the lecturers of the Society." What he did point out was that the design of Sir Thomas Gresham was to establish, in the heart of London, University teaching for busy people engaged in the City, and that the aim of the University Extension movement, whether in London or the country, was in spirit the same.

Prof. Lankester charges this Society with making an objectionable use of the word "University" in order to gain financial support. He says, "the implication is that the teaching is such as is given at the Universities, and it is an entirely false implication." This implication, which Prof. Lankester calls false, we do assuredly make in the most explicit way. We assert that the teaching is deserving of the title University teaching, and I am prepared to submit to Prof. Lankester overwhelming evidence in support of this assertion.

The definition which he gives to University teaching is one which includes all the good schools, and is in no sense diagnostic of University teaching. His first condition our lecturers completely satisfy, for they have, as a rule, been men of the highest academical position, in every way the equal of those who fill ordinary College Professorships and Lectureships.

We contend that the essential characteristic of University teaching is the *method* employed in dealing with a subject; that the teaching of the Universities is directed to the elucidation of the principles of the subject taught, and to the end of bringing all the mental faculties of the student into play, so that he may be placed on the high road to pursue his studies in their higher developments; and that an important factor in producing these results is the personal intercourse between teacher and student. We assert that the University Extension method possesses these characteristics.

Our idea is that Gresham College would best fulfil its founder's intention if it were enlarged into a great central College, with permanent Professorships and all the facilities for laboratory work; the Professors, however, teaching in the evening instead of the day, so as to provide for the needs of the class which Sir Thomas Gresham intended to benefit, and for which the London Society is, in a tentative way, attempting to make imperfect provision. R. D. ROBERTS.

Charterhouse, E.C., November 5.

I CANNOT agree with Mr. Roberts that I have written under any important misapprehension of the nature and general objects of the organization of which he is secretary. I have expressed my conviction of the excellence of the courses of lectures given through its means. I object to its profession of bringing "University" teaching into London, and to its claim to represent either the University of the future or Gresham's University of the past. The fact that the Universities of Oxford and Cambridge and London have appointed members of a Committee to arrange lectures in London does not, in my opinion, constitute those lectures as parts of the teaching of those Universities, and the suggestion that this is the case—encouraged by the use of the term "University Extension"—is, in my opinion, greatly to be regretted. It is, perhaps, difficult to be sure as to the nature of the audiences contemplated by Gresham for his Professors. But supposing that his intentions could be realized in this special point by the delivery of lectures in the evening, I am at a loss to understand what public good can be served by the introduction of a new organization into London for the purpose of giving such lectures, when there are already two public institutions—viz. King's College and University College—which are not only ready to undertake such teaching if found desirable in the future, but have actually carried on such teaching in the past. The Professors of King's and University Colleges are University graduates, they are provided with laboratories and libraries and lecture-rooms, they have numbered among them some of the most distinguished scholars and *savants* of the day, and they have produced both trained investigators and large additions to existing knowledge. They only require additional endowment and public sympathy to fulfil in every respect the ideal of a true University in and for London. Yet a certain number of gentlemen connected with Oxford and Cambridge have persuaded those Universities to nominate a Committee called a Joint Board to kindly undertake the introduction of "University" teaching into London. I cannot believe myself that this new body, competing for the support of Londoners as representing the great educational want of London, viz. a real University, will fail to do harm by dividing the support which London can give to University institutions. I cannot suppose—after observation of their proceedings—that those who form the active body of the London Society for the Extension of University Teaching are as anxious to promote a true University in London as they are to find employment for their lecturers This is quite natural, and, if admitted, is not otherwise than creditable; but the assertion of a claim to be representatives of University teaching in London on the part of these gentlemen is not so creditable.

November 6. E. RAY LANKESTER.

The Barbary Ape in Algeria.

IT may interest your readers to know that monkeys are still to be found wild at a place within three days' journey of London, and easily accessible to the most unenterprising traveller. Yesterday, in company with my son, I drove up the gorge of the Chifa, on the excellent main road between this place and Mediah. We halted at the spot where the appropriately named "*Ruisseau des Singes*" falls into the Chifa on its left bank, and ascended the narrow side-valley on foot. Its steep slopes are densely covered with brushwood, intermixed with a few oaks and stunted junipers. We had not proceeded more than ten minutes from the main road before we heard the chatter of a Barbary ape on the bank above us, and saw him scrambling along the rocks. Shortly afterwards, a fine large male of the same species was kind enough to mount a juniper-tree on the opposite side of the gorge to that on which we were seated, and exhibited himself to our gaze for at least fifteen minutes. His various attitudes were distinctly observable through a pair of opera-glasses, and we calculated his distance from us as not more than 400 yards in a straight line. A third ape was subsequently met with farther up the gorge, at a much nearer distance, but did not wait to be looked at.

I had previously seen Barbary apes on the Rock of Gibraltar, but they are there in a semi-protected condition, and perhaps introduced. In the gorge of the Chifa they are quite in a "state of nature," and in their native wilds. P. L. SCLATER.

Hôtel d'Orient, Blidah, Algeria, October 29.

Are there Negritos in Celebes?

PROF. FLOWER, in his interesting lecture on "The Pygmy Races of Men" (Journ. Anthr. Inst. vol. xviii. p. 82, 1888, and NATURE, vol. xxxviii. p. 67), after having spoken of the Negritos in the Philippines, says, apparently on the authority of Quatrefages: "As the islands of these eastern seas have become better known, further discoveries of the existence of a small Negroid population have been made in Formosa, in the interior of Borneo, Sandalwood Island (Sumba), Xulla, Bouron, Ceram, Flores, Solor, Lomblem, Pantar, Ombay, the eastern peninsula of Celebes, &c."

Without discussing here the foundation of this whole statement, I only beg to remark that in my opinion no Negritos or the like exist in the eastern peninsula of Celebes, or in the Island of Celebes at all.

Already in the year 1876, in a lecture, "Die Minahassa auf Celebes" (p. 29, note 11), I said:—"Prof. Gerland places Papuans, in the map of Waitz's 'Anthropologie der Naturvölker' (vol. v. part 1, Malays), in the eastern peninsula of Celebes, but I could not find in the letterpress of the work, on whose authority he makes this entry. It was this very note of Gerland, which induced me, when on the spot (in the year 1871), to search after them, but I did not succeed in discovering the slightest positive proof for such an assertion." And (*l.c.* p. 8) "In Celebes . . . no autochthonic Papuan element has been discovered." Neither has Dr. Riedel, the special and foremost investigator of the whole island, obtained any trace of Celebesian Negritos. I am therefore of opinion that Celebes at least (if not many more—perhaps all—of the quoted islands) ought to be omitted from the list.

As to the occurrence of Negritos in the Philippine Islands, I only spoke of them as existing in Luzon (as generally known), in Panay, Cebu, and Negros (see *Zeitschrift für Ethnologie*, 1873, p. 90, and "Ueber die Negritos oder Aëtas der Philippinen," Dresden, 1878, p. 25). A. B. MEYER.

Royal Museum, Dresden, October 24.

Altaic Granites.

HUMBOLDT and Rose, when descending the Irtysh between Boohtarminsk and Oostkamenogorsk, saw large masses of granite lying as if poured on the ends of metamorphosed slates (S. Rose, "Reise nach. d. Ural," i. 610); an observation mentioned by Zirkel ("Petrogr.," i. 506, 1866) as a famous one in relation to the age of the Altaic granite. No subsequent traveller appears to have succeeded in repeating that observation, because nobody could rediscover the actual place, which Humboldt and Rose did not define with much precision. Ritter, however, in referring to the subject, indicates the place as lying between two rivulets—Baryshnikof and Kozlovskaya.

After some unsuccessful attempts, I at last succeeded in finding this interesting locality. It is situated some five or six miles from Boohtarminsk, on the right bank of the river, just at the entrance into the Kozlovskee gorge, and is known among the local inhabitants under the name of Slepoy Borok (Little Blind Forest). But the illustrious travellers have made rather a blunder in defining, after only a rapid examination from the deck of an Irtyshian karbaz, the mutual relations of the rocks. A section at right angles to the stream shows that the granite lies not *on* the slates, but *in* them, and that it occurs as a main vein, with some secondary ones, all having the same strike and dip as those of the slates. The main vein is some 30 or 40 metres thick, the secondary 0·5 metre, or still less. From the river one can see only the lower limit of granite, and as the joints of this rock are nearly horizontal, whilst the bedding of slate stands almost vertical, the appearance is presented which suggested the original inference that the granite has been poured out over the ends of the slates.

My measurements gave the following results:—On the level of the current the strike of the slates varies between 9h. 45m. and 10h., dip = 82°–85° north-north-east; lower limit of granite strike, 7h. 30m., dip = 73° north-north-east; upper limit of the same, strike 8h. 45m., dip 43°–45° north-north-east. The contact of the two rocks can be observed occasionally exceedingly well. In the vicinity of the granite the slate loses all traces of fissility, and becomes a very compact rock, with abundant scales of muscovite. Generally the slates are schistose, phyllitic, and chiastolitic. Both rocks are welded together. The secondary veins of granite somewhat differ in structure from the main vein, which is of a normal fine-grained variety, with little scales of biotite. The main vein is covered with young forest, consisting of pine, birch, and aspen trees, while on the slates nothing grows but rare bushes of gooseberry, honeysuckle, some species of horse-tail, and some grasses.

The conclusion of Humboldt and Rose, that some Altaic granites are younger than local schists and slates, remains indisputable. I wish to add that they are also younger than some local greenstones, as may be seen at Beeshbanovskee crags on the Irtysh, near Oostkamenogorsk, where a dioritic breccia is cemented with granitic matrix.

A. BIALOVESKI.

Oostkamenogorsk, Western Siberia, September 20.

Rankine's Investigation of Wave Velocity.

THE investigation relating to the propagation of waves contained in chapter xv. of Maxwell's "Theory of Heat," and based on that of Rankine (pp. 530–31 of "Collected Papers") presents peculiar difficulty to most readers. "The kind of waves to which the investigation applies are those in which the motion of the parts of the substance is along straight lines parallel to the direction in which the wave is propagated, and the wave is defined to be one which is propagated with constant velocity, and the type of which is not altered during its propagation."

Two cross-sections of unit area at a fixed distance apart are conceived to travel through the substance with the velocity of the wave, inclosing between them a cylindrical space within which things are always in the same condition though the matter is continually changing. The momentum of the matter which enters through the front section in the unit of time is duly expressed, and also the momentum of the matter which escapes at the rear section. The difference of these two momenta is then equated to the difference of the pressures before and behind. The puzzle is to justify this *quasi* deduction from the second law of motion; and in connection with this puzzle, the question of sign occurs. For instance, if the momentum of the entering fluid exceeds that of the issuing fluid are we to attribute the gain of momentum to the fact that the contents of the cylinder are more strongly pushed forward behind than they are pushed backward in front? Such is the impression produced on the reader's mind by Maxwell's words: "The only way in which this momentum can be produced is by the action of the external pressures"; but it is not correct.

The momentum included between the two travelling sections is changed in two distinct ways: first, by convection—that is, by gain and loss of moving matter; secondly, by pressure before and behind. *The change from pressure must be equal and opposite to the change from convection; since, by hypothesis, the momentum included between the two sections remains always the same.*

Rankine merely says, "Then in each unit of time the difference of pressure $p_2 - p_1$ impresses on the mass the acceleration $u_2 - u_1$," and gives no explanation.

I remember being puzzled by this reasoning of Maxwell's some years ago, when I was writing Note A in Part 4 of "Deschanel," and getting over the difficulty by taking the two sections very near together; but my attention has been drawn to it afresh by the receipt of a paper by Prof. MacGregor, of Nova Scotia, in which the difficulty is pointed out, and evaded in the same manner in which I evaded it. Prof. MacGregor points out that Maxwell obtains a correct result only by help of a mistake in the algebraical work—the sign of a difference being changed in obtaining equation (7) from equation (6). This is certainly true as regards the fourth and fifth editions, which are now before me. In a later edition, Prof. MacGregor remarks, the sign of the difference is changed in equation (6), thus making the algebra right, but at the expense of making equation (6) inconsistent with what goes before it. The explanation contained in the sentence printed in italics above clears up the difficulty.

J. D. EVERETT.

Belfast, November 2.

Alpine Haze.

PROF. TYNDALL'S letter in NATURE about Alpine haze induces me to say that as a non-scientific observer I have never, I think, during a residence of many years here, seen so much *local* fog or haze as this autumn.

On October 29—a perfectly clear and cloudless day here (Vevey and La Tour), with no appearance of fog, haze, or cloud, anywhere in the distance—I received a letter from Lausanne saying, "While I write (11.30) so dense a fog has suddenly come up that we fear for the boats on the lake." Other friends took a trip to Lavey les Bains. They were in perfectly clear air until a little beyond Villeneuve, when they found the whole Rhone Valley thick with fog, but on turning off at St. Maurice Station to Lavey les Bains (ten minutes' walk, and on perfectly flat ground) they again came into a quite clear atmosphere. As no fog whatever came here all day, I cannot say whether it was aqueous or not. We have both sorts here from time to time, but most commonly *dry*; this year has been rather an exception. I should say fogs had been more frequently damp than usual, and by observing the grass morning and evening I have found that there has been much more dew than is common in this locality.

Streaky hazes or "long horizontal striæ," as Prof. Tyndall calls them, have certainly been unusually prevalent this year.

La Tour de Peilz, November 4. M. C. C.

The Animals' Institute.

THE long-continued suffering of animals fatally injured in our streets, before the services of a slaughterer can be obtained, or the owner be found to give his permission, has often been referred to. Poor animals with incurable abdominal wounds, or, it may be, complete fracture of a limb, not unfrequently lie in the streets for hours before being put out of their misery. The police have no power to order their destruction until the person in charge assents, and he frequently cannot do this until his master has been communicated with. I remember one case where eight hours elapsed. I have recently found that complete absence of pain can be easily induced by subcutaneous injection of morphia, and perhaps you would allow me to publicly state that the apparatus and drug are always here at the service of the police gratuitously in cases of street accidents.

JOHN ATKINSON.

9 Kinnerton Street, Wilton Place, Knightsbridge,
November 5.

N. M. PRJEVALSKY.

A TELEGRAM from Vyernyi—one of those small Russian towns which have grown of late in the outspurs of the Tian-Shan Mountains—announces the death of Prjevalsky, the bold and indefatigable explorer of the wildernesses of Central Asia. In September last, immediately after having terminated the work which embodies the results of his fourth great journey to Central Asia, he started on a new journey, the fifth, thus prosecuting again what has been the aim of his life during the last twelve years—that of reaching Lhassa in Tibet, and opening to science the lofty plateaus and highlands which separate East Turkestan from India. This time he proposed to start from Russian Turkestan, and his expedition had to be equipped at Vyernyi, on the north of Lake Issyk-kul. He arrived at Tashkend in October, and had left it on October 13 (old style?) on his way to Vyernyi, but he seems not to have reached that town, and must have died on the route, as far as we can judge from the telegram. The new expedition, which promised to be even richer in scientific results than all those which preceded it, was thus prevented. But Prjevalsky has left, in the travelling companions who remained so true to him in his adventurous journeys, a staff of young men who will certainly continue his work, and sooner or later open to science the dreary highlands which have baffled so many a bold explorer.

N. M. Prjevalsky was only in his fiftieth year, and usually enjoyed robust health. He belonged to a noble family, and was born in 1839, in the Government of Smolensk. At the age of seven he lost his father. During the early years of his life he was trained by his mother (whose maiden name was Karetnikoff), a teacher who stayed in their house, and a brother of his mother. He soon became an eager hunter, and spent all his holidays in hunting in the Smolensk forests with his uncle. This taste he retained during the rest of his life, and he frankly admitted that his first journeys in Central Asia were due as much to his passionate longing for rich hunting-grounds as to his desire to conquer for science the unknown wildernesses. Scientific interest developed more and more during and after his first Central Asian journey, when, accompanied only by three men, and possessing ridiculously small pecuniary means, he crossed the Gobi, reached Pekin, and, pushing westwards and south-westwards from the Chinese capital, explored the Ordos and the Ala-shan, and reached the Kuku-nor as well as the upper parts of the Yang-tse-kiang—the mysterious Dy-tchu of the Chinese geographers. And yet, when we saw him on his return from that wonderful journey, his eyes glittered and his face radiated chiefly when he was telling us of his achievements as a hunter and a discoverer of the ancestors of our domesticated animals—much more than when he was talking of his geographical discoveries, about which he always was, in fact, remarkably modest.

