THURSDAY, JANUARY 16, 1896.

EUCLID AND HIS EDITORS.

Euclid's Elements of Geometry. Edited for the Syndics of the Press by H. M. Taylor, M.A. Books I.–VI., XI., XII. Pp. xxii + 658. (Cambridge: at the University Press, 1895.)

THE appearance of a school edition of "Euclid's Elements," published under the auspices of the Cambridge University Press, provokes reflections upon the strange position so long maintained in this country by Robert Simson's authorised version (so to speak) of the work of the Alexandrian geometer. For more than a hundred years the Simsonian text enjoyed an unchallenged supremacy; and not so very long ago any proposal to amend it, or to teach elementary geometry by means of some other book, was regarded as something very like profanity.

It is only in accordance with the nature of things that this professed veneration for Euclid should coexist with a profound ignorance of the real *Elements*, and of the other extant works of their author. To this day the reputation of Euclid is not unlike that of the wizard Virgil in the Middle Ages. Most educated Englishmen are quite unaware of the existence of those books of the Elements which are not read in schools; there is even a legend current in some quarters that they were destroyed in MS. by Euclid's wife! For the only good critical edition of Euclid's works (Heiberg's, in the Teubner Series) we must go to Germany; and it would be interesting to know how many English mathematicians are acquainted with the original text, and how many English scholars have had the curiosity to find out whether "parallel*o*piped" (rhyming with "biped," by the way) is vouched for by the Greek. To crown the absurdity, it is just that book of the Elements which is of greatest permanent value that, by common consent, is never read.

After all, the study of the real Euclid may very fitly remain the privilege of the minority; the really urgent need is that geometry should be taught rationally and effectively in our schools. Happily, we have outlived the glacial period which still prevailed in the early part of this century; and all good authorities are practically agreed upon the main lines of reform. The weight of opinion among experienced teachers seems still to be in favour of retaining at least the framework of the Elements, and of following, generally, Euclid's sequence of propositions. In favour of this course there is something to be said, independently of the base consideration of examination requirements. That there is a certain advantage in a recognised order of propositions will probably be admitted by most of those who have wandered in the chaos of geometrical conics; and with regard to Euclid's methods of proof, it is doubtful whether the various alternatives which have been suggested are really easier for a schoolboy to learn and understand. A beginner is very apt to appeal to his powers of intuition in a quite illegitimate way; and in trying to reproduce a proof which depends upon superposition or symmetry he often loses himself in a haze of words, and fails to give a sound demonstration. Proofs of this kind may very well be included, of course; but should not, we think, take the place of the more formal ones in the text.

Mr. Taylor's book is one of several which, while harmlessly masquerading as "editions" of Euclid, are really excellent treatises on elementary geometry, based upon the lines which Euclid has laid down. Signs of the wholesome reform that has taken place, meet the eye on every page. The antiquated terms, the clumsy repetitions, the tiresome rigmaroles of Simson's text are done away with; notes and explanations are given where necessary; additional propositions are introduced; and there is an abundance of exercises, carefully graduated, and properly distributed throughout the book, instead of being hidden away at the end of it. One of the extraordinary superstitions of former days was that nobody could do a geometrical deduction unless he had previously learnt three books of Euclid by heart; it is to be hoped that this ridiculous theory is at length abandoned. Some boys, of course, can never do a "rider," even the easiest; but those who have any capacity can be started successfully after learning the first five propositions, or even before.

School Euclids may be roughly divided into two classes, according as symbols of abbreviation are used or avoided. While such a notation as AB^2 for "the square on AB" is decidedly objectionable, the use of symbols of *mere* abbreviation is a matter of taste. Personally we detest them, and rejoice that they do not appear in Mr. Taylor's treatise. Brevity has been secured in the proper way, by a careful choice of words, and not by a host of contractions and ugly symbols for "circle," "parallelogram," and so on.