He received his first school education in the Smolensk Gymnasium, but he soon left this institution, and entered in 1855 an infantry regiment as a subaltern. Next year he became an officer, and five years later he entered the Academy of the General Staff. His love for geographical exploration had been to some extent developed by that time, and the dissertation he wrote on leaving the Academy was upon the Amur region, which was much spoken of in Russia. But he had not yet the means of satisfying his desire for travel, and he was compelled to return to his regiment and take part in the suppression of the Polish insurrection. He soon withdrew from active military service, and accepted the position of teacher of geography at a Warsaw Gymnasium, devoting his leisure hours to studies in natural history. It was only in 1867 that he was admitted into the General Staff and sent to Irkutsk, whence he immediately started for the exploration of the very little known highlands on the banks of the Usuri—the great southern tributary of the Amur. Here he found a wide field for exploration and hunting, and wrote a book on the Usuri region (published in 1869), partly of an ethnographical character. The Geographical Society awarded him for this book only a small silver medal; and, when Prjevalsky applied for means to enable him to explore Southern Mongolia, the Society was anything but generous in its response. Had it not been for his own small economies—he always lived a very simple life—and for the help he received from the then Russian Ambassador at Pekin (M. Vlangalli), himself an explorer of Mongolia, Prjevalsky could hardly have started on that remarkable journey. When he began the exploration of the land of the Tangutes, he possessed only 178 roubles (about £25); and when he reached, with his three companions, the sources of the Yang-tse-kiang, after having crossed the province of Han-su, the Tsaidam, and part of Northern Tibet, he had only 10 roubles left, and his camels were quite exhausted. The whole expedition, which lasted thirty-four months (November 1870 to September 1873), had cost only 6000 roubles; yet this undoubtedly was the most remarkable journey that had been made in Asia in the nineteenth century. Prjevalsky proved that, for resolute and enduring men, travelling on the Central Asian plateaus was much easier than had been supposed. He twice crossed the Gobi, reached the Kuku-nor, penetrated as far south-west as the spot where the Yang-tse-kiang rises from the confluence of the Mur-usu and the Nantchitai River, and returned with exceedingly rich zoological and botanical collections, after having travelled no less than 7320 miles across formerly quite unknown deserts and highlands. The work in which he embodied the results of that wonderful journey, "Mongolia and the Land of the Tangutes," was immediately translated into all civilized languages. The Russian Geographical Society hastened to present him with its great Constantine Medal, and most of the Geographical Societies all over Europe congratulated him on his discoveries, and awarded him medals, honorary diplomas, and the like.

Prjevalsky, in the meantime, was trying to find the means for continuing his explorations; but it was only in 1876 that he succeeded in obtaining from the Ministry of War the 25,000 roubles which were necessary to enable him to push as far as Lob-nor. His aim was not only to rediscover the basin of the Tarim and the great lake of East Turkestan, which had not been visited by any European from the time of Marco Polo; he desired to cross East Turkestan and the northern plateaus of Tibet, and to reach Lhassa. This time he started from Turkestan, and, following the upper part of the Ili River (the Kunges), he reached Kurla in East Turkestan, whence he crossed the desert and reached the Lob-nor. The great lake was thus rediscovered. But it was impossible to reach Lhassa by this route, and Prjevalsky returned to Kulja, and thence to the Russian post Zaisan. His aim was to penetrate into Tibet *viâ* Hami, the Tsaidam, and the sources of the Blue River. So he started again, from Zaisan to Gutchen. Unhappily, the skin disease of the steppes (*pruritis scroti*) overtook him, and he was compelled to return from Gutchen. Still, next March, he was again on his way to Lhassa, when the frontier authorities ordered him to postpone his expedition. He then returned to St. Petersburg.

The Lob-nor journey was made in 1877, and although only eleven years have elapsed since, it is almost impossible now to realize the imperfection of our knowledge of Central Asia at that time. When it became known that Prjevalsky had visited the Lob-nor, Baron Richthofen contested the fact, and maintained that the lake which receives the Tarim must be situated further north and due east from the mouth of the Ughen-daria; while now Lob-nor is perfectly well known. As to the natural history collections which were brought in from this second journey, they were even more valuable than those gathered during the first journey. They gave us a clear insight into the flora and fauna of those parts of East Turkestan; while the barometrical measurements enabled us to form, for the first time, a correct idea as to the characters of the Tarim depression of the great Central Asian plateau. It was also from this journey that Prjevalsky brought the wild camel—the ancestor of the domesticated species.

As soon as he was back at St. Petersburg, Prjevalsky hastened to prepare for a new journey; and after having written a short account of his Lob-nor journey, "From Kulja, across the Tian-Shan, to Lob-nor," he left the Russian capital for Zaisan, and began his third journey, the most remarkable of all. He soon reached Barkul and Hami, the two Turkestan oases which were almost less known than some parts of the moon. He crossed the Western Gobi, and reached a spot, Dzun-zasak, in South Tsaidam, at the foot of the highlands which separate Mongolia from Tibet. Thence he went south, in order to reach the longed-for Tibetan city of Lhassa. The journey in the highlands which border the great plateau on the north-east was exceedingly difficult. Ridges, 16,000 feet high in their lowest parts (one of them was named after Marco Polo), separated from one another by deep valleys, the bottoms of which are 13,000 and 15,000 feet above the level of the sea, had to be crossed; and when the expedition reached the upper parts of the Blue River, it was brought by the guide to quite impracticable highlands, and had to find its way amidst the barren mountains, peopled by Tangutes, whose attacks had to be repulsed by force. Nevertheless, Prjevalsky crossed the highlands, and had already reached, under the 32nd degree of latitude, the great valley of the Tibetan river Khara-usu, whence the route to Lhassa was relatively easy; but here a new obstacle rose before him. The Dalai-lama had sent officials, who declared to Prjevalsky that the Tibetan nation would not allow Russians to enter the capital of the great chief of the Buddhist religion. The expedition was thus compelled to return; and so it did, recrossing the same highlands in the midst of the winter. Having returned to the Ala-shan town Sinin, Prjevalsky did not like to go back to Russia without having visited the Hoang-ho, which makes a great bend to the north in the neighbourhood of Kuku-nor. He reached, in fact, the great river of China at Guidui, crossed it, and explored it for some 200 miles, and only then returned to Kiakhta, after having travelled about 14,700 miles, half of which stretch was surveyed, and bringing in more than 4500 specimens of mammals, birds, and fishes, 6000 insects, and many thousands of plants. The most remarkable "find" was, however, the wild horse—the ancestor of our present horse—which inhabited Russia and Poland some two hundred years ago, and has been described by the late I. Polyakoff under the name of *Equus przewalskii* (*Izvestia Russ. Geog. Soc.*, 1881). It is hardly necessary to say that this remarkable journey produced the greatest impression on the scientific world. The Russian Geographical Society elected Prjevalsky an honorary member; the city of St. Petersburg offered him its honorary citizenship, and many scientific bodies bestowed on him all kinds of distinctions. The general results of this journey were embodied in a work entitled "Third Journey to Central Asia," which also has been translated into many European languages.

As soon as the publication of this work was ready, Prjevalsky started again, in November 1883, on a new journey, again proposing to visit Tibet. This time he started from Kiakhta, crossed the Gobi in the winter, and soon reached the spot, Dzun-zasak, whence he intended to start for the exploration of the highlands of North-Eastern Tibet. But all kinds of misfortunes attended him. The expedition, freely provided with money, already numbered twenty-one men, and so it could not move with less than fifty camels and several horses. It was found very difficult to obtain such a number of animals from the poverty-stricken populations of South Tsaidam; and Prjevalsky, usually so mild in his relations with the natives, resorted to violence. The animals he thus secured proved to be quite unfit for journeys across the high ridges which fill up the space in the south of Dzun-zasak; and it seems most probable that by taking a route due south from that point, instead of proceeding south-westwards as he did during his third journey, Prjevalski committed an error. Not taking into account the north-eastern direction of the ridges, he had to cross the numerous ridges of the Upper Hoang-ho, instead of availing himself of the depressions having a south-western direction, which permitted him to reach the Khara-usu in 1880 without serious difficulty.

It is true that, by taking a southern direction, he reached the two great lakes Jirin and Orin, through which the Upper Hoang-ho flows, and that he thus solved one of the problems of the geography of Asia. But when he went further south, he had to cross such a succession of wild highlands of an Alpine character, that his camels were soon disabled; and when he reached the Dy-tchu, or Upper Yang-tse-kiang, some 120 miles to the east of the spot he visited in 1872, he found it impossible either to cross it or to follow the river downwards. He was obliged to return, and on his way back he even could not fully explore the lakes Jirin and Orin, because the Tangutes, gathering in hundreds, violently attacked the caravan, and were repulsed only after having lost a great number of their warriors.

Having returned to Dzun-zasak, Prjevalsky went north-westwards along the foot of the ridges which separate Mongolia from Tibet, and, when at the lake Gas, he made a winter excursion into the highlands. This excursion enabled him to get a clear idea as to the series of parallel ridges which separate the Tsaidam from the higher terrace of plateaus of North-Eastern Tibet. Moreover, instead of returning from Lob-nor by his usual route, he pushed westwards into East Turkestan, as far as Khotan, and returned to Russian Turkestan *viâ* Aksu, thus covering nearly the same ground as that visited at the same time by Mr. Carey.

Years and years will pass before all the specimens of plants and animals brought in from his four journeys can be fully described. Maximowicz's description of Central Asian plants, now being printed by instalments in the Bulletin of the Moscow Society of Naturalists, already gives some idea of the richness of Prjevalsky's collections, which represent a total of 700 specimens of mammals, 5000 of birds, 1200 of reptiles and amphibia, 800 of fishes, 2000 mollusks, 10,000 insects, and from 15,000 to 16,000 plants. All the zoological specimens are in the St. Petersburg Academy of Sciences, the botanical specimens at the St. Petersburg Botanical Garden, the geological collections at the St. Petersburg University, and special funds have been granted by the Government for the publication of the scientific results of these journeys as soon as the necessary work has been done by the specialists.

The volume embodying the general results of Prjevalsky's fourth journey, and entitled, "From Kiakhta to the Sources of the Yellow River, Northern Tibet; and the Journey from Lob-nor through the basin of the Tarim," reached London only a few weeks ago, and the present writer was preparing an account of it when the sad news reached us from Vyernyi. Although less striking than his previous books, so far as geographical discovery is concerned, this work may be even more important for the light it throws on the nature of a wide unknown country. It presents also the clearest view of the traveller himself, and affords a clue to the causes of his success.

In a chapter devoted to the ways and means of travelling in Central Asia, Prjevalsky gives detailed instructions as to how an expedition ought to be organized, and when speaking of the traveller himself he writes:—"As to the person who will have before him the beautiful task of scientifically exploring new regions, his task will not be easy. The explorer will have to pay for the smallest discoveries by plenty of suffering, physical and moral. He must be strong physically and morally. Flourishing health, strong muscles, and still better an athletic complexion, on the one side, and strong character, energy, and resoluteness, on the other—such are the features which best guarantee success." And, after mentioning the necessity of general scientific knowledge, and of special knowledge in, at least, some one branch, as well as the necessity of a real passion for travelling, Prjevalsky adds :—"Moreover, he must be an excellent shooter, and, still better, a passionate hunter. He must not despise any hard manual work, as, for instance, the saddling of horses and camels, the packing of luggage, and so on—in short, he must never be a 'white-handed' person ; he must not have habits of luxury ; and he must have a pleasant, lenient character, which will soon acquire for him the friendship of his travelling companions." In these sentences he characterized himself. To renounce, if necessary, every comfort ; to live the life of the other members of the expedition, without any distinction between the scientific staff and the simplest soldiers or Cossacks ; to sleep in the same tent, to eat the same food, and to do the same work as the rest—such were Prjevalsky's rules. We must add also that, especially during his first two journeys, his relations with the natives were of the most friendly character. He carefully avoided any conflict with them ; and when it happened once, during his first journey, that the natives were hostile to him, and this hostility might have ended in an armed conflict, he preferred to win their respect by the following stratagem. He and his three men—all four admirable sharp-shooters—opened a fire from their breech-loading rifles upon the carcass of a horse, from a great distance. In two minutes they had discharged thirty bullets each, and they advised the Mongols to see if any bullet had touched the carcass. The Mongols rushed, of course, to the carcass, and, to their great astonishment, after hard work with their knives, discovered most of the 120 bullets in it. They did not fail, after this, to treat their visitors properly.

It is impossible to mention Prjevalsky's name without being reminded of his travelling companions. He himself so often expressed his gratitude to them, and he always wrote with so much sympathy about their common experiences, that we shall only be carrying out his wish in stating that Lieut. Pyevtsoff during Prjevalsky's first two journeys, Lieut. Roborovsky in the last two journeys, and M. Kozloff during the fourth, have their full share in what Prjevalsky modestly described as his "scientific reconnoitrings" in Central Asia. Their portraits, as well as his own, are given in his last work. P. K.

SMOKE IN RELATION TO FOGS IN LONDON.[1]

LONDON fogs are produced by the mechanical combination of particles of water with particles of coal or soot, and require for their fullest development the following conditions : a still air, a temperature lowest at or near the ground in comparison with an elevation of some hundreds of feet, saturation or partial saturation of the air within a moderate distance of the ground, absence of clouds overhead, and free radiation into space. The artificial darkness and peculiar colouring occur with greatest effect at times when a very large quantity of coal is being burnt in domestic fireplaces, and cannot as a rule prevail during the night between 10 p.m. and 5 a.m., or to any great degree in warm summer weather. The early hours of summer mornings are the only ones in which clear views of the whole city are possible. Next in clearness come fine Sunday afternoons in summer, when fires are allowed to go down. The hours of greatest density are those following the time of greatest cold on the earth's surface and of the lighting of large numbers of kitchen and other fires. Thus about 8 to 10 a.m. is frequently the period of thickest and darkest fogs. It may be noted that on Sundays, when factory fires are inoperative, fogs in winter have been densest ; on one Christmas Day there was absolute darkness during the whole day, thus showing the dependence of light-absorbing matter on kitchen and domestic fires. Many distinct conditions may alter the time of maximum density.

The formation of a London fog appears to take place as follows. An ordinary thick white fog covers the city, say at 6 a.m. ; about a million fires are lighted soon after this hour, and the atmosphere becomes charged with enormous volumes of smoke—that is, the gases of combustion bearing carbonaceous particles. Now, these particles, as soon as they are cooled to the temperature of the air, or below it, begin to attach to themselves the water spherules already present and visible, and vapour may also be condensed on the particles. A thick layer of these united particles prevents light from penetrating it, and a very small quantity of finely divided carbon may stop the bright sunshine altogether, like the film of soot on a smoked glass. The invariable redness of the sun through smoke seems to show that the majority of particles are comparable in diameter to the length of a wave of blue light. Smoke prevents the warmth of the oblique sunshine from reaching and evaporating the white fog near the ground, and the white fog continues to radiate towards space and towards the ground, if colder than itself, without receiving compensation from the solar rays. A difference of 10° has occasionally been noted between thermometers at 4 feet and 100 feet above the ground, the upper one always being the warmest in fogs. Carbon is a good radiator, and tends from this cause to keep itself cold by radiation into space, and thus to accumulate vapour from the air, like the dewy surface of the earth. The importance of a clear sky and a dry upper air in promoting fogs in this respect is obvious.

It has been supposed, quite erroneously as I believe, that, as even without any visible smoke an enormous quantity of fine invisible dust exists in the London atmosphere, the abolition of coal smoke would fail to give us freedom from dark fogs. Proof is altogether wanting that ordinary invisible dust in cities or plains is of a kind to create an abnormal amount of fog, or to produce those dismal obfuscations of which tarry carbon is capable. Paris, as long as it burnt wood and charcoal, was free from idiosyncratic fogs ; so are the wood and anthracite-burning cities of the United States ; and so are the towns of South Wales, where anthracite is the common fuel. If London were to cease using fuel in the solid form, it would be as free from fog as the surrounding country.

The accumulation which produces the worst and most dangerous fogs in London cannot, as a rule, proceed for many hours without disturbances arising which tend to reduce their importance. In winter the warmth of the air exceeds by 2° or 3° that of the surrounding country, consequently an upward current is started, which rises to some altitude, and then flows away, bearing with it a stream of murky cloud ; a circulation of air consequently takes place in the lower strata. If, however, the cold of the lower layers greatly surpasses that of the strata some hundreds of feet higher, and if the sun dissipates the fog in the surrounding country, thus making the environs warmer than London itself, the black fog may very likely remain on the town all day. For this reason, on a fine cold still morning, with a bright sun, and temperature near the dew-point, persons arriving from the country are pretty sure to find a black fog in town between 10 and 12 a.m. The finest winter days are nearly always very bad ones in London, unless there be any wind between the surface and an altitude of 1000 feet, or the dryness be unusual for the time of year.

When the air is very dry near the surface, no dense fog is formed in London, and when very wet, streaming with fog, in the country, little fog occurs in London. The dry warm surfaces of the houses themselves, and the elevation of temperature above the dew-point, prevents wet fogs from reaching anything like the density they attain in the

[1] Abstract of an Address delivered by the Hon. F. A. R. Russell, on March 1, 1888, under the auspices of the Smoke Abatement Institution.

country. A wet fog disappears under cover, showing its causation by the radiation of its particles towards colder surfaces or space, as well as by mixture of differing air-currents. A dry fog persists to some degree in a warm room, showing it to be largely composed of carbonaceous particles of visible magnitude. There is nothing in the geographical position of London to make it more foggy than many other parts of the country, and, owing to the conditions just mentioned, it would probably rejoice in a clearer air, on the whole, than that of the surrounding districts if ordinary coal were superseded by anthracite and gaseous and liquid fuel.

From the daily tables of weather of the Meteorological Office for 1872, 1873, 1875, 1876, 1877, and 1882, which happened to be in my possession, I have obtained the following results, showing the prevalence of fog at different stations at 8 a m.

The first column (*b*) shows the number of days per cent. of blue sky or free from cloud at 8 a.m., and the second column (*f*) the number of days per cent. when fog more or less prevailed at that hour.

	b.	*f.*
Aberdeen	22	2
Valencia	10·1	2·4
Hurst Castle	13·7	3·2
Leith	11	5·3
Dover	27·9	6
Holyhead	13·2	6·2
Liverpool	12·4	6·6
Pembroke	12	8·5
Scilly	2	10
Oxford	10·4	10·5
Yarmouth	14·5	12·2
London	8	13·5

Aberdeen and Dover have by far the largest number of fine mornings, Aberdeen, Valencia, and Hurst Castle the smallest number of fogs.

The following list, from data of the second order stations of the Royal Meteorological Society, shows the percentage of fogs—that is, the number of days with fog —for eleven stations, during the years October 1879 to September 1882.

	Days of fog.	Notes.
Carmarthen	4·5	No observations in 1880.
Southbourne	4·8	
Ramsgate	5	
Cheltenham	7	
Eastbourne	7·9	Only two years' observations.
Llandudno	8 8	
Babbacombe	14·6	
Hereford	19·1	Only one year's observations.
Croydon	25·9	
Strathfield Turgis	26	
Norwood	34·5	

The following table gives the results of the registration of bright sunshine by glass recorders at seven places in the South of England. The figures give the number of hours of bright sunshine recorded in the four years, 1883, 1884, 1885, and 1886. In the cases of St. Lawrence, Isle of Wight, and St. Leonard's, where data for only two years existed, the result is arrived at by multiplying the value in each case by two. Eastbourne only recorded in 1886, and the result for this year has been multiplied by four. The second column gives the number of hours of bright sunshine in November and December 1885, and January and February 1886.

City of London	3925	62
Kew	5713	222
Greenwich	4845	157
Eastbourne	6660	300
St. Lawrence, I.W.	6774	316
Southbourne	6115	
St. Leonard's	6880	

This absence of light must tell decidedly on the vital force of the community, taken as a whole, and even if we had no dense fogs it would be worth cleansing our atmosphere to get the proper amount of sunshine.

In the great fogs of 1880, the death-rate of London rose from 27·1 for the week ending January 24 to 48·1 for the week ending February 7, which was the period of thickest fog. The death-rate for nineteen provincial towns in this last week was 26·3. At Croydon the rate only rose from 35 to 36. In this period of three weeks from January 24 to February 14, the excess of deaths over the average in London was 2994. Probably ten times as many were ill from the combined effects of smoke and cold. In the week ending February 7, the deaths from whooping-cough were unprecedentedly numerous, 248, and from bronchitis, 1223. Clearly, persons liable to bronchial attacks should if possible keep out of London during winter anticyclones.

The moral reaction of this atmosphere is well worthy of consideration. If smoke were got rid of, there would be a great revival of plant vigour and human gaiety, the housewives who now give up in despair the attempt to keep their houses bright and clean would no longer lose heart, the dull brick walls would begin to deck themselves with colour and ornament, the grime which seems to pervade everything would disappear, and sky and earth would appear in their natural brilliancy.

As the result of a computation taking into account the damage to buildings, furniture, ceilings, wall-papers, works of art of all kinds, the extra washing, and consequent wear and tear, for 4,000,000 people, window-cleaning, waste of coal, extra lighting required, chimney-sweeping, loss of time by artists, &c., impairment of health, and many other items, it appears that the loss by our wasteful method of burning coal must be about £5,000,000 a year.

There are many ways by which householders may economize in the use of fuel. Among them may be mentioned, the use of hot-water pipes and coils at low pressure heated by a coke stove, improved kitcheners, anthracite, patent fuel, mineral oil, and gas. With a reduced price of gas, gas cooking-ranges ought to come into general use. Gas fires throughout a house, except perhaps in one room where an open fire might be kept up, save the following expenses: burning fuel at times when not required, labour and wear and tear in carrying coals, dirt and blackening of ceilings, &c., wood for lighting, sweeping of chimneys, coal-scuttles, fire-irons, emery, and the very considerable amount of domestic labour now taken up by cleaning, laying, and attention generally. Wherever an open coal fire is insisted on, the various improved grates may be employed with great advantage both for economy and smokelessness. Rows of houses could probably be heated economically by hot-water or steam pipes from a boiler in a central position; but the uncertainties of our climate make independent arrangements on the whole preferable. Wasteful ranges might be subject to a tax, which the wasteful householder might be presumed to be capable of paying without inconvenience, and smoky chimneys should not be allowed to pollute the atmosphere with impunity. This would have an effect opposite to that of the tax on light, the window-tax, which vexed the last generation, for it would tend to increase the brightness of London dwellings by the admission of sunlight.

The method of heating water by the arrangement known as the "Geyser" or "Therma" has the merit of utilizing nearly the whole of the heat given off by the gas in burning. This could be employed at the top of the house, the hot water running into pipes in the rooms or on landings, and finally into a cistern in the kitchen, and here, if necessary, an ordinary boiler for heating coils in the upper part of the house or in the hall would utilize the water not yet cooled to the temperature of the air.

The abolition of smoke would certainly effect a very large saving to the community, and would add greatly to the amenity of the climate, not only of London, but of all the adjoining counties. Thousands of acres in the environs could be acquired and turned into gardens with the savings of a single year in the perfect combustion of fuel. In times of distress a sum equal to the wages of 100,000 labourers is now thrown away in the manufacture of an artificially coloured atmosphere. Remedies in accordance with science are at hand; it only remains for society to see that they are applied.

DESICCATED HUMAN REMAINS.

SOME time ago, Signor S. Marghieri, the Mexican archæologist, while exploring the eastern side of the Sierra Madre Mountains in Mexico, at an elevation of nearly seven thousand feet, discovered and explored a hermetically sealed cave. The floor was nearly smooth, the sides rough and rugged, and the vault covered with stalactites. At the far end of the cave, which was of considerable dimensions, four mummified human bodies were found. The bodies—a full-grown male and female, and a boy and girl—were in a sitting posture, hands crossed on the breast, and knees approaching the chin, with the head inclined forward. They were all carefully enshrouded in burial garments, and accurately placed facing the rising sun. We may suppose that the elder male and female were husband and wife. They sat side by side; the elder child, a boy, was placed to the right of the father; the younger, a little girl, to the left of the mother. There was no trace of any implements, utensils, or personal effects; nor were there on the walls hieroglyphics or pictographs. The cave had been sealed by means of sun-dried, adobe bricks, and adobe paste or plaster, together with natural rocks from the mountain. So well was the work done that none but an acute observer would have noticed the artificial closure.

The bodies were brought to San Francisco, and bought by Mr. J. Z. Davis, by whom they were presented to the State Mining Bureau, in the archæological department of which they are now preserved. The following description of them is taken from a careful report drawn up by Dr. Winslow Anderson, for the Board of Trustees of the California State Mining Bureau:—

These naturally mummified bodies differ from mummies proper, in the general acceptation of the term, inasmuch as no embalming process for their preservation was used. They were desiccated in their cave sepulchre by natural elements. The dry hot atmosphere extracted all the moisture from the tissues, and the bodies literally dried up as we would dry jerk-beef, or as the Indians of to-day dry the bison (buffalo) meat which keeps for years.

There is no evidence of these bodies having undergone any preparatory process. The brain, heart, lungs, abdominal and pelvic viscera are all intact and dried to a solid consistency.

The elder male body is about five feet eight inches tall, and well proportioned. The bones are large, and he must have had an excellent physique. He probably weighed between one hundred and eighty and two hundred pounds. All the body now weighs is fourteen pounds.

The integument is well preserved, and presents the appearance of dried hide, or thick parchment, of a dark gray colour, and all that remains between it and the bones are the dried muscles, tendons, nerves, and fascia. The body is well developed, the shoulders measuring from one acromion process to the other, three hundred and ninety millimetres (about fifteen and a half inches); the hands are small, and the fingers tapering; the feet are also small, measuring two hundred and forty millimetres (about nine and a half inches), and highly arched. The phalanges of the digits are perfect, each having the normal number of bones, and the ungual appendages are well preserved and not unusually long.

The body has dried in the sitting posture, hands crossed and knees drawn towards the chin. The cheek and lips on the left side protrude. This probably occurred during the time of mummification; the moisture leaking from the interior of the brain and surrounding tissues, through the cribriform plate of the ethmoid at the anterior portion of the calvaria, through the cribriform foramina into the inferior meatus nasi, and the head being inclined toward the left, produced this bulging from the force of gravitation. Being itself in turn dried up, the mouth maintained its present shape. Short stiff hairs can be seen on the head. The eyebrows and eyelashes are also distinctly visible. A little hair can also be noticed on the upper lip, but very little beard anywhere on the face. The ears are closely pressed against the sides of the head, and only the cartilages remain. The eyes are quite perfect, and present a slight outward obliquity. The nose, originally broad, has been more flattened by the shrinking of the cartilages and the alæ nasi. The lips are stiff and solid, and the tongue is shrivelled to the consistency of cork. There is a full set of masticators in his mouth, thirty-two in number, and all quite well preserved. A few of the dentures only have the enamel worn down to the dentine. The ribs are large and well formed, indicative of a well-shaped chest. The genitalia are well preserved. On the head there has been a large growth of hair, on the face very little, and on the body scarcely any at all.

Owing to the dried integument and fascia covering the cranium, accurate measurements of the skull are well nigh impossible. The following measurements, however, have been made with as much care and accuracy as the subject permitted. The cranial measurements are as follows: circumference, 530 millimetres; length, occipito-frontal, 178 mm.; breadth, bi-bregmatic, 140 mm.; breadth of frontal, 108 mm.; height, 135 mm.; facial angle, 71°.

The sutures and wormian bones cannot be inspected. The malar bones are quite prominent and the lower maxillary and face may be classified with the group orthognathous.

A careful study of this mesocephalic head would indicate that its possessor was of more than average intelligence. The perceptives are well developed. And, although the animal passions undoubtedly predominate, there is enough veneration or religion to class it among the scaphocephalic skulls.

The elder female body is in a better state of preservation than the preceding body. From a measurement of the individual bones, she would be about five feet five inches tall, and weighed, perhaps, about one hundred and fifty to one hundred and seventy pounds. The body weighs, in its present condition, only twelve pounds. The posture, integument, body, &c., resemble the one previously described. The large, oval pelvis, and the once well developed mammæ bear unmistakable evidence of gestation. The hands and feet are small and well shaped; the foot measuring only two hundred and fifty millimetres (about eight and one half inches). On the head is a luxuriant growth of hair, which centuries have not succeeded in destroying. It is very fine in texture, of a dark brown colour, and entirely unlike any Indian hair seen to-day. A curious feature is observed in connection with the small, well-proportioned ears, both of which are perfectly preserved, and that is, in each lobe is worn, even in the stillness of death, a piece of hollow bamboo or reed, about forty millimetres in length, and ten millimetres in diameter. This was probably considered an ornament in her day. The Indians of to-day pierce the helix and antihelix of the ear, through which holes they suspend ornaments of different kinds. The single perforation in the lobe of this mummified woman's ear would indicate a custom observed by her people, similar to the customs in vogue in the more civilized countries, and are not usually observed by Indians of our own period.

The eyes are singularly perfect, presenting a slightly outward and upward obliquity of the external canthi.

The nose is also quite perfect, and inclined to be rather broad and flat than thin and protruding. The malar bones are very prominent. The lips are thin and stiff, and the tongue is dried and solid. Two central incisores and one canine of the superior maxillary are gone, and several other teeth are badly caried.

Here, again, the hair and dried integument prevent absolutely accurate cranial measurements. The skull measures: circumference, 503 millimetres; length, occipito-frontal, 166 mm.; breadth, bi-bregmatic, 128 mm.; breadth of frontal, 103 mm.; height, 132 mm.; facial angle, 69°.

This skull presents a large forehead and well-developed reasoning powers. It is very rare to find so good a head among Indian women of to-day.

The little boy seems to have been about seven years old. The little fellow had been enveloped in his burial shrouds the same as the larger bodies—hands crossed on the chest, knees doubled on the breast, and the head inclined forward. All the bodies were probably tied in this position when placed in the cave. The body is about three feet tall, and weighs now only three pounds. The same general characteristics as to skin, tissues, bones, &c., that were observed in the preceding bodies, may also be seen here. The head is well developed for a boy of his age. The hair has been broken off near the scalp. Only the cartilaginous parts of the ears remain. There is the same contour of face—flat nose, high cheek-bones, outward obliquity of the eyes, &c. The upper and lower incisores and canine of the temporary or milk teeth are gone, and the permanent set coming at their roots in the alveolar processes.

The two anterior molars of the superior maxillary are just appearing through the alveolar processes, establishing the age with tolerable accuracy at about seven years.

In circumference the skull measures 440 millimetres; length, occipito-frontal, 146 mm.; breadth, bi-bregmatic, 120 mm.; breadth of frontal, 60 mm.; height, 114 mm.; facial angle, 71°.

A considerable part of the burial shroud remains about the body yet. The major portion of it is cotton fabric, firmly secured around the body by a stronger cord, made of braided hair.

The little girl may have been about fourteen to eighteen months of age. She weighs only a pound and a half. She has been enveloped in an animal's skin, the better to protect the tender frame. Both feet are gone, and the tibiæ and fibulæ protrude through the skin. The four upper and four lower incisores, with the corresponding canine teeth, have made their appearance, showing the child to be about fourteen to eighteen months old. Otherwise the same features are noticeable in this as in the proceding figures.