There are several attractive features in Mr. Taylor's book to which attention may be drawn. The selection of additional propositions is very good, and it is needless to say that the proofs given are very elegant. There is a most interesting collection of proofs of Pythagoras's theorem (i. 47); Ptolemy's theorem is proved by means of Book iii.; and Gergonne's construction for the circles touching three given circles, is to be found on p. 458. There are also sections dealing with poles and polars, coaxal circles, projective rows and pencils, Pascal's and Brianchon's theorems for the circle, centres of similitude, and inversion (including an account of Peaucellier's cell); besides this, there is a long supplement to Book xi., which discusses, *inter alia*, properties of tetrahedra and parallelepipeds, spherical geometry, the regular solids, and the elements of perspective. In conclusion, we have the determination of the surface and volume of a sphere. It will be seen from this mere list how liberally Mr. Taylor has interpreted his editorial function, and how many important theories he has contrived to touch upon; at the same time, the book is anything but "stodgy," and cannot fail to interest and stimulate an intelligent reader. There is a good index, and here and there brief historical notes are given.

It is instructive to observe how Mr. Taylor has dealt with Euclid's text. He explains in the preface that he began by translating the first book; he ended by "giving up all idea of simple translation, and retaining merely the substance of the work, following closely Euclid's sequence of propositions in Books i. and ii., at all events." To see what this means, let us take propositions 1–26 in the first book. Besides alterations of minor importance, proofs other than Euclid's are given for propositions 5, 6, 14, 24, and the first part of 26; and two additional propositions (10 A, 10 B) are introduced for the purpose of proving that all right angles are equal. It may be thought by some critics that it is injudicious to have discarded altogether so many of Euclid's demonstrations; but, in any case, additional evidence is given of the impossibility of returning to the text of the Elements pure and simple. That the idea of doing so should have, apparently, presented itself to the mind of an accomplished geometer like Mr. Taylor, is very remarkable.

The great merits of Mr. Taylor's work are sure to meet with general appreciation. Experience alone can show whether it approaches more nearly than any of its numerous predecessors the ideal of a school text-book. The reasons why one book turns out to be a good one for teaching purposes, and another not, are often difficult to discover; but we should expect the present volume to undergo the ordeal successfully.

So far as we have been able to test it, the book appears to be very accurately printed; some of the figures are not so exactly drawn as they might be, and the lines (except in Book xi.) strike us as being too thin. The occasional use of small letters instead of capitals, to denote points, is also, we think, undesirable. It is so important to preserve young eyes from unnecessary strain, that even minute details of this kind deserve attention. There is, alas! only too much reason to be assured of the editor's sympathy with the spirit of this remark; for, as we learn from an affecting passage in the preface, Mr. Taylor lost his sight while his book was going through the press. To the mathematician, as to his twin-brother, the poet, sight is perhaps the most precious of nature's gifts of sense. Happily in each case the imaginative faculty, which feels the loss of vision so keenly, not seldom supplies its best alleviation; and we sincerely trust that Mr. Taylor is still able to find solace in the pursuit of his favourite science.

In conclusion, we cannot refrain from quoting the extraordinary regulation for the Cambridge Local Examinations, as printed on the fly-leaf of Mr. Taylor's book:—

"Proofs other than Euclid's will be admitted, but Euclid's axioms will be required, and *no proof of any proposition will be accepted which assumes anything not proved in preceding propositions in Euclid.*"

The clause which we have ventured to italicise makes proofs other than Euclid's not only admissible, but necessary; while the retention of the axioms becomes superfluous, except perhaps for sentimental reasons. How the regulation can be complied with is not very clear to the ordinary mind; perhaps a recent "demonstration" of Euclid's fifth postulate (Simson's eleventh axiom) may be the first instalment of a new geometry without assumptions. Or, possibly, the regulation may be intended as an object-lesson, to illustrate the truth of the assertion that Cambridge graduates cannot write plain English, and thus to support the present agitation for imposing some test of composition in the Little-Go?

G. B. M.

RECENT HISTORY OF THE CARBOHYDRATES.

Kurzes Handbuch der Kohlenhydrate. By B. Tollens. Band ii. Pp. xvi + 407. (Breslau: E. Trewendt, 1895.)

THERE is not much apparent analogy between the province of the carbohydrates and the African continent; but viewed as arenas of research, discovery, and appropriation, they present very similar histories. The author of the work before us has accepted the mission of record-keeper in the march of annexation in the first-named and more abstract region, and he must have found his office during the last ten years quite as engrossing as those who provide us with maps of the once dark continent.