It would appear that the group of four belong to one family, and that they were buried by friends, and hermetically sealed in this cave for fear of some real or imaginary foe. It may have been at the time of the Spanish invasion, or it may have been during the warlike times anterior to this date, when the Aztec confederation was warring with the Toltec people.

From their physical and mental developments the race seems to have been a superior one.

The facial features observed in these bodies are not those found in that locality now. The cranial configurations and physical appearances would rather favour Aztec lineaments than those of the Indian of to-day. The fine dark brown hair is certainly not Indian, nor do the small hands and feet bear much resemblance to the huge hands and feet we see on the Indians now living.

The fabrics found on the bodies, forming the burial shrouds, are chiefly composed of cotton, hair, hide, grasses, and the bark of willows. The cotton is twisted and coarsely woven, each thread being from a half to one millimetre in diameter. The hair is treated in like manner occasionally, although usually it is braided with three or four divisions in each cord. Frequently we find strong strands made of strips of hide covered with willow bark.

Although the weaving of this interesting people is that known as the "plain" process—that is, where the weft passes alternately under and over the threads of the warp, producing more or less open mesh cloth—yet considerable skill and ingenuity were observed in the manufacturing of their blankets, mats, and ornamental cloths, which were frequently interwoven with beads and coloured threads, presenting various designs. Grasses and straws were also woven into mats and cloths, which were of great durability. The skins of animals were also used for clothing purposes.

THE PHILIPPINE ISLANDS.

MR. WALLACE, in his great work "The Geographical Distribution of Animals," divides the Oriental or Indian region of Mr. Sclater into four subregions, of which Java, Sumatra, Malacca, Borneo, and the Philippine Islands form one, which he calls the Indo-Malayan. In his discussion of the Indo-Malayan subregion Mr. Wallace recognizes several subdivisions of it, and treats of the Philippine Islands as one of the most important of these. Though acknowledging the existence of divisions of his sub-regions, he failed to give them technical names, as being at that time uncalled for.

The purpose of this paper is to show that the Philippines themselves are separated into several distinct zoological divisions, and it seems therefore necessary for their study to give technical names to the primary and secondary divisions of the already recognized sub-regions. The terms province and sub-province seem least objectionable, and will be made use of, the Philippine Islands thus forming one of the provinces of the Indo-Malayan sub-region, and the divisions of the group itself sub-provinces.

The zoological province of the Philippines is co-extensive with the political division of the same name, with perhaps the exception of the islands of Sulu and Tawi Tawi, which lie between the Philippines and Borneo, but are claimed by the Spanish.

The sub-provinces proposed are—first, the Northern Philippines, consisting of Luzon and Marinduque, and a number of other small islands about Luzon; second, Mindoro; third, the Central Philippines, made up of the islands of Panay, Negros, Guimaras, Zebu, Bohol, and Masbate; fourth, the Eastern Philippines, comprising the islands of Samar and Leyte; fifth, the Southern Philippines, embracing the great island of Mindanao, with Basilau, and perhaps Sulu; and sixth, the Western Philippines, consisting of the islands of Paragua or Palawan, and Balabac.

The geographical positions of these sub-provinces are so far fortunate, that these names show their relations to each other very closely, as may be seen by consulting a map of the archipelago.

Of the sub-provinces, the Western Philippines, made up of Paragua and Balabac, and perhaps the Calamines, is of most importance, its animal life being much more closely allied to that of Borneo than that of any other sub-province of the group. This is especially noticeable in its mammals, of which it possesses, in common with Borneo, the genera *Tragulus*, *Tupaia*, and *Manis*, which are apparently absent from the rest of the archipelago. Of Bornean genera of birds, not found elsewhere in the group, *Iora*, *Criniger*, *Polyplectron*, *Tiga*, and *Batrachostomus*, are examples. This sub-province has evidently received a large part of its fauna from North Borneo, through Balabac, at a comparatively recent date, and since its separation, on the north, from the rest of the Philippines, so that these genera have not flowed over into Mindoro and Luzon. In addition to these apparently late arrivals from Borneo, the sub-province possesses a large number of peculiarly Philippine birds and mammals, which show it to be an integral part of the province.

The rest of the Philippines would seem to have received their Malayan fauna at another time, and by the other way of Sulu and Mindanao. They possess the mammalian genera, *Galeopithecus*, *Tarsius*, and *Cervus*, which are apparently wanting in the western sub-province, and the genera *Macacus*, *Sus*, *Viverra*, *Paradoxurus*, and *Sciurus* in common with it. Of birds, the genera *Loriculus*, *Cyclopsitta*, *Buceros*, and *Penelopides* are examples of forms which are more or less generally distributed over the archipelago outside of the western sub-province.

The grounds for dividing the Philippines east of Paragua into sub-provinces are, to a great extent, based upon species, and especially upon the existence in each of representative forms of the genera *Loriculus*, *Buceros*, *Penelopides*, *Pitta*, *Chrysocolaptes*, *Dicæum*, *Cinnyris*, &c. The hornbills form perhaps the most striking example of this distribution of representative species. Of the eleven species of hornbills obtained in the islands, the western sub-province has one, the southern three, the central two, the eastern two, Mindoro one, and the northern sub-province two, and we have found no case of a single species occupying more than one sub-province, or of more than one species of a genus in a single sub-province. The genus *Chrysocolaptes* of woodpeckers is also noticeable, each sub-province possessing its own species, with the exception of Mindoro, which lacks the genus altogether. The genus *Loriculus* of the parrots is of the same character. Of other animals than birds, the genus *Sciurus* of mammals, and *Draco*, the flying lizards, seem to have representative species in each sub-province, and the land-mollusks are probably distributed in the same way.

The above examples are a few that come to mind before a careful study of our collections has been made, and they do not by any means show all the reasons for the conclusions arrived at. These are the results rather of the general observations of five careful men who have been collecting and studying in the Philippines during the last year. During this time we have visited and collected in fifteen islands of the group, and these the largest and most important. I am satisfied that the study of our collections with the aid of the libraries and collections at home, will only strengthen the conclusions of this paper. It may be necessary to make the so-called western sub-province of more importance in the arrangement, but the non-existence in nature of exactly equivalent divisions of any kind is well recognized.

It is hoped that our work may aid in untangling some of those puzzles in which students of Philippine zoology have found themselves involved, and that it will also add considerably to the sum of knowledge concerning this, as yet, imperfectly known corner of the earth.

Manilla, July 2, 1888. J. B. STEERE.

BAROMETRIC OSCILLATIONS.

THE following account of what appears to have been the passing of H.M. surveying-ship *Egeria* through the embryo of a cyclonic disturbance, has been received from Captain Aldrich, of that ship.

Admiralty, August 1. W. J. L. WHARTON.

H.M.S. "Egeria," at sea, June 6, 1888.

I send the following extract from my journal, which may possibly be of interest to meteorologists:—

"*May* 31.— . . . There has been a swell from the south-west during the day. The lower clouds come from the eastward, while the upper ones are from the westward. This appears to be a common occurrence in this locality.

"♀ *June* 1.—Weather cloudy all night, and wind-force 2·3, gradually veering, till at 3.30 a.m. it was to the northward of east. Barometer rising slowly. At 6 a.m. the wind shifted to the north-east in a rain-squall; nimbus, and a generally dark appearance in the sky. At 7 a.m. the officer of the watch sent down to tell me the barometer had fallen 0·12 of an inch in the previous hour. I was about to commence dressing at the time, but, hurrying on my things, I looked at the aneroid in my fore-cabin, and found the report correct. I immediately reset the aneroid and went on deck, and although there were no signs of any forthcoming disturbance, the light sails and mainsail were taken in. At 7.20 I had the barometer again read, when it was reported to have risen nearly $\frac{1}{10}$ inch in the twenty minutes. I went down immediately, and found by the aneroid this jump had taken place. During this time there was no change in the weather, though the wind drew to the north-north-east."

Now there is no doubt whatever that the barometer went up 9/100 in twenty minutes. Of course, it cannot be known to an hour when it previously dropped ·12, as the instrument was not read between 6 a.m. and 7 a.m., and the drop may possibly have been greater even, and also *may* have taken place as suddenly as it rose afterwards. There is no doubt that some extraordinary disturbance of the atmosphere took place, though beyond the foregoing observations we neither saw nor experienced anything of it. The following are the actual readings of the mercurial barometer:—

a m.		Inches.	Position.
6	...	30·170	Lat. 24·04 S.
7	...	30·050	Long. 179·04 W.
7.20	...	30·144	
7.30	...	30·154	
7·45	...	30·186	
8	...	30·186	
9	...	30·200	

PELHAM ALDRICH.

NOTES.

THE following is the list of names recommended by the President and Council of the Royal Society for election into the Council for the year 1889, at the forthcoming anniversary meeting on the 30th inst.:—President: Prof. George Gabriel Stokes. Treasurer: Dr. John Evans. Secretaries: Prof. Michael Foster and Lord Rayleigh. Foreign Secretary: Prof. Alexander William Williamson. Other Members of the Council: Prof. Henry Edward Armstrong, Henry Bowman Brady, Charles Baron Clarke, Dr. William Huggins, John Whitaker Hulke, Prof. John W. Judd, Dr. Edward Emanuel Klein, Prof. E. Ray Lankester, Prof. Herbert McLeod, Sir James Paget, Bart., William Pole, William Henry Preece, Sir Henry E. Roscoe, Dr. Edward John Routh, Prof. Arthur William Rücker, and Captain William James Lloyd Wharton, R.N.

THE Pasteur Institute, Paris, is to be opened on the 13th inst., in presence of numerous delegates of the French Academies of Science and of Medicine, and of the Medical and Scientific Faculties. President Carnot will perhaps be present.

WE regret to announce the death of the well-known geologist, Dr. Theodor Kjerulf, Professor at the University of Christiania, and Director of the Geological Survey of Norway. He died at Christiania on October 25, at the age of sixty-three. He received his appointment as Professor in 1858, and since that time has made many important contributions to geological science.

THE death is announced of Herr Johann Kriesch, Professor of Zoology and Prorector of the Royal Joseph Polytechnic at Budapest.

THE first wing of the Durham College of Science, Newcastle, was opened by the Princess Louise on Monday. The plans for the structure as a whole are very elaborate, and it is expected that the building, when completed, will be a great ornament to Newcastle. The wing just opened is about a third of the College, and has cost £23,000. The remainder will be built when the necessary funds are raised. Many of those who took part in the opening ceremony afterwards met at luncheon. Mr. John Morley, responding for the House of Commons, referred to the number of eminent men of science now in Parliament. Touching on the question how far Parliament may be expected in future to sanction expenditure for the promotion of such objects as the Durham College of Science has been founded to maintain, Mr. Morley said that the House of Commons would be willing to sanction grants from the public purse for objects of this kind in proportion to one thing, and that was to the evidence that could be brought before them that in localities an effort had been made to raise as abundant funds as these localities could provide.

H.M. SURVEYING-SHIP *Egeria*, under the command of Captain P. Aldrich, R.N., has, during a recent sounding cruise and search for reported banks to the south of the Friendly Islands, obtained two very deep soundings, of 4295 fathoms and 4430 fathoms (equal to 5 English miles) respectively; the latter in latitude 24° 37′ S., longitude 175° 8′ W.; the other about 12 miles to the southward. These depths are more than 1000 fathoms greater than any before obtained in the southern hemisphere, and are only surpassed, as far as is yet known, in three spots in the world—one off the north-east coast of Japan, of 4655 fathoms, found by the United States s.s. *Tuscarora*; one of 4475 fathoms, south of the Ladrone Islands, by the *Challenger*; and one of 4561 fathoms, north of Porto Rico, by the United States ship *Blake*. Captain Aldrich's soundings were obtained with a Lucas sounding-machine and galvanized wire. The deeper one occupied three hours, and was obtained in a considerably confused sea, a specimen of the bottom being successfully recovered. Temperature of the bottom, 33°·7 F.

IT appears from the Annual Report of the Société des Naturalistes de Moscou, which was read at its annual meeting on October 15, that the Society now has 535 members. During the past year the Society sent out MM. Zarudnyi, Litvinoff, Lorentz, Milutin, Kosmovsky, Golenkin, and Rostovtseff for the exploration of the Transcaspian region and the Caucasus, as well as for zoological and botanical explorations in several provinces of Central Russia. Besides its *Bulletin*, the Society has brought out a new instalment of its *Mémoires*.

THE courses of lectures at the Tomsk University were opened on September 13. There are already sixty-nine students, all Siberians.

NOTWITHSTANDING the considerable difficulties which have been met with in the digging of a canal to connect the Obi with the Yenisei, and the want of money for the completion of the undertaking, the work of connecting the two great arteries of navigation in Siberia is still advancing. In the summer of the present year a boat 56 feet long and 14 feet wide, taking 3½ feet of water, was drawn from the Obi into the Yenisei with a load of 40 tons of flour. The two rivers are 630 miles apart.

ON October 17, 1887, Mr. William Colenso, F.R.S., read before the Hawke's Bay Philosophical Institute a "Jubilee paper," entitled "Fifty Years Ago in New Zealand." This paper has now been published. It contains, among other interesting records, an excellent account of the introduction of the printing-press into New Zealand, and of the printing of the New Testament in the Maori language in 1837. Recalling the events of his life during his long residence in New Zealand, Mr. Colenso refers to December 25, 1835, when he met Darwin in the Bay of Islands, and spent with him "a happy long day."

THE atomic weight of tin has been redetermined by Prof. Classen and Dr. Bongartz, of Aix-la-Chapelle. Four distinct series of determinations have been made, including in all no less than forty-seven separate estimations. The accuracy of the work may be judged from the fact that the difference between the highest and lowest values obtained is no more than 0·4. The first series consisted in oxidizing pure tin to stannic oxide, and thus determining the ratio $Sn : O_2$. The purest commercial tin was taken as the starting-point, and the 0·5 per cent. of impurities removed by the following process. It was first converted to stannic chloride, $SnCl_4$, by the action of dry chlorine gas; the chloride was next fractionally distilled, and a portion eventually obtained boiling constantly at 120° C. This was diluted with water, and treated with solution of sodium sulphide until the precipitated sulphide of tin redissolved; a quantity of caustic soda solution was then added, and the liquid allowed to stand for a few days. It was subsequently submitted to electrolysis in weighed platinum dishes, upon the interior surface of which the tin was deposited as a beautiful silver-white metal. The tin obtained in this manner was exceedingly pure, and eminently suitable for use in atomic weight determinations. Weighed quantities of it were, in the first series of experiments, oxidized with redistilled nitric acid; the excess of acid was expelled upon a water-bath, and the residual stannic oxide first gently ignited over a small flame, and finally more strongly heated in a muffle furnace. The mean atomic weight derived from eleven such experiments is 118·76, a value considerably higher than the usually accepted one, 117·8, based upon Dumas's redetermination in 1858. In the second series the ratio of $Sn : Cl_4 + 2NH_4Cl$ was estimated, as given by electrolysis of the double chloride of tin and ammonium, $SnCl_4 . 2NH_4Cl$. Pure stannous chloride prepared as above was readily converted into this double salt which was obtained in fine crystals. Weighed quantities were dissolved in solution of ammonium oxalate and submitted to electrolysis, the tin being again deposited, washed, dried, and weighed. Sixteen such estimations give the mean value 118·81. The third series were precisely analogous, the double chloride of tin and potassium being employed; the mean of ten determinations affords the number 118·80. In the fourth series pure tetrabromide of tin was electrolyzed in presence of ammonium oxalate and oxalic acid, and the ratio $Sn : Br_4$ thus arrived at. The mean result of ten experiments in this series is 118·73. Finally, the mean value deduced from the whole forty-seven experiments is 118·77, or in round numbers 118·8, oxygen being taken at Stas's value, 15·96. If oxygen be 16, tin becomes slightly less than 119·1. This important metal may therefore be added to the interesting list of those whose atomic weights are probably whole numbers.