The volume is supplementary to that which appeared in 1888 under the same title (Band i.), and deals with events in this extremely interesting field of enterprise, up to last year (May 1895). If it were not for the self-evident fitness of the number 7, we might have pronounced the selection of time for antiquating the earlier volume as somewhat hasteful; but that would have been before acquainting ourselves with the contents of the present vol. ii. Afterwards, we have merely to record our conviction that seven years has become "quite a" period in "chemical time." Of course, this effectual antiquating of vol. i. in no sense lessens its historical value, and it will continue to occupy a not "too top-shelf" in our library of working manuals.

Like its predecessor, the book is substantially a reprint of an article or monograph written for the "Handwörterbuch der Chemie" (Ladenburg). It is necessarily therefore cyclopædic in style, and restricted in its treatment of the subject to the experimental results of investigations, and their immediate bearings upon current developments of chemical theory pure and simple. Seeing that in the compass of 370 pages the author deals with the substance of 1200 original papers, it will be gathered that he has not indulged in much speculative discussion of the problems peculiar to this borderland between chemistry and physiology. He has produced rather a rigid *précis* of positive results, and, backed by his well-deserved reputation for thoroughness and critical exactitude, the book needs no further recommendation to chemical specialists. But the subject appeals to a wider circle of readers, and it may not be out of place to examine the author's work from a somewhat broader point of view.

The lines of classification adopted are, of course, those laid down and developed by Émil Fischer, and expounded by himself in his two monumental dissertations, "Synthesen in der Zuckergruppe" (*Deut. Chem. Ges. Ber.*, 1890, 2114; 1894, 3189). These are dealt with in the earlier sections. The basis of the isomeric relationships of the glucoses and their immediate derivatives is briefly set forth. In respect of constitution, the discussion as between an aldehyde or ethylene oxide formula for the typical glucose is impartially summed up. We may remark on this important point, that there is no suggestion of the probable influence of aqueous solution. The very recent researches of Lobry de Bruyn (*Rec. Trav. Chim.*, 1895, 14, p. 203), showing that mannose, dextrose, and fructose are reciprocally transformed, each into the two others by the action of sodium hydrate in aqueous solution, are a striking illustration of the mobile equilibrium of the typical CO group, and of the ease with which its migration is determined. That changes of structure take place in aqueous solution is evidenced by the phenomena of rotation, and the influence of hydrolytic agents points to a very direct connection with changes of "ionic" equilibrium. A grouping of these relationships, with a not too positive conclusion as to their significance, would have added a suggestive section.

From constitution the author proceeds to configuration, the section consisting in the main of Fischer's well-known tables. In the next edition these may be accompanied with advantage by the mnemonic symbols recently proposed by Lobry de Bruyn (*Chem. Zeitung*, 1895, No. 75), or by some similar pictorial concession to the limitations of the average memory. In the nomenclature of the group, there is the usual struggle between systematic and trivial terms. There is some ambiguity created in the numerical basis of the terminology, as between the number of C atoms in the molecule of a simple carbohydrate, and the number of such simple units in the condensed molecule of a "polysaccharide." Thus the term "triose" designates a glycerose of the dimensions C_3, and the sugars of dimensions $3C_6$. The author evidently avoids innovations in this direction, and it is not for us to step in where the leaders fear to tread. In the following sections, dealing with the experimental methods of general significance, whereby the relationships of constitution and configuration have been elucidated, the treatment of the subject is of the briefest. The sections which suffer most under the severe discipline of brevity are those devoted to "the formation of the carbohydrates in nature," and to "fermentation." The former is chiefly devoted to the recent work of Brown and Morris, and the latter to Fischer's observations on the relationship of fermentation to configuration. It is evident that much matter of the greatest interest to physiologists is left unnoticed. We can only regard the omission as expressing the author's judgment that this province still refuses to yield to the positive methods of a systematic handbook. From this condensed review of the generalities of the subject, we are taken at once to the description of the individual compounds in systematic order: glucoses, saccharoses, and polysaccharides. It would be gratuitous to say anything in commendation of these sections. They constitute a condensed reproduction in strictly systematic order of the very prolific researches of the last few years, and the labour which they represent on the part of the author will be fully appreciated by specialists. Anything which might be said in depreciation of these sections could only be translated into the common-place that no one can be a general specialist; and in the chemistry of the carbohydrates the specialising process has passed into the second degree, as witness the literature of the sugars, of starch, of cellulose. The consequent difficulty of subordinating the parts of so wide a subject to the main plan has been effectually overcome in the work before us. The remainder of the work is devoted in order to the alcohols, to derivatives of the cyclic hexamethylene, and lastly to the complex groups of acids which stand in relationships of the first or more remote degrees to the carbohydrates.

The work, therefore, satisfactorily exhausts the recent history of the subject in its systematic relations; on the other hand, to those who have the fear that the objectives of the science in this fertile field of research are being rapidly exhausted, we may speak a word of comfort in the reflection *l'appétit croît en mangeant*. It is evident that, although the writer limited himself to the plan of a somewhat "high and dry" dictionary article, and in enlarging his text to confer upon the article the standing of an independent monograph, keeps well within the limits of history, the subject-matter is continually breaking bounds and revealing by implication the remarkable further developments which it promises on every hand. The natural history of the carbon compounds remains to be written. There is abundant evidence in the recent history of the chemistry of the carbohydrates that this new objective of the science is taking positive shape. These compounds constituting in a prominent degree the arena for the primary processes of natural organic synthesis, it is in the order of things that the fundamental relationships of these compounds should be first elucidated as the necessary basis of plant physiology. It would take us much beyond the obvious limits of the matter in hand to attempt a discussion of the many broad physiological issues directly raised by the results of the last seven years' investigations. We would suggest that the author's next volume should treat this side of the subject specially and adequately. We should also suggest an historical preamble and a brief survey of the chief developments marking the period. With these slight qualifications, we heartily commend the book to all students of natural science.

OUR BOOK SHELF.

Practical Inorganic Chemistry. By Dr. G. S. Turpin, M.A. Pp. 158. (London: Macmillan and Co., 1895.)

It is gratifying to all who are interested in scientific education to know that instruction in elementary science in this country is steadily improving, both in methods of teaching and in the subjects taught. In the spring of this year, a new scheme of work for organised science schools was issued by the Department of Science and Art. These schools include all the best carried on in connection with the Department, and for some time a definite scheme of study, extending over three years, has been followed in them. What the Department did recently was to issue a remodelled scheme for such schools, embodying several commendable features. Elementary practical physics was introduced as an obligatory subject, and a course of real chemistry was substituted for the drill of test-tubing, which had gone under the name of practical chemistry for so long. Dr. Turpin's book has been designed to meet the improved requirements; and, as it has had a reasonable basis for its construction, it possesses many good qualities. The course of work described begins with weighing, measuring, the determination of relative density, and other elementary physical principles; then follows a chapter on mixtures and compounds, and another on the setting-up of apparatus. After this fundamental knowledge has been experimentally studied, the constitution of the air is investigated, and then the most important gases, and common chemical compounds, form the subjects of the student's work for the remainder of the course. We cannot speak too highly of the introduction of such a course of work as is herein described. It encourages thought, creates interest in chemistry, and furnishes the kind of knowledge most likely to prove of advantage in after years. Not only in organised science schools, but in every school where chemistry is taught, the course described in this book could be profitably introduced.

Observaciones de precision con el Sextante. Por el Conde de Cañete del Pinar, Cápitan de Fragata Retirado. Pp. 180. (Madrid: Ricardo Álvarez, 1895.)

A DESCRIPTION of the sextant and the uses to which it can be applied is here given in seven chapters, of which the first describes the instrument, and shows how it may be corrected. Following, we have four chapters on different means of the determination of latitude by means of stars, showing the methods trigonometrically, and also giving examples. The accuracy of observations taken by the sextant is graphically shown by two tables, giving the latitude obtained on several successive days. Lastly, we have a description of the means by which time is determined, and also how the longitude is obtained by means of the moon and stars. Throughout the book there are numerous examples, and no pains have been spared to make it useful.

First Stage Mechanics. By F. Rosenberg, M.A. Pp. 296. (London: W. B. Clive, 1895.)

THIS book has been made to fit the requirements of the elementary stage of theoretical mechanics of solids, as laid down in the syllabus of the Department of Science and Art. It is the first volume of a new series of Departmental text-books, and it possesses all the characteristics of the literature of the University Correspondence College Press; by which remark we mean that the text is concise, the examples numerous, and the comparative importance of the sections is indicated by the thickness of the type in which they are printed. What more does a student require, who is learning theoretical mechanics for examinational purposes?