MR. G. V. HUDSON notes in the current number of the *Entomologist* that on March 7 he observed the largest assemblage of moths he has ever seen in New Zealand. They were flying round an electric light suspended from the yard-arm of the steamship *Aorangi*, at the wharf in Wellington Harbour. He thinks that at a moderate computation there were over three hundred specimens. He could not capture any, owing to the great height of the light; but they appeared to be chiefly *Mamestra composita* and *Porina signata*. Mr. Hudson points to this as a good instance of the efficiency of the electric light in attracting insects. He has found that an ordinary lamp will not attract more than a dozen or twenty specimens, even under the most favourable circumstances.

In the current number of the *Zoologist* Mr. John Cordeaux has some valuable notes on the occurrence of Pallas's sand grouse in Lincolnshire. Exclusive of the flocks seen near the coast late in August and in September and October, which may probably be referred to birds coming from the interior, and approaching the sea before taking their departure, the number actually recorded as visiting Lincolnshire is, as far as Mr. Cordeaux is able to ascertain, about 184. Making a liberal allowance for flocks seen more than once, he thinks the number may certainly be estimated as considerably exceeding a hundred. Taking the dates as they occur, the number in each flock, and the localities in which the birds have been seen, he is inclined to place the actual number at about 140 to 150 between May 18 and July 28. The number killed was twenty-five, of which sixteen were shot, eight died of poisoned grain, and one was killed on the railway. Mr. Cordeaux has no information which indicates that any sand grouse nested, or attempted to nest, anywhere in Lincolnshire.

The current number (vol. xvi. Part 2) of the Transactions of the Asiatic Society of Japan contains a number of specimens of Aino folk-lore translated literally by Mr. Batchelor, whose name is already known to our readers in connection with Aino studies. Mr. Meik, a civil engineer, employed by the Japanese Government to travel round the Island of Yezo to advise as to the most suitable sites for the construction of harbours, describes his journey. He draws attention to the diurnal inequality of the tides on the Yezo coasts. This amounts to 3 feet at spring-tides along the south-east coast, the maximum rise of a spring-tide being 6 feet, while the range of an ordinary spring-tide is about 4½ feet. The lowest tide at new and full moon occurs about 10 a.m., and the second daily tide reaches a minimum about three days and a half before new and full moon, or at the change of tides. On the south-east coast this minimum afternoon tide occurs about 6 p.m., and only registers a few inches, while on the west coast there is practically only one tide in the twenty-four hours for four days before and one day after new and full moons, and during this period the tide takes sixteen hours to rise and eight to fall. Mr. Parker discourses in his usual very learned way on the Chinese and Annamese languages.

At a recent meeting of the Society of Science of Christiania, Prof. G. Storm demonstrated the identity between Ginnunga Gap, referred to in the *Sagas*, and meaning the "World's End," and the present Davis Straits.

The first discovery of remains of cave-dwellers in Scandinavia has been made in a cave in the Great Carl's Island, in the Baltic, a couple of miles west of the Island of Gothland. Last year a farmer, while digging for mould for a plantation, discovered in a cave or grotto layers of ashes and charcoal mixed with bones. The latter, having been forwarded to the Royal Museum at Stockholm, were found to be the bones of horses, bullocks, pigs, birds, and fishes. In consequence of this discovery, Prof. G. Lindström commissioned Dr. L. Kolmodin to carry out excavations in this cave in a scientific manner; and the result is that indubitable remains of cave-dwellers have been found. The cave is situated about 20 metres above the sea-level, and consists of two parts, an outer one, about 12 metres long and 7 metres wide at the mouth, and an inner one, about 9 metres long and 1½ metre wide; the latter leading into a transverse gallery running south-west and north-east. Dr. Kolmodin began by excavating the layers at the mouth of the cave, and here he encountered, almost in the exact spot where the fire-place had been, a grave 5 metres in length, 2½ metres in width, and 3·2 metres in depth. There are alternate layers of ashes and charcoal, interspersed with remains of the animals named above. The bones of "domestic" animals decrease in quantity downwards, whilst those of seals increase. The explorer found, at a depth of 24 decimetres, fragments of coarse pottery of a primitive kind and some chips of flint; at a depth of 28 decimetres an implement of flint; and in the lowest layer, at 32 decimetres depth, two small drills of bone. Several of the fragments of pottery found below a depth of 24 decimetres bore traces of simple ornamentation. Everywhere in the layers were found bits of granite and chalk, clearly showing that they had been split by fire. Most of the bones had been split or crushed, and the marrow extracted. Among the remains was part of a human cranium. It may be added that the island on which the discovery was made is only a couple of hundred acres in extent, and uninhabited.

The Pekin correspondent of a Shanghai newspaper writes that a special edition of a work on natural philosophy, compiled by Dr. Martin, the head of the Foreign College of Pekin, has been prepared for the use of the Emperor of China, and that sixteen volumes of Macmillan's Science Primers have been translated into Chinese by Dr. Edkins, the well-known scholar, at the instance of Sir Robert Hart, the Inspector-General of Chinese Customs. "These elementary books will supply a want felt in the preparatory science schools which are now being inaugurated, especially in Tientsin. Excellent prefaces to the series, inculcating the advantages of a scientific training, praising the advance made in science in the West, and the valuable contribution or legacy which Sir Robert Hart, amid all his other work for the regeneration of China, is leaving, have been written by the two foremost statesmen in China—the Viceroy, Li Hung Chang, and the Marquis Tseng."

The ninth monthly part of "The Cyclopædia of Education" (Sonnenschein) has been issued. The work will be completed in about twelve parts.

Dr. A. B. Griffiths has in the press "A Treatise on Manures," which will be published by Messrs. Whittaker and Co., of Paternoster Square.

Great pains are taken to secure that the penny science lectures at the Royal Victoria Hall shall be attractive and successful. On November 6, Mr. W. Lant Carpenter delivered a lecture on "Speech-Recording Machines." The following are the announcements for the remainder of the present month: November 13, Mr. Harold Cox, "India"; November 20, Dr. W. D. Halliburton, "The Throat and the Voice"; November 27, Prof. H. G. Seeley, "Underground Heat."

Since September last a system of storm-warnings has been in use on the coasts of the Black Sea; they are issued from the Odessa Meteorological Station in connection with the Central Physical Observatory at St. Petersburg. Signals announcing the approach of strong north-eastern and south-western winds, as well as of storms, are shown at Odessa, Sebastopol, Kertch, Taganrog, Rostoff, Poti, and Batum. The signals are the usual cones and cylinders.

In the Jamaica Weather Report for the month of August, Mr. Maxwell Hall gives an interesting account of the more prominent features of some of the West Indian cyclones observed there during the last ten or twelve years. These hurricanes usually originate in the regions of heavy rains which advance as far north as latitude 15° in August and somewhat farther north in September and October. From November to July the rains withdraw nearer the equator, where the divergence of the air-currents is insufficient for their generation. All the cyclones which have passed Jamaica confirm the theory of the influx of the wind towards the centre. Mr. Hall states that there is a feature often observed in Jamaica which is not noticed elsewhere, viz. after a cyclone has passed, and is moving away, it draws the winds and clouds after it for one or two days, and that this fact enables him to draw conclusions as to the direction in which the cyclone is moving.

THE thirteenth yearly Report of the Forest Meteorological Stations of the German Empire, for the year 1887, published by Dr. A. Müttrich, contains monthly and yearly results for sixteen stations. The temperature and humidity are observed in the open country, in the forests, and in the crowns of the trees. The Report contains, besides, other data of interest, such as evaporation and rainfall, and the dates of first and last frosts.

IN a lecture delivered at Trevandrum by Lieut. Harold Ferguson, and reproduced in the *Madras Mail*, on "Some Popular Errors about Snakes," poisonous snakes are divided into three classes: (1) sea-snakes; (2) viperine snakes; and (3) poisonous colubrine snakes. All members of the first class are poisonous. The second class have flat triangular heads, and may be subdivided into pit vipers and true vipers. The true vipers are recognizable by having scales and not shields on the head, and the pit vipers by a deep depression between the eye and nostril. It is not easy to distinguish the third class at first sight from the harmless snakes, but it is an unfailing sign that the latter are covered on the head with large flat scales, which are absent from the head of poisonous colubrine snakes. With regard to Southern India, the poisonous snakes are not numerous. The largest is the dreaded hamadryad (*Ophiophagus elaps*), which is very rare. Other poisonous snakes found in that region are the cobra, the bungarus or krait, the callophis (four species), two species of *Trimeresurus*, *Daboia elegans*, and *Echis carinata*. In all there are about twelve species of poisonous snakes, five of which inhabit the low country—namely, the cobra, the two species of bungarus, the daboia, and the echis; the others are met with only in the hills.

THE British Vice-Consul at Candia, in Valencia, in a recent report on the agriculture of his district, refers to the insect pests of that province. He says that almost all men and boys there are fond of shooting, and they ruthlessly slaughter the small insectivorous birds. The result is, of course, disastrous to the farmers. The apple-trees in the district have been almost all destroyed by a worm called locally "*bañarriquer*," which eats its way into the trunks of the trees, and then spins a thick cobweb over the branches. The eggs, which number from thirty to fifty in each nest, are easily found; but this is rarely, if ever, done. Strange to say, the worm confines its attention to apple-trees; other fruit-trees flourish there. At Lucerne, in the same district, two species of insect pests are found, both caterpillars—*oruga verde* and *gusaro negro*. The latter is difficult to deal with, as it burrows under the roots of plants, but the former is easily swept off the leaves by a net. The pea crop is attacked by the *cadell*, a worm, and the *blanquuta*, an aphis. To complete a list of the ills from which agriculture suffers in that region, mildew has this year attacked the vine.

THE *Journal de la Chambre de Commerce de Constantinople* states that a method of solidifying petroleum has just been discovered. A small quantity of soap is added, and the mixture is heated. When the mixture is allowed to cool, the product can be cut into small cubes like those of compressed charcoal. Thus petroleum can be used as a combustible, it being now easy to transport and manipulate it.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Miss D. Hughes; a Vervet Monkey (*Cercopithecus lalandii* ♂) from West Africa, presented by Miss Helena Blow; a Common Genet (*Genetta vulgaris*) from Andalusia, presented by Lord Lilford, F.Z.S.; a —— Fox (*Canis* ——) from India, presented by Colonel Sir Oliver B. C. St. John, K.C.S.I., F.Z.S.; an Axis Deer (*Cervus axis* ♀) from India, presented by Captain W. Miller; two Hobbies (*Falco subbuteo*) from France, presented by M. P. A. Pichot; a Peregrine Falcon (*Falco peregrinus*), captured at sea, off the coast of Florida, presented by Captain J. Smith; a Knot (*Tringa canutus*), British, presented by Mr. C. Whymper, F.Z.S.; a Pallas's Sand-Grouse (*Syrrhaptes paradoxus*) from Fifeshire, N.B., presented by Mr. John Duncan; an Egyptian Vulture (*Neophron percnopterus*) from North Africa, presented by Captain A. Kent; a Polar Bear (*Ursus maritimus*) from the Arctic Regions, a Ruffed Lemur (*Lemur varius*) from Madagascar, a Yak (*Poëphagus grunniens* ♀) from Tibet, deposited; a Blue Jay (*Cyanocitta cristata*) from North America, purchased; a Crested Pigeon (*Ocyphaps lophotes*), a Bolle's Pigeon (*Columba bollii*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBSERVATION OF FAINT MINIMA OF VARIABLES.—Mr. S. C. Chandler has followed his Catalogue of Variable Stars by another much-needed piece of work. Pointing out how deplorably deficient is our knowledge of the light-changes of such variables as become too faint for ordinary telescopes to follow them, he strongly urges (*Astr. Journal*, No. 183) upon the possessors of the great modern refractors that they could not better employ their high optical powers than in this neglected field. And in order to afford the greatest possible inducement for them to undertake such a research, or at all events to remove as many hindrances out of their way as possible, he has supplied the data necessary for identification for some sixty-nine or seventy stars, the minimum for which is fainter than the 12th magnitude, together with a hypothetical ephemeris for the time of minimum for those stars which are likely to pass through that phase during the next fourteen months. The time of minimum has been assumed to precede that of maximum by 0·45 of the period. Mr. Chandler believes that he has discovered a curious relation between the form of the light-curve and the period. He does not, however, give this relation, but expects that the minima will fall earlier than predicted for stars with periods of from five to ten months or longer than thirteen months, but that in stars with periods from ten to thirteen months the minima will probably fall a little late. Argelander's method of observation is recommended.

OXYGEN LINES IN THE SOLAR SPECTRUM.—M. Janssen has made a very toilsome, not to say somewhat dangerous, expedition in order to determine whether the groups of lines seen in the solar spectrum, and which he had shown to belong to oxygen, were wholly due to the influence of our atmosphere, or partly due to the absorption of oxygen in that of the sun. He therefore resolved to ascend Mont Blanc at a late period in the season, when the cold would be sufficiently intense to secure the absence of any appreciable amount of water vapour from the atmosphere. The station chosen was that of Les Grands Mulets, on account of the cabin there, which would afford shelter to the observers during the period that it might be necessary to continue the observations. The ascent was made on October 13, and the following day was devoted to the adjustment of the instruments. October 15 and 16 were most fortunately very fine days, and the observations were made under the most favourable conditions. The result was to show that both the bands and lines of oxygen, as identified by M. Janssen in the solar spectrum by his previous experiments, are due entirely to the earth's atmosphere. The system of bands—those in the red, in the yellow, and the blue, the intensity of which varied with the square of the density of the absorbing oxygen—was altogether wanting, and the groups of dark lines, viz. A, B, and α, which M. Janssen had found, in the experiments above referred to, to vary as the simple density, were so much enfeebled as to leave little doubt but that they, too, would disappear could we wholly eliminate the influence of our atmosphere. Of course this result does not prove the absence of oxygen from the sun, but merely that it does not show its presence by the same characteristic bands and groups of lines as it does in the case of our own atmosphere.

NEW MINOR PLANETS.—Herr Palisa has discovered three new minor planets, No. 279 on October 25, No. 280 on October 29, and No. 281 on October 31. Of these No. 279 may possibly prove to be Medusa, No. 149; and No. 280 was at first thought to be Oppavia, No. 255, but is more probably a new planet.

COMETS FAYE AND BARNARD.—The following ephemerides for these objects for Berlin midnight are in continuation of those given in NATURE, vol. xxxviii. p. 626 :—

1888.	Comet 1888 *d* (Faye). R.A.	Decl.	Comet 1888 *e* (Barnard). R.A.	Decl.
	h. m. s.	° ′	h. m. s.	° ′
Nov. 11	8 6 9	5 49·9 N.	4 30 32	0 24·4 S.
13	8 7 39	5 27·6	4 17 59	1 5·4
15	8 8 59	5 5·6	4 4 55	1 46·7
17	8 10 11	4 44·1	3 51 26	2 27·5
19	8 11 15	4 22·9	3 37 39	3 7·4
21	8 12 9	4 2·4	3 23 43	3 45·7
23	8 12 56	3 42·4	3 9 45	4 21·9
25	8 13 34	3 23·1 N.	2 55 56	4 55·3 S.

DISCOVERY OF A NEW COMET.—Mr. E. E. Barnard, Lick Observatory, Mount Hamilton, discovered a new comet on October 30 (local time). Place at October 31·0399 G.M.T., R.A. 9h. 43m. 22·2s. ; Decl. 15° 18′ 52″ S. Daily motion, R.A. + 1m. 32s. ; Decl. 9′ *n*. Physical appearance : slightly elongated ; 1′ in diameter ; 11th magnitude, or fainter ; strong central condensation.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *NOVEMBER* 11-17.

(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 November 11

Sun rises, 7h. 14m. ; souths, 11h. 44m. 13·2s. ; sets. 16h. 14m. : right asc. on meridian, 15h. 8·4m. ; decl. 17° 38′ S. Sidereal Time at Sunset, 19h. 39m.