The Story of the Solar System. By George F. Chambers, F.R.A.S. Pp. 202. (London: George Newnes, Limited, 1895.)

WE are glad to be able to state that the twenty-eight illustrations in this book are better than those in the companion volume on the "Stars," by the same author. Mr. Chambers has contrived to compress an immense amount of information within a small compass, and his descriptions possess the double quality of simplicity and attractiveness. We do not know of a book in which so much is told about the solar system within such narrow limits.

British Guiana and its Resources. By the author of "Sardinia and its Resources." Pp. 104. (London: George Philip and Son, 1895.)

THE question of frontier between British Guiana and Venezuela is now so much to the front, that a large public will be interested in this description of the history, features, and resources of the region in which the debatable land lies. The book will be found valuable not only on this account, but because it is full of information useful to visitors to British Guiana. Travellers of all tastes and inclinations will find that the country offers many attractions, and is as wide a field for observation and collection as could be desired.

Mammals of Land and Sea. By Mrs. Arthur Bell (N. D'Anvers). Pp. xii + 191. (London: George Philip and Son, 1896.)

ALTHOUGH this volume will assist its readers to know the general characteristics of members of the mammalian family, it possesses no novel features, and the illustrations belong to a past age. Some readers may find the book interesting, but few will pronounce it attractive.

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.*]

A New Method of Measuring Temperature.

THE recent publication of papers dealing principally with thermometry, by Mr. Griffiths, and by the Kew Standardising Bureau, has suggested to me that the publication of a new thermometric method which I have used for some years may be of use.

Briefly, in this method two thermo-junctions are used; one is placed, protected or not, as circumstances dictate, in the substance of which the temperature is to be measured, the other in the bulb of an air or nitrogen thermometer. This junction is blackened, and may or may not be protected, but should be in the same state as the other. The bulb of the air thermometer may or may not be silvered or platinised. Within the bulb of the air thermometer is placed a coil of platinum wire, in series with this being a carbon resistance and a storage battery. The bulb of the thermometer is protected by a layer of slag-wool, or, if this cannot be obtained, of asbestos; or a sheath of polished metal may be used. In the thermo-electric circuit a low resistance galvanometer is placed. I prefer to use a d'Arsonval.

The *modus operandi* is as follows. The free thermo-junction is placed in the substance whose temperature is to be measured. The galvanometer is immediately deflected. The circuit of the platinum heating coil is then closed, and the carbon resistance screwed down till the galvanometer needle comes back to zero, or until making and breaking the thermo-electric circuit produced no movement of the needle. When this is the case the temperature of the air or nitrogen in the bulb will evidently be the same as that of the substance to be measured, and can be directly read off in any of the usual ways on the thermometer. I prefer myself to use the constant volume method.

It is necessary, of course, that the thermo-junctions be both in the same physical state. This is generally secured with sufficient accuracy by cutting the wire from the middle of a much larger piece which has been well annealed. In connection with other work I have found that two samples of metal, chemically identical but having different rigidities and thermo-electric powers, may always be brought to identical states by heating for a time at white heat in vacuo, first introducing, if necessary, oxygen or hydrogen to decompose any hydride or oxide combined with the metal. I have never found it necessary to do this in making thermo-junctions, but its use is recommended to experimenters who are studying the physical properties of metals.

The advantages of this method are as follows:

(1) No assumption is made in regard to any law of variation of thermo-electric effect with temperature.

(2) No assumption is made with respect to variation of voltage of standard cell in relation to temperature. The error due to the fact that the saturation of the sulphate solution of the standard cell always lags behind the temperature, and that due to the fact that the temperature is never known exactly, are thus done away with.

(3) No assumption in regard to temperature or temperature coefficient of wires is made.

(4) Both junctions being maintained at the same temperature for approximately the same length of time, and under the same conditions, the likelihood of changes in physical state, produced by one wire being annealed more than the other, is reduced to a minimum.

(5) The temperature is read directly by a nitrogen thermometer, and no intermediate standards need be used.

(6) No complicated apparatus is needed, the only instrument used being the galvanometer, and that only as an indicator. The only standard used is the kathetometer for measuring the height of the mercury column.

The only assumption made is that the air in the bulb is at a uniform temperature throughout. This assumption is justified, however, by experiment. In 1890 Mr. A. E. Kennlly and the writer made a number of experiments to determine the temperature coefficient of the electrical resistance of copper wire. In these experiments the wire was wound in two coaxial coils in the bulb of an air thermometer, the idea being that there would probably be a difference of temperature between the coils, and the mean would be taken. On testing the matter, however, no such difference was found, even up to the highest temperature used, 250° C. If any difference existed it was less than one-tenth of 1° C., as that amount could have been measured. This being the case in a narrow tube where the air circulation was hindered by a number of mica discs (see *Physical Review*, February 1893, for description of apparatus), it is improbable that there is any appreciable difference when there is no hindrance to the air currents except the heating coil of platinum.

I have never used the apparatus for very high temperatures, but see no reason why it should not be so used; and it would apparently present a number of advantages for such work, chief among which is the fact that the temperature would be obtained by direct comparison with an air or nitrogen thermometer, and no assumptions made as to the law of variation of thermo electric force with temperature.

It can, of course, be made self-recording by placing a recording pressure gauge in place of the mercury column, the observer simply keeping the galvanometer at zero by manipulation of the carbon resistance.

It is obvious that platinum resistance coils can be used instead of the thermo-junctions, the platinum resistance coils forming two arms of a Wheatstone bridge, and the galvanometer placed across them.

A method of measuring the heat conductivity and temperature coefficient of metals devised by me, and at present being used by one of my students, may be of interest. A metal bar, well annealed, polished, and with special precautions taken to preserve homogeneity of physical state, has its ends placed in two mercury baths, A and B. The bar is protected from radiation by concentric polished metal tubes. A is heated electrically, and B cooled by a water tube. In the regular laboratory exercise, I have been in the habit of letting the students use thermometers. But in this case, where accurate results are required, capillary tubes are led off from A and B, filled with mercury, thus forming a thermo-junction. Another thermo-circuit has its junctions placed at the entrance and exit of the cooling water. It would, of course, be possible to measure the thermo-voltage directly by standard cell; but instead of this, in the present method, the two thermo-circuits are balanced against one another, the elements which are immersed in the water being chosen so as to have a much higher thermo-voltage than the copper-mercury couple. It is seen, without much difficulty, that by this means the conductivity of the copper may be measured without knowing more than one temperature, and that only approximately, to a considerable degree of accuracy. As the experiments are not concluded, I am unable to state definitely what the value of the method is, but the indications are that it will prove successful. REGINALD A. FESSENDEN.

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On Crookes' Spectrum of Helium.

IN his investigation on the spectrum of helium,[1] Crookes has examined the spectrum of five different samples of gas, two being developed from cleveite (No. 1 and No. 5), another from uraninite (No. 2), and two from bröggerite (No. 3 and No. 4). Sample No. 5 has been prepared with special care, and is designated "helium purissimum." The five spectra are by no means identical, and it has been concluded that besides helium there are other gases present. E. A. Hill[2] has even gone so far as to infer the existence of at least fifteen new elements from the comparison of these five spectra. Thirty of the seventy-nine wave-lengths measured by Crookes coincide (within the limits of error) with wave-lengths that we have measured in the spectrum of cleveite gas.[3] But the remaining forty-nine lines, many of which are strong, do not coincide with any of ours. As far as we know, it has not been noticed that thirty-three of these forty-nine lines almost certainly belong to argon, among them nearly all the stronger lines. Six more may also be argon lines, but the identification is rather doubtful. Two lines in all probability are mercury lines, which naturally are likely to appear in a vacuum-tube made by means of a mercury pump. One line may be due to carbon. The table on p. 246 contains a list of the forty-nine wave-lengths that do not coincide with wave-lengths that we ascribe to helium, and gives their probable origin. The wave-lengths of argon lines are taken from Kayser (*Chemical News*, August 30, 1895), Eder and Valenta (*Ber. der Wiener Akad.*, October 24, 1895), and from Crookes' own measurements.