Moon (at First Quarter November 10, 16h.) rises, 14h. 7m. ; souths 19h. 0m. ; sets, 0h. 2m.*: right asc. on meridian, 22h. 25·5m. ; decl. 13° 20′ S.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	° ′
Mercury..	5 27	10 39	15 51	14 2·6	10 10 S.
Venus.....	10 13	13 57	17 41	17 21·7	24 35 S.
Mars	11 50	15 38	19 26	19 3·0	24 11 S.
Jupiter....	9 10	13 14	17 18	16 39·0	21 41 S.
Saturn....	22 41*	6 7	13 33	9 30·8	15 41 N.
Uranus ...	4 22	9 49	15 16	13 13·2	7 6 S.
Neptune..	16 51*	0 36	8 21	3 57·9	18 44 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

Nov.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.
			h. m.	h. m.	° °
12	ψ^3 Aquarii	5	17 9	18 24	103 267
16	ξ^2 Ceti	4	21 11	near approach	10 —

Variable Stars.

Star.	R.A.	Decl.			
	h. m.	° ′			h. m.
U Cephei	0 52·4	81 16 N.	Nov.	15,	1 8 *m*
Algol	3 0·9	40 31 N.	,,	14,	4 33 *m*
			,,	17,	1 22 *m*
λ Tauri...	3 54·5	12 10 N.	,,	11,	1 15 *m*
			,,	15,	0 7 *m*
T Monocerotis ...	6 19·2	7 9 N.	,,	14,	3 0 *M*
R Canis Majoris...	7 14·5	16 12 N.	,,	15,	22 34 *m*
			,,	17,	1 49 *m*
R Leonis	9 41·5	11 57 N.	,,	16,	*m*
R Virginis	12 32·8	7 36 N.	,,	15,	*m*
U Virginis	12 45·4	6 7 N.	,,	16,	*m*
β Lyræ...	18 46·0	33 14 N.	,,	14,	18 0 *M*
η Aquilæ	19 46·8	0 43 N.	,,	17,	18 0 *M*
S Sagittæ	19 50·9	16 20 N.	,,	11,	19 0 *M*
R Sagittæ	20 9·0	16 23 N.	,,	15,	*m*
U Capricorni ...	20 41·9	15 12 S.	,,	15,	*M*
Y Cygni	20 47·6	34 14 N.	,,	13,	3 0 *m*
			,,	16,	3 0 *m*
δ Cephei	22 25·0	57 51 N.	,,	12,	19 0 *m*

M signifies maximum ; *m* minimum.

Nov.	h.	
13	13	Venus at greatest distance from the Sun.
17	4	Mercury at greatest elongation from the Sun 19° east.

Meteor-Showers.

The principal periodic shower of the week is that of the *Leonids*, max. November 14, radiant R.A. 149°, Decl. 22° N. ; but no great display is to be expected this year or for several years to come. Other showers are as follows :—

	R.A.	Decl.	
From Lynx	125	40 N.	Swift ; streaks.
Near ξ Ursæ Majoris ...	165	30 N.	,, ,,

GEOGRAPHICAL NOTES.

THE great Constantine Medal was awarded this year by the Russian Geographical Society to Prof. Romanovsky for his geological work in Russian Turkestan. For more than five years the learned Professor explored various parts of Turkestan, and thus laid the first foundations for the geological knowledge of this region. His first work, "Materials for the Geology of Turkestan," was published in 1876, and it contained the description of eighty-eight species of fossil animals (of which thirty-four were new species) and fourteen species of plants belonging to the Carboniferous, Triassic, Jurassic, and Chalk deposits of Turkestan ; the Silurian and Devonian deposits of the region being so greatly metamorphosed as to have most of their fossils destroyed. This first work was soon followed by papers contributed to the *Verhandlungen* of the St. Petersburg Mineralogical Society, in which papers Prof. Romanovsky described the fossils of the Ferghana deposits (Upper Chalk, characterized by their richness in *Ostreæ*, some of which belong to new genera), and the Sarvadan brown-coals, which contain the new lizard *Brontozoum tianschanicum*, and are of the same age as the Connecticut Trias Sandstone. The second part of the "Materials for the Geology of Turkestan," published by Prof. Romanovsky, contains the description of all the palæontological collections gathered in Turkestan by MM. Mushketoff, Syevertsoff, Barbot-de-Marny, and Okladnykh ; and no less than 144 species of fossils (of which forty-nine are new) have been described in this second instalment of the "Materials." It was precisely the palæontological work of Prof. Romanovsky which enabled M. Mushketoff to arrive at the remarkable general conclusions as to the great features of the geology of Turkestan, which are embodied in his capital work, "Turkestan," and which rendered it possible for both geologists to draw up the geological map which illustrates it.

AT the same sitting the great medal of Count Lütke was awarded to Th. P. Köppen for his work in botanical and zoological geography. His work on the distribution of Conifers in Russia, published in 1885, is an exhaustive inquiry into the subject, and his numerous monographs on the distribution of insects in Russia, as well as of the squirrel and the stag, as also his monographs about the Siberian cedar, the Scotch fir, the larch, the *Juniperus*, and so on, are most valuable contributions to the botanical and zoological geography of Russia ; while his last work on the birth-places of the Indo-Europeans and the Finns and Ugrians (published in the Russian Journal of the Ministry of Public Education for 1886), although made in a new direction, is an important contribution to this much debated subject. Large gold medals were awarded to Prof. M. M. Kovalevsky for his "Modern Customs and Old Law : the Customary Law of the Ossetes" ; to Prof. Vs. Th. Miller for his "Ossetian Studies" ; and to M. Pirogoff for a statistical work about Kostroma. A small gold medal was awarded to L. P. Zagursky, to whom the ethnography of the Caucasus is indebted for so many valuable works, and all ethnographers will be grateful for his endeavours to save from oblivion and to continue the works of Baron Uslar, which undoubtedly are the most serious researches ever made into the study of Caucasian languages. Gold medals were also awarded to A. S. Vilkitzky for his determinations of the length of pendulum on Novaya Zemlya and at Archangelsk ; to N. Y. Dinnik for explorations in Northern Caucasia ; and to D. Bulgakovsky for a manuscript work on the inhabitants of the Pinsk marshy tracts. Nineteen silver medals were awarded for various geographical works of less importance.

ON THE ORIGIN AND THE CAUSATION OF VITAL MOVEMENT.[1]

II.

To this end permit me to go a little into detail concerning nerves.

Nerves are processes of nerve-cells composed of fibrils of immeasurable fineness, which, in the so-called axis cylinder of the medullated nerves, are united by a stroma inside a very fine membrane called the axolemma. In proportion to the microscopic dimensions of the ganglion cells, of which the separate nerve-fibres form a part, these latter are for the most part enormously long, many as long as our arms and legs, and that is one of the reasons why the perception of the unicellular nature of the nerves made way but slowly. In fact, it was not easy to accustom oneself amid the microscopic swarm of cells, to find single ones so grown in length that they could be wound about us like a cocoon thread. As it is the task and function of the motor nerves to lead towards the periphery the impulses sent out by their ganglion cells in the spinal cord, their activity always admits of ready perception through the muscular twitching. Even when the nerve is divided and artificially excited at the peripheral end, the muscles betray it. On the other hand, no visible physiological reaction is found at the central origin of the motor fibre when stimulated at the periphery, so that at first we were quite in darkness as to whether in general it conducted centripetally. Nature, however, has presented us with a contrivance by which we are enabled to demonstrate the possibility of such an inverted or centripetal nerve-conduction. The contrivance consists in the branching division of nerve-fibres, so

FIG. 3.

FIG. 4.

frequently found in muscles, as will at once be seen in a preparation from a frog (Fig. 3). In many muscles these branchings are so arranged that we can use them for an experiment as simple as it is conclusive of nerve-conduction in both directions.

In the *gracilis* muscle of the frog the nervation is fashioned in the manner displayed schematically upon this diagram (Fig. 4), and in more detail on the following (Fig. 5). In reality the arrangement is like this. Now, if I cut up the muscle according to this diagram (Fig. 6), we get at the tip, *z*, nerve-fibres, which are connected with the muscle-fibres at *o* and *u* only by the branchings at the points *x x*, but which in life served only for the parts of the muscle removed at *f* and *f'*.

An experiment[2] will now convince you that nerves severed from their own muscle-fibres act quite well backwards upon those placed centripetally to them, which they can only do if nerves can also conduct centripetally, and so long as a path is preserved for this through the branchings. If we cut out the neighbourhood of the branchings, it is all over with the reaction of the muscle.

[1] "On the Origin and the Causation of Vital Movement (*Ueber die Entstehung der vitalen Bewegung*)," being the Croonian Lecture delivered in the Theatre of the Royal Institution on May 28, 1888, by Dr. W. Kühne, Professor of Physiology in the University of Heidelberg. Continued from vol. xxxviii. p. 629.

[2] Kühne, "Ueber das doppelsinnige Leitungsvermögen der Nerven." *Zeitschr. f. Biol.*, vol. xxii. p. 305. To demonstrate the experiment on the *gracilis*, the muscle was fixed on a white piece of cork by needles, and held by elastic holders, and its image thrown on the wall highly magnified by the so-called Krüss lantern.

We can make another experiment on the same muscle.[1] We see that when we excite the lower tip of the muscle, only the lower portion twitches and not the upper. The two portions are in fact connected only by means of a very short tendon, the so-called *inscription*, which passes completely through the muscle (*i i* in Fig. 5), so that it really consists of two muscles. If the nerve common to both is stimulated at any point, then both parts of the muscle contract, but if the muscle substance itself is stimulated, then the contraction travels no further from the place where the stimulus was applied than to the limits of continuity of the muscle-fibres.

The power of motor nerves to conduct in both directions is certainly of general significance in regard to the inner mechanism of nerves, but we have only approached it here, because it was necessary for the decisive proof of muscular irritability, as obtained in our last experiment with the *m. gracilis*. Whenever a muscle is provided with a nervation and branchings of the separate nerve-fibres like that of the *gracilis*, some group of muscle-fibres can serve to indicate whether a stimulus has affected this alone or the nerves lying in it as well. If nerves are present at the point of stimulation, and if the agent was at the same time a nerve stimulus, this is shown by the simultaneous contraction of distant parts which are accessible by means of the nerve's power of conducting in both directions. In cases where we can see the coarser nervation, the indirectly produced contractions can be predicted, and these form so certain a criterion of neuro-muscular excitations that by them the presence of the finest nerves may be proved, whose existence might otherwise be quite incapable of proof by any other means, as, for instance, by the use of the microscope. If these contractions are wanting,

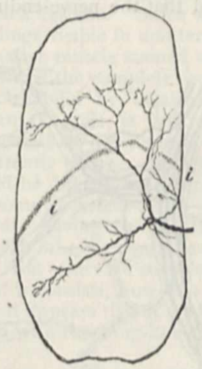

FIG. 5.

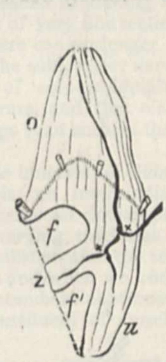

FIG. 6.

was the case in our experiments with the lower end of the muscle, we know that either the spot stimulated is free from nerves, or that the stimulus employed was ineffectual as to the nerves, and affected the muscle substance exclusively. In both cases, then, independent irritability is proved for those muscle-fibres which were directly excited and contracted.

Now, since we have just employed an electric stimulus which is equally effectual on muscle and nerve, it follows that we had to do with the first case; that is to say, the muscle showed itself free from nerve at its end. We have reason for specially bringing forward this experimental proof of the absence of any kind of nerves in large tracts of muscle, because it compels those who in spite of all assume the presence of nervous matter in certain microscopic disks and striæ of the muscle-fibre as a whole, to deny that this supposed nervous element possesses any power of conducting in both directions or any irritability at all; for in fact it is not possible to excite the motor nerve of a muscle-fibre by any stimulus whatever applied to the actual terminations of the nerve within the fibre. The facts besides combine to prove, as need hardly be said, yet another proposition—they prove at the same time that pure muscular excitation does not travel back to the nerves.

This may be shown still better with the small pectoral muscles of the frog's skin than with the *m. gracilis*. We need only dissect it in the manner shown in the drawing (Fig. 7), and stimu-

[1] Kühne, *ibid.*, pp. 312, 324.

late the spots *n* and M: if we stimulate *n*, everything contracts; if M, the excited half only.

The preparation which you now see (corresponding to Fig. 2), and which shows the nervation of the very thin muscle with all the nerve-endings stained dark with gold, makes that relation clear, for here again in truth the result of morphological research is in gratifying accordance with results obtained experimentally. The muscle is seen to be for the most part free from nerves; indeed the entire nervation with all the nerve-endings might be

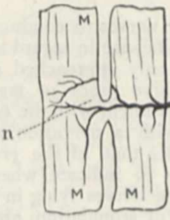

FIG. 7.

said to be formed of one nerve-*line* only, if we disregard the few digressing fibres, which, again, in part are not motor.

Under rather higher powers we see the nerve-endings proper (Fig. 8), the distinct demonstration of which by means of the gold method has now been achieved, in much the same way as here, in all the classes of vertebrates with the exception of the osseous fishes. In all cases these decisive preparations have proved that the vastly preponderant number of the muscle-fibres is entirely free of nerves, and that the nerve-endings are

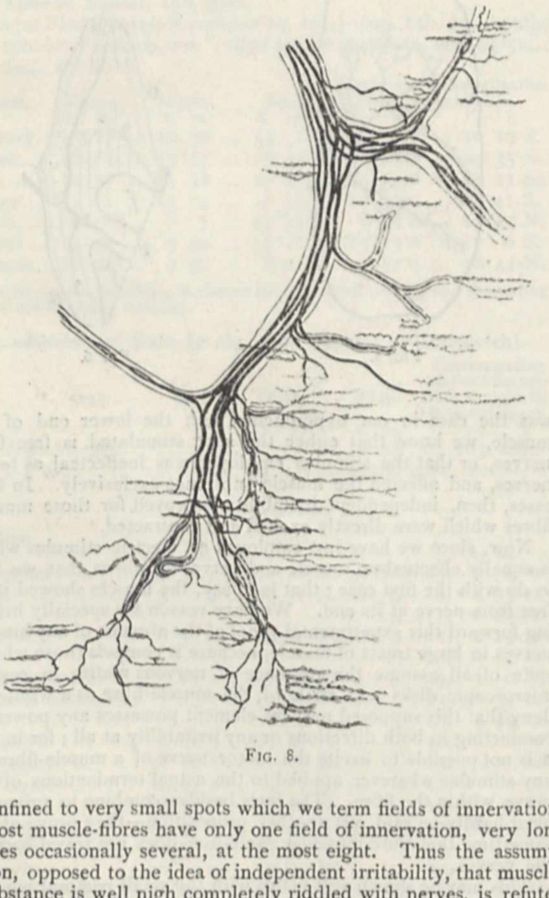

FIG. 8.

confined to very small spots which we term fields of innervation. Most muscle-fibres have only one field of innervation, very long ones occasionally several, at the most eight. Thus the assumption, opposed to the idea of independent irritability, that muscle-substance is well nigh completely riddled with nerves, is refuted and rejected from the morphological side also.

From the absence of nerves in long tracts of muscle-fibre we immediately conclude that the latter shares with nerves the faculty of independently propagating its own excitation. This is what the beautiful microscopic observations of Sir William Bowman[1] on insects' muscles long since led us to suspect. As in the nerve, so in the muscle, conduction takes place in every direction, and as the field of innervation almost without exception occupies a median position during a normal contraction, the conduction takes place in both directions, towards the tendinous ends. By way of distinction the velocity of conduction is, according to species, temperature, &c., three to ten times less than von Helmholtz fixed it for nerve. As conduction in irritable tissues means nothing else than that one excited spot becomes the stimulus for the adjoining portion at rest, the independent irritability of the muscle-fibre comes into employment in every movement and during the entire duration of life; from the moment that the field of innervation becomes active all the muscle substance remains left to itself, and until the contraction is ended must be regarded as independent and acting in response to its own direct excitation.