3890·5 and 3885·9 are strong lines that have been seen in the spectra of all five samples. Crookes considers them as satellites or components of the strong line between them, the wave-length of which is 3888·785 according to our measurements. But as our photographs show that this line is single, or if not single has a weak component 0·05 lower, which can only be observed with much greater dispersion than Crookes has used, we are inclined to believe that 3890·5 and 3885·9 are spurious lines due to some error of apparatus having made their appearance on account of the enormous energy of 3888·8.

Of the five remaining lines, three are only of intensity 2. The two stronger ones have only appeared in the gas from uraninite, and may possibly belong to a substance hitherto unknown. But it is far from being established.

C. RUNGE AND F. PASCHEN.

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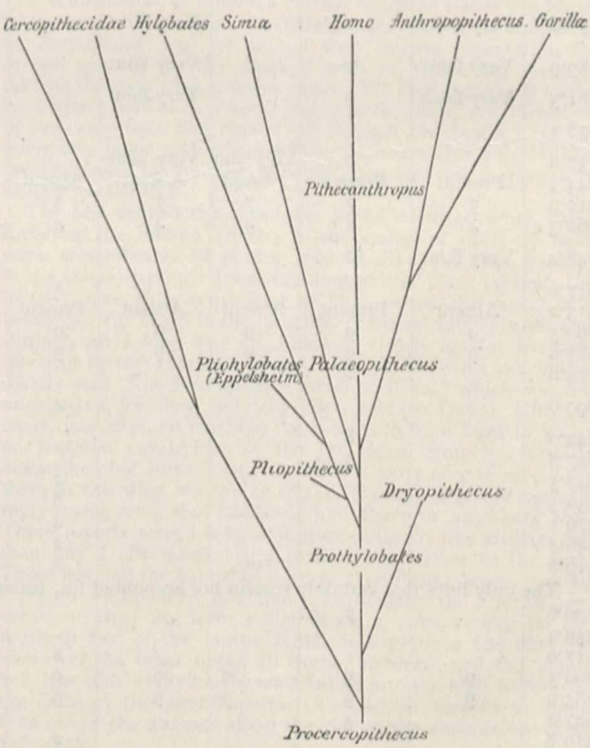
[1] *Chemical News*, August 23, 1895, reprinted in NATURE, August 29, 1895.

[2] *American Journal of Science*, November 1895.

[3] *Berichte der Berl. Akad.*, July 1895. See also NATURE, September 26, 1895.

The Place of "Pithecanthropus" in the Genealogical Tree.

IN the report on the scientific meeting of the Royal Dublin Society on November 20, in NATURE of December 5, 1895, it is stated that I placed Pithecanthropus in the genealogical tree, drawn by Prof. Cunningham, below the point of divarication of the Anthropoid apes from the human line. This indeed I did. But this statement could be misleading as to my real views on the genealogy of Pithecanthropus, such as I stated them already on p. 38 of my original memoir ("*Pithecanthropus erectus*, Eine menschenähnliche Uebergangsform aus Java," Batavia, 1894), and more fully at the last meeting of the Anthropological Institute of Great Britain and Ireland, on November 25.



It may not be superfluous to explain my views here by means of the accompanying diagram, representing the evolution of the Old World apes from a hypothetical common ancestor, whom I call Procercopithecus.

In Prof. Cunningham's tree, figured in NATURE of December 5, p. 116, he regards the left branch as all human, the right one as entirely simian, and he placed Pithecanthropus midway between recent Man and the point of divarication.