Once clear on the fundamental question, and sure as to the method we have to employ in order to stimulate according to choice either muscle- or nerve-substance alone, or both together, we may seek to determine in what respect the irritability of the two components of the motor machine differs. The differences as regards chemical stimulation appear very great; in respect of electric, thermic, and mechanical, on the other hand, only quantitative. However, under chemical stimulation, according to Hering's classical researches,[2] a point formerly overlooked comes into consideration—namely, the complication introduced by the electromotive behaviour of the tissue, an automatic electrical stimulation one might say. When stimulation takes place by moistening the transverse section with conducting liquids, it is indeed difficult, if not impossible, to trace the chemical factor in presence of the electrical. Gaseous stimuli alone, like ammonia, have thus far remained free from the suspicion of acting electrically. To these a few others of similar action, such as bisulphide of carbon,[3] have been added, and such as are conveyed to the muscle by blood-vessels, and bathe the fibres from all sides. With these in particular we may class distilled water, which is excessively destructive to irritable substances, von Wittich[4] being the first who showed how strongly it stimulates muscles, while killing nerves without excitation. But, again, with this kind of stimuli, we cannot at present tell whether they do not set up in the tissues, over narrow but numerous areas, excitatory electric currents, thus working only indirectly by way of auto-electric stimulation. And since, finally, the same might apply to the thermic and mechanical actions which likewise arouse demarcation currents in the muscle—that is, to all stimuli—we find ourselves in the presence of the possibility of reducing all irritability to a reaction to electrical processes, and of seeing vital electricity elevated into immeasurable importance.

The means by which muscle may be stimulated interests us, in the first place, on this account—to ascertain, once for all, how it procures its excitation *in life*, or what may be the action of nerve upon it. Did we know that, we should have grasped at the same time the nature of nervous activity.

Nerves end blindly in the muscles; as a rule they are not even finely pointed, and still less do they spread out diffusely in such a way as might make the true ending difficult to find. They end quite distinctly. But the ends always lie beneath the sarcolemma, in such a way that no foreign tissue intrudes between them and the muscle, so that what is fluid in the muscle can directly moisten the nerve. The sublemmar nerve is clothed with nothing else than the axilemma. The nerve never penetrates into the depths of the muscle-substance; on the contrary, it remains confined to the sublemmar surface of the contractile cylinder or prism. Each nerve-end consists of several branches, like antlers, arising by division, which together

[1] "On the Minute Structure and Movements of Voluntary Muscle," Phil. Trans., 1840, p. 457; and "Muscle—Muscular Motion," in the "Cyclopædia of Anatomy and Physiology," edited by B. B. Todd, vol. iii. 1847, pp. 506–530.

[2] "Ueber direkte Muskelreizung durch den Muskelstrom," Vienna, *Sitzber. k. Akad.*, vol. lxxix., Abth. 3, 1879.

[3] "Ueber chemische Reizungen; nach Versuchen von. stud med. C. Iani." *Untersuch. aus der Physiol. Instit. der Univ. Heidelberg*, vol. iv. 1882, p. 266.

[4] "Experimenta quaedam ad Halleri doctrinam de musculorum irritabilitate probandam instituta," Königsberg, 1857; and *Virchow Archiv*, vol. xiii. 1858, p. 421. In these papers, with the discovery of the excitation of muscle by distilled water, appears without doubt the first fact which overthrew the old theory of the equal irritability of muscle and nerve.

form the terminal nerve-branch. Apart from the form of the antlers, this short description is exhaustive for many animals, since neither in the sublemmar nerve need any special additional structures occur, such as nuclei, nor any kind of modification of the muscle-substance in the field of innervation. There is much to indicate that the nerve-fibre proper, or axis-cylinder, does not change its constitution in passing through the sarcolemma, still it is to be remarked that the twigs of the terminal branches, although as long as they live often apparently longitudinally striated, have not yet, even in the most favourable stainings, been found to present the general fibrillar structure of nerves.

According to these results of morphological research, it appears that contact of the muscle-substance with the non-medullated nerve suffices to allow the transfer of the excitation from the latter to the former. The only strange thing is that in reversed order excitation of the muscle never extends to its own nerve. This is still stranger because, according to Matteucci's well-known discovery, a *foreign* medullated nerve simply laid upon the muscle is powerfully excited by the contraction—so powerfully that the smallest contracting muscle barely touching it in more than a mere point excites the strongest nerve, while, on the other hand, we never see muscles excited by nerves which are merely pressed against them.

In the investments, then, of the nerve and the muscle-substance appears to exist one of the elements which admits the neuromuscular excitation *exclusively* to the field of innervation, and among those investments it need not be the medullary sheath. The delicate membranes of the sarcolemma and neurilemma suffice, for muscle cannot be excited by superimposed *non*-medullated nerves. At any rate, I have tried in vain to excite muscles by the most intimate contact of the fine terminal ramification of the optic nerve in the retina or the *n. olfactorius* from the pike, or even the delicate nerves of Anodonta, by stimulating these non-medullated nerves.

If we imagine the activity of the nerve to start with a chemical process, and that a chemical stimulant, as du Bois-Reymond[1] once suggested, is, at the same time, secreted in contact with the muscle, we understand very well the necessity of direct contact, and in this case it would suffice if the sublemmar nerve were to run in *any* form for a short distance under the sarcolemma. The branching then would mean the enlarging of the contact. But however rich and intricate the ramifications may be, we can by no means say they display throughout the principle of increase of superficies; on the contrary, they are often astonishingly poor and small. As concerns their form, they are *not* irregular, but so strikingly uniform that this point deserves particular attention as being apparently indispensable for innervation.

Instead of describing the forms, allow me to show you the object itself in a selection taken from the most diverse vertebrates. First from the Amphibia (Fig. 9): rod-like branchings with long outstretched twigs, a form which crops up again in a remarkable way in many birds. The rule here is asymmetry of the divisions: all the twigs have the form of a bayonet.

The following preparation shows the termination in the dog (Fig. 10). Here the branches are crooked, and hence quite divergent, so that the points of agreement with the form of the Amphibia are at first overlooked. But if we examine the divisions, you will remark that these are again unsymmetrical and give off branches whose ends lie very diversely removed from the common place of origin. The ends are, as a rule, turned towards each other, and often so approximated that it is at times troublesome to find the gaps between them, and if they do not lie in the same plane they appear to be united into a ring. In other cases one end overlaps the other, but we then find that all the points of the branches which are turned towards each other lie at unequal distances from the nearest bifurcation. This law holds good in all the thousand cases of motor endings thus far observed, and shows a strict order in the apparent chaos of these structures. And yet among the organic forms there is scarcely one which varies so much in other respects, and often is so inextricably complicated as this.

The drawings (Fig. 11, from the muscles of the guinea-pig, and Fig. 12, of the rat) and a preparation from a lizard (Fig. 13) may serve as a voucher for the truth of the above statement. We see there everywhere the hooks making their appearance with a short and a long claw, like the swivel we hang our watch on in the pocket.

[1] "Gesammelte Abhandlungen zur allgemeinen Muskel und Nervenphysiologie," vol. ii., p. 700.

The voluntary muscles of all vertebrates and of many invertebrates consist of fibres, the contents of which are pefectly regularly disposed in layers and transversely striped. For shortness, this striped mass may be called "rhabdia." This it is which has been universally identified with the contractile substance. But it has been ascertained that in many cases the nerve-ending does not come at all into direct contact with the rhabdia, but with another mass, which is highly nucleated and of pap-like softness. This latter is unstriped, and has all the appearance of protoplasm. It occurs in very varying quantity under the nerve-antler; in Amphibia, where the sublemmar nerves run out in a long course, it is not apparent as a separate layer, but it occurs more abundantly in the same measure that the branchings retract, and the field of innervation becomes smaller. At first it is found chiefly between the twigs, in the intervals of the branching, and then in the form of a sole, which, among the much-contorted branchings of reptiles and mammals,

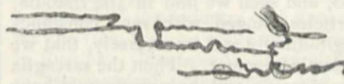

Fig. 9.

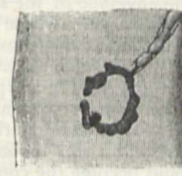

Fig. 10.

grows thicker, till it sometimes in some nerve-eminences forms quite a thick cushion. Since we have succeeded in making the nerve-endings visible in uninterrupted series of very fine sections of mammalian muscle stained with gold, there can no longer be any doubt that the complete separation of the sublemmar nerves from the rhabdia by measurable layers of sole-protoplasm, though not the rule, is yet by no means rare, and that many muscles possess no other sort of nerve-endings than such as these with apparently indirect contact.[1]

It would be difficult to understand why the innervation should have in some muscles, as in the Amphibia, no intermediate layer, while having in the majority of cases an interrupted layer, and in others a continuous layer of varying thickness to traverse. But when we consider what the substance of the sole is, of what it consists, how it is distributed, and when we know its origin, it appears that it is identical and stands in continuous connection with the long-known second constituent of muscle-

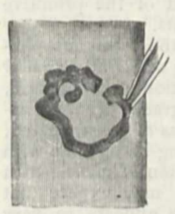

Fig. 11.

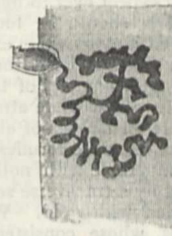

Fig. 12.

Fig. 13.

fibres, of which, as well as of the rhabdia, the fibres are composed. It is that substance, considered by Max Schultze to be the protoplasmic remnant of the cells composing muscle, which occurs in greatest amount around the nuclei of muscle, and extends in long threads throughout the entire muscle-fibre. So many transverse connections occur on the very numerous stronger and finer nucleated threads that the whole mass, called sarcoglia, becomes a trellis-work almost of the same fineness as the better-known transverse striation of the rhabdia, and everywhere surrounds and interpenetrates the latter. This minute internal structure of muscle has only become at all well known since the introduction of gold staining, thanks especially to Messrs. Retzius and Rollett.[2] Had it been suspected earlier, and had we appre-

[1] Kühne, *Verhandlungen des Naturhist.-medicinischen Vereins zu Heidelberg*, Neue Folge, vol. iv. pp. 4, 5.

[2] G. Retzius, "Biologische Untersuchungen," 1881. A. Rollett, "Untersuchungen über das Bau der quergestreiften Muskelfaser," *Wien. Akad. Denkschr.*, vol. xlix., 1885.

ciated the volume of the sarcoglia, whose existence is thereby shown, and which rivals that of the rhabdia, we might have studied this component of muscle in its physiological relations to contractility, as well as in its morphological and genetic relations, which are the only ones yet known.

If now, in many cases, it appears that the nerve comes in contact only with the surface of a thick layer of sarcoglia, while the rhabdia everywhere is covered by very fine layers of the latter, whose absolute absence in the field of innervation can nowhere be demonstrated, we have to conclude that in general the nerve does not act directly upon the rhabdia, but only on the sarcoglia. This at once gives the latter a physiological interest. We have to ask whether the glia is the medium that conducts the stimulus between nerve and rhabdia, or whether it is itself the contractile element, while the rhabdia has a signification other than that formerly attributed to it when we were completely ignorant of the glia.

All contractile substance requires the co-operation of an elastic element. Where is this to be found in the muscle-fibre? The envelope of the sarcolemma, which is certainly elastic, but delicate, and whose mass is almost infinitesimal compared with that of the muscle-fibre, cannot satisfy the requirement; but more solid structures freely distributed in the paste-like sarcoglia could perhaps do so, and such we find in the rhabdia, in the form of prismatic particles, ranged with such constancy and with such regularity longitudinally and transversely, that we may hold them to be the elastic element. Then the sarcoglia would become the contractile element, and the nerve would have an easier task.

I could wish that this view might be accepted as an hypothesis. As far as I can see, it does not contradict experience, for it only puts back the muscle nearer to the protoplasm and to all that is contractile, and so far coincides with experience that we find muscles in the same measure less elastic and more sluggish in protoplasmic movement the richer they are in sarcoglia, as in the case of the red muscles, nucleated and rich in glia, which contract more slowly but with greater power than the white muscles, poorer in glia, which are quick and spring-like, and also the sluggish embryo muscles, in which glia predominates because as yet but little protoplasm has been converted into rhabdia; and further the cells of unstriped muscle-fibre, which are wanting in the regular transverse striation, and contain, as it appears, besides more abundant glia, an elastic material of special form and arrangement.

The hypothesis would be overthrown if contractile fibrils were found in which no sarcoglia was to be detected. But even in the finest fibrils of *Stentor*, the structure of which Bütschli [1] has recently elucidated, we must hold the significance of punctated transversely penetrating indentations to be protoplasmic, and we can therefore scarcely expect ever to find a contractile thread in which nothing whatever should be found of the primitive contractile material such as it everywhere exists.

Of late, this view [2] has been defended from the purely morphological side,[3] on the strength, namely, of the very fine reticular structure of protoplasm to which more attention is being paid, and which is demonstrable on objects of all grades of organization. Protoplasm, in fact, is not so formless as at first appeared, but shows a structure comparable with nothing better than with the appearance presented by a transverse section of muscle with its glia framework stained with gold. We may expect that these reticular structures, whose consistency appears to vary extraordinarily, will some day lead to the establishment of a fruitful hypothesis of the inner mechanism of protoplasmic movement, in place of that held hitherto, which affords no glimpse into the essence of vital mechanical work.

Compared with this larger problem, that of the causation of vital movement appears the more accessible of the two, the latter being considered as a physiological inquiry after the constitution of the normal stimulus by which work is done. Perhaps, indeed, the answer is to be looked for from the most perfected organization of muscle, where the iniatory process is localized by a distinct nerve-ending, rather than from the primitive organization, where the excitation may set in at any place, and lies in the protoplasm itself. We know distinctly that the muscle-wave begins in the field of innervation, for we have long seen the natural contraction in the interior of transparent insect larvæ starting from the nerve-eminences. We know this also from the experiments of Aeby, who followed the muscle-wave myographically from the nerve-line onward, and now we are able to display the beginnings of the contraction as local thickenings at the point of attachment of the nerves caught and fixed by sudden hardening. Since the nerve grasps the muscle in a restricted region, it expends its action upon this exclusively; that which follows on as muscular activity is the nerve's work no longer.

Galvani and his successors for more than a century suspected that nervous forces were electrical, and, in reality, the celebrated champion of electro-physiology in our day has been able with the galvanometer to render the excitation of nerves, unattached to muscles or ganglion-cells, evident as the negative variation of the natural nerve-current, to cause movement of a magnetic needle instead of a muscle, or to put the needle in the place of sensation. After this no consideration of the nature of nervous activity is conceivable which does not take into consideration this discovery of du Bois-Reymond's—least of all where the nerve has to excite something with which it is not fused, like muscle, but which it only touches, and that not directly, while still invested by the axolemma. Only during excitation, as Ludimar Hermann has taught us, are electric currents issuing from the nerve through its conducting surroundings, in which the course of these currents of action is to be estimated from the duration of the negativity of the nerve-tract excited, and from the speed of propagation of the nerve-wave, if we know the conductor and the disposition of the nerve. The motor ending fixes the latter, and so peculiarly that we can only presuppose from it a furthering of the excitor effects of the currents of action.

The currents of action of muscle, whose electromotive behaviour agrees so wonderfully with that of nerve, have long been proved to produce excitor effects, although only powerful enough to act upon nerves; but there are also, under certain conditions discovered by Hering, such effects from nerve to nerve.[1] Is the possibility, we may hence ask, to be excluded, of one muscle exciting another, and is it quite impossible that a nerve only throws a muscle into contraction by means of its currents of action?

The first question we can answer. I will do so by a simple experiment. Two muscles, the nerves of which are disposed of by poisoning with curare, need only to be pressed together transversely over a narrow area to make a single muscle of them of double length, in which the stimulation and contraction are propagated from one end to the other. Since the transference from one muscle to the other is done away with as soon as we bring the finest gutta-percha between the muscles as an insulator, or gold-leaf as a secondary circuit, the first muscle must have excited the second electrically.[2]

1 "Dr. H. G. Bronn's Classen und Ordnungen des Thierreiches," neu bearbeitet von O. Bütschli, Leipzig und Heidelberg, 1888, vol. i. p. 1298.

2 Kühne, "Neue Untersuchungen über motorische Nervenendigung," *Zeitschr. Biol.*, vol. xxiii. pp. 88-95.

3 A. van Gehuchten, "Étude sur la structure intime de la cellule musculaire striée," *La Cellule*, vol. ii. p. 289.

1 *Sitzber. der k. Akad. zu Wien*, vol. lxxxv. Abth. 3, 1882, p. 237.

2 Kühne, "Secundäre Erregung vom Muskel zum Muskel," *Zeitschr. Biol.*, vol. xxiv. p. 383.

THE ASTRONOMICAL OBSERVATORY OF PEKIN.

IN the course of a lecture delivered before the Pekin Literary Society, on the Astronomical Observatory of the Chinese capital, Prof. Russell said that it is the oldest in the world. The oldest in Europe is that of Denmark, founded in 1576 by Frederick III., at which Tycho Brahé made his famous observations. The Royal Observatory at Paris was not opened till 1671, and that of Greenwich three years later. The Pekin Observatory was established in 1279, in the reign of Kublai Khan, the first emperor of the Mongol dynasty, and three of the original instruments yet remain. In 1378, these instruments were probably used in observing Halley's comet, and they will be used twenty-two years hence to witness its next return. If the visitor enters by a door in the south wall of the Observatory, he comes into a court running east and west. In this court are kept the three original instruments. There were four at one time, but the fourth, a celestial globe, has disappeared. Kuo Shouching, a Chinese astronomer, who flourished in the reign of Kublai Khan, was the maker of these. Before their construction, bronze astronomical instruments, which were made about the year 1050, were used, first at K'ai Fêng Fu, the capital of Honan, whence they were removed to Pekin. Kuo Shouching found these worn out by age, and otherwise unsuitable, as the height of the Pole differed by 4°; and so he constructed four instruments, of which three now remain. In the east end of the court is the equatorial armillary, which is made of bronze, and consists of (1) a massive horizontal circle, held up at four corners by four dragons, each of which with one upraised palm supports the bronze circle, while round the other palm a chain is passed and fastened behind to a small bronze pillar,—the dragons are themselves works of art; (2) a double vertical circle firmly connected with the horizontal circle at its north and south points, and supported at its lowest point by a bronze pillar. On the vertical circle, which, like the other, is fixed, at a distance equal to the latitude of Pekin, that is 40°, are two pivots corresponding to the North and South Poles. Revolving round these pivots are two circles, one double, corresponding to the solstitial colure—that is, the great circle passing through the Poles and the solstices; the other single, corresponding to the equinoctial solure—that is, the great circle through the Poles and the equinoxes. Half-way between the Poles is another circle, which corresponds to the equator, the rim of which is let into the two colure circles. There is also another circle, making with the latter an angle of 23½°, and corresponding to the ecliptic. Finally, inside these circles, all of which revolve together round the polar axis, there is another double circle, representing the polar circle or declination, and between the rims of this double circle revolves the hollow tube through which observations were made. It is probable that there were originally threads across the tube to define the line of sight. There are in the circles 365¼°—that is, a degree for each day in the year—and each degree is subdivided into divisions of 10′ each. When using this instrument the observer turned round the inner circle till the heavenly body was sighted in the centre of the tube, and then the distance of the star was read from the Pole on the polar circle, and its position on the equator by the equatorial circle. The complex construction was in some particulars of no use whatever: the ecliptic and one of the colures were useless. At the west end of the court are the other two instruments, the equatorial, or astrolabe, and the altitude and azimuth instrument. The former is remarkably simple in its construction. There is a fixed bronze circle placed parallel to the equator, and there is another double circle perpendicular to it, which moves round an axis passing through the centre of and perpendicular to the equatorial circle. Of course there is also the hollow tube for observation. This instrument is free from the clumsiness and complexity of the first-named instrument, and in the form of its mounting much more closely resembles those in use at present in all Observatories than the other instruments. The altitude and azimuth instrument consists of two circles, one horizontal and fixed, the other vertical and movable round an axis passing through the centre of the horizontal circle, and was used to observe the altitudes of the heavenly bodies and their distances from the north and south points. It is curious to observe that all these instruments are exactly similar to those constructed by Tycho Brahé, the great Danish astronomer, who was the first European to make astronomical instruments of metal. And thus we see that the Chinese anticipated European astronomers by at least three centuries, and that the former had at that very early date attained great proficiency both in the science of astronomy and the art of metal-carving. Verbiest, the Jesuit father, says that these instruments had, at the beginning of the present dynasty, fallen into disrepair. The truth was that they were far too clumsy, and were so heavy that it took several men to move them; and in some positions, from the profuseness of ornament, the stars could not be observed at all. Besides they had got out of position, and there were no appliances for righting them. It is more than probable that during the latter part of the Ming dynasty astronomy had been neglected, and so the old instruments fell into disuse. In the year 1670, so bad were the old instruments, that Verbiest was ordered to make six new instruments. It appears that when the high Ministers of State were ordered to go to the Observatory, and make certain observations, the calculations of Verbiest were verified as correct, while those of Wu Ming Hsuen, the Chinese astronomer, were proved to be wrong. And so Verbiest was intrusted with the calculation of the calendar and the construction of these instruments, which were of the same general character as the old instruments, but much more accurate, and more easily adjustable. The circles are divided into 360°, and each degree into six parts of 10′ each. By means of the diagonal scale and a movable divided scale, the observer could, on the new instruments of Verbiest, read to 15″, instead of 10′ as in the old instruments. Since the time of Verbiest two more instruments have been added—namely, an altitude and azimuth instrument, in the fifty-fourth year of Kang Hsi (1715), the other an equatorial armillary in the ninth year of Khien-Lung (1745). The former is said to have been a present from Louis XIV. to the emperor, but by some it is attributed to a German Jesuit, named in Chinese Kilian, and is remarkable for the total absence of ornamentation, and for the degrees being marked in foreign numerals. One of the most curious objects in the Observatory is the Qw'ei Ying T'ang, a three-roomed building lying a few yards to the south of the steps. It is evidently very old. In it is a stone slab 16 feet 2 inches long and 2 feet 7 inches broad, with a groove on both sides, and raised about 3 feet above the ground. At the south end of the slab is a brass pillar, which was formerly 8 feet high, but to which the present dynasty have added 2 feet more, extending to the roof, and at its summit is a small circular hole $\frac{3}{16}$ inch in diameter. Another brass pillar 3 feet 5 inches high stands at the north end of the slab. At noon the sun shines through the little hole in the roof, and throws an elliptical shadow of the sun on the slab, or on the brass pillar at the north end about the winter solstice. By observing the distance of the sun's image from the foot of the south brass pillar the solstices and equinoxes were determined. For instance, at the summer solstice the distance should be 2 feet 9 inches. The instruments of Verbiest are almost perfect of their kind, and will remain a lasting memorial of the industry and genius of the devoted missionary. At the time that he made them they were growing out of date in Europe. The telescope had already begun to be used largely in astronomical observations, and Verbiest must have known of it. The question arises, How does it happen that the Chinese, who in the thirteenth century were far ahead of Europe in the construction of these instruments, seem to have made no headway since? Many reasons can be given, but the chief one is that with them the main object of making astronomical observations was to regulate the calendar, and to give the time to the people; and for this accurate instruments were not needed, and their want was never felt. The greater problems of the heavens never seriously attracted the attention of the Chinese astronomers. The Astronomical Board consists of eighteen officials, with the fifth prince, an uncle of the emperor, at their head. There are, including students, altogether 196 persons attached to the Board. The privilege of becoming a member of this Board has become hereditary, though it is not of necessity so. The policy, however, pursued by the Board, of keeping secret the book tables of the sun and moon, and everything used in regulating the almanac, tends to encourage the hereditary principle. No one can see them but the relatives of the Board; and so vacancy after vacancy is filled up by members of the same family as the predecessor, and as the office is an honorary, and not a lucrative, one, the people do not grumble at their exclusion. The principal duty of this Board is to prepare the calendar, the most important book published in China. Besides astronomical facts, it gives the lucky and unlucky days, on the latter of which no Chinese will transact the least business. Another duty is to observe eclipses, and this appears to be the only occasion on which the instruments are still used. On every New Year's Eve, at midnight, astronomers from the Board seat themselves in the Observatory, and watch the way in which the wind blows a number of banners which are hung around. As the wind blows, so will the new year be. This year the wind blew from the north-east, the fortunate direction, and therefore it will be a year of long life and plenty.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following were elected Fellows of St. John's College at the annual election on November 5: W. N. Roseveare, B.A. (mathematics), Master at Westminster; E. H. Acton, B.A. (botany and chemistry); F. W. Hill, B.A. (mathematics); T. Darlington, B.A. (philology), University Scholar, London, Head Master of Queen's College, Taunton, author of "The Folk-Speech of South Cheshire"; H. F. Baker, B.A. (mathematics), bracketed Senior Wrangler in 1887.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, October 30.—Anniversary Meeting.—Mr. L. Fletcher, President, in the chair.—The Hon. Secretary, Mr. Scott, read the Annual Report, which showed that the state of finances was not unsatisfactory. The excess of assets over liabilities was £247 6s. 11d., and the expenditure on the Journal during the year had been £79 13s. 9d., being about the average of late years. The elections to the Society during the year had been six, of whom one was an Associate. The Council had to regret the loss by death of one of their Corresponding Members, Prof. vom Rath, of Bonn, of whom an obituary notice by Prof. Lewis appeared in No. 37 of the Journal. Mr. Solomon Birkett, one of the Associates, had also died, having been killed by a railway train near Whitehaven. Three meetings had been held since the last anniversary, two in London, and one in Edinburgh.—The following is the list of officers and Council elected for the coming session:—President: R. H. Scott, F.R.S. Vice-Presidents: Rev. S. Haughton, F.R.S., and Dr. Hugo Müller, F.R.S. Council: Prof. J. W. Judd, F.R.S., Prof. E. Kinch, Prof. W. Ivison Macadam, J. J. H. Teall, Prof. A. H. Church, T. M. Hall, J. Stuart Thomson, Major-General C. A. MacMahon, Dr. C. A. Burghardt, H. A. Miers, R. H. Solly, and Dr. J. M. Thomson. Treasurer: Prof. T. G. Bonney, F.R.S. General Secretary: L. Fletcher. Foreign Secretary: T. Davies. Auditors: B. Kitto and F. W. Rudler.—The President then delivered an address which will be printed in the next number of the Journal.—The following papers were read:—On large porphyritic crystals of feldspar in certain basalts of the Isle of Mull, by T. H. Holland, communicated by Prof. Judd, F.R.S.—Note on the crystalline forms of silicon and carbon, by Prof. Judd, F.R.S.—On the supposed fall of a meteorite stone at Chartres, Eure-et-Loire, in September 1810, by the President.—On percylite from a new locality, by the President.—On various twins of calcite, by H. A. Miers.—A description of a new polarizing microscope, by Allan Dick, communicated by J. J. H. Teall.—Note on Colorado hydrophane, by Prof. A. H. Church, F.R.S.

Paris.

Academy of Sciences, October 29.—M. Janssen in the chair.—On the telluric spectrum at elevated stations, and particularly on the spectrum of oxygen, by M. Janssen. We print elsewhere (see "Our Astronomical Column") a brief account of M. Janssen's conclusions.—Decomposition of the phases of a continuous movement by means of successive photographic images taken on a tape or band of sensitized paper while being unrolled, by M. Marey. In order to complete the researches lately communicated to the Academy, the author here submits a strip of sensitized paper on which a series of images has been fixed at the rate of twenty per second. The process, as now perfected, will allow of successive images being taken of a man or an animal in motion, without the necessity of operating before a dark ground.—On the alleged subsidence of the ground in the centre of France, between Lille and Marseilles, by General Alexis de Tillo. The author traverses the conclusions arrived at by M. Goulier in his communication on this subject inserted in the *Comptes rendus* of August 20, 1888.—Survey of the Upper Javary, by Admiral de Teffé. A short account is given of the expedition undertaken in 1874 by Baron de Teffé and Don Guillermo Black, to determine the frontier between Brazil and Peru, where those States are conterminous in the valley of the Javary, a headstream of the Amazons.—On vapour-tensions, by M. Ch. Antoine. Some new relations between tensions and temperatures are worked out theoretically.—Photography applied to the study of electric discharges, by M. E. L. Trouvelot. During a series of experiments carried out for the purpose of studying the electric spark, the author has been led to repeat the interesting researches made in 1884 by M. E. Ducretet, and published in the *Comptes rendus* for December 1 of that year.—On the separation of cobalt and nickel, by M. Baubigny. Here the separation is effected by the method of the nitrites.—On the chlorureted derivatives of acetylacetic ether, by M. Genvresse. The monochlorureted derivative of this ether was prepared by M. Allihn, and the bichlorureted by M. Conrad. But doubts having been thrown on the formulas determined by them, the author here resumes the study of these compounds.—On the employment of the bichloride of mercury as a therapeutic remedy and a prophylactic against Asiatic cholera, by M. A. Yvert. During his recent residence in Tonquin, the author successfully employed this preparation for the cure of cholera in doses varying from 0·02 to 0·04 gr. in twenty-four hours. Of forty-five patients so treated nine only succumbed, or about 20 per 100, the normal rate in that region as in Europe being 66 per 100. It was also administered to convalescents in districts where the epidemic had again broken out and had already made one victim. None of those who took this preventive medicine was attacked.—M. Raphael Dubois contributes an account of some new researches on the action of the chloride of ethylene on the cornea; and M. C. J. A. Leroy describes the normal form of the cornea of the human eye.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Colour: C. T. Whitmell (Lewis, Cardiff).—Die Korallenriffe der Sinaihalbinsel: J. Walther (Hirzel, Leipzig).—Table of Quarter-Squares: J. Blater (Trübner).—On the Use of Certain Organic Acids: J. F. Knott (Bale).—Fifty Years Ago in New Zealand: W. Colenso (Napier).—Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou, tome xv. liv. 3, 4, 5 (Moscou).—Alpine Winter in its Medical Aspects, 4th edition: T. Wise (Churchill).—Animal Physiology: W. S. Furneaux (Longmans).—Graphic Pictures of Native Life in Distant Lands: H. Leutemann, translated by G. Philip, jun. (Philip).—The Unknown Horn of Africa: F. L. James (Philip).—A Course of Elementary Mathematics, 2 parts: S. Ray (Lahiri, Calcutta).—The Zoo: Rev. J. G. Wood (S.P.C.K.).—Practical Geometry for Science and Art Students, 10th edition: J. Carroll (Burns and Oates).—Recherches Expérimentales et Théoriques sur les Équilibres Chimiques: H. le Chatelier (Dunod, Paris).—On the Pollination of Phlomis Tuberosa, L., and the Perforation of Flowers: L. H. Pammel (St. Louis).—Specimens of Eozoon canadense and their Geological and other Relations: Sir J. W. Dawson (Montreal).—Observations upon the Morphology of Gallus bankioa of India: R. W. Shufeldt.—Vaccination proved Useless and Dangerous: A. R. Wallace (E. W. Allen).—Himmel und Erde, 1 Jahrg. Heft. 1 (Berlin).—The Auk, October (New York).—Quarterly Journal of Microscopical Science, October (Churchill).—Contributions to our Knowledge of the Meteorology of the Arctic Regions, Part v. (Eyre and Spottiswoode).—Hourly Readings, 1885, Part iv. (Eyre and Spottiswoode).—The Geological Magazine, November (Trübner).—Journal of the Chemical Society, November (Gurney and Jackson).

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