	Intensity. Sample No.					Sample not specified.	Argon. Red.				Argon. Blue.			
	1	2	3	4	5		Crookes.	Int.	Eder and Valenta.	Int.	Crookes.	Int.	Kayser.	Int.
5062·15						3					65·	10	·258	2
4931·9 *a*						3								
4870·6 *b*		7												
4847·3		7							·95	3			·965	3
4805·6		9				2			6·10	5			6·185	6
4764·4 *c*									4·99	4			5·030	3
4735·1		10							6·03	6			6·069	5
4658·5		8							8·01	4			·070	4
4579·1		3							·49	3			·531	5
4559·4						2								
4544·1						5			5·28	4			5·231	5
4520·9		3							2·45	8				
4511·4		5					09·5	9	10·83	10	09·5	8		
4497·8						2			8·62	1			8·874	1
4437·1						1							9·541	1
4428·1		10							30·35	4	26·5	10	30·365	6
4424·0		10							6·15	6	22·5	10	6·170	9
4399·0 *d*		10							01·17 00·20	5 3	99·5	10	01·165 00·269	5 3
4378·8		8							9·79	4	76·5	9	9·832	6
4371·0		8							1·46 0·89	3 2	69·0	9	1·504 0·921	4 4
4348·4		10							·11	8	48·5	10	·231	10
4333·9		10					33·5	9	·64	10	33·5	9	·701	2
4298·7		5					00·5	9	00·18	10	99·0	9		
4281·3		5											3·084	3
4271·0		5					72·0	8	2·27	10				
4258·8	7	7	7	7	7		59·5	9	9·42	10	59·5	8		
4227·1		5							8·30	4			8·301 7·142	5 2
4198·6	Very faint	9		Very faint			98·0	9	00·76 98·42	10 10	98·0	9		
4189·9	Very faint	9		Very faint			91·5	9	91·15 90·76	6 6	91·5	9		
4181·5	Very faint	9		Very faint			83·0	8	2·07	9	83·0	8		
4178·1						1							9·478 8·477	1 1
4157·8		8	Veryfaint	Very faint			59·5	10	8·63	10	59·5	10		
4044·3	Present	Present	Absent	Absent	Absent	9	44·0	9	4·56	8	44·0	8		
4012·9	7	7	7	7	7				3·97	4	13·0	8	3·997	6
3962·3 *e*	4	4	4	4	4								0·620	2
3948·2	Very faint	10					48·5	10	9·13 7·70	10 5	48·5	9		
3917·0 *f*					2									
3913·2 *g*	Absent	Present	Absent	Absent	Present	4							4·918	3
3890·5	9	9	9	9	9									
3885·9	9	9	9	9	9									
3874·6		6												
3800·6 *h*					4								5·413 3·383 0·429	3 2 1
3642·0		8									3·27	3		
3627·8		5												
3247·5 *i*					2									
2536·5 *j*					8									
2479·1 *k*					4									
2446·4 *l*					2									
2419·8					2									

The only lines that certainly remain not accounted for, leaving aside those where the coincidence is not very satisfactory, are:

	1	2	3	4	5	Sample not specified.
4870·6		7				
4559·4						2
3917·0					2	
3890·5	9	9	9	9	9	
3885·9	9	9	9	9	9	
3627·8		5				
2419·8					2	

a There is an argon line at 4933·4 stronger in the blue spectrum seen on our own plates, but not mentioned by Kayser nor by Crookes. Crookes gives 4938 int. 10 as a line of the blue spectrum of argon. But as there is no strong line at 4938, we are inclined to think that it is meant to be 4933. *b* The deviation is too great to suggest the argon line 4879 (Crookes), though its intensity is about the same as that of 4848, and would therefore suit very well. *c* Schuster has also measured these lines, and gives them, together with 4879 and 4726, as characteristic argon lines of the spectrum at atmospheric pressure. *d* H. F. Newall, experimenting with one of our vacuum tubes filled with cleveite gas, found that these five lines appeared in the periphery when it was put into a coil through which the discharge of a Leyden jar passed. We could not detect the lines on photographs taken with an induction current passing through the tube in the ordinary way. *e* Coincidence very uncertain. *f* H. F. Newall gives a line 3918·8 int. 5,* but at this place there is no argon line on our photographs. *g* Coincidence doubtful. *h* Coincidence doubtful. *i* We see a line in the blue spectrum of argon at 3248·4 on our plates. *j* 2536·65 strong mercury line. *k* 2478·66 strong carbon line. *l* 2446·96 mercury line, intensity 6.

* *Astrophysical Journal*, May 1895.

Now I could find no place for the fossil Javanese form, which I consider as intermediate between Man and Anthropoid apes, in any of the branches of *that* tree, only in the third chief line, the main stem, very near to the point of divarication.

Owing to the same circumstances, which indirectly prevented me from explaining my own views on the matter at Dublin, I did not then reply to two remarks of Prof. Cunningham, which omission I now wish to repair by the following declaration.

(1) I did not exaggerate the relative height and quality of the cranial arch, which Prof. Cunningham had in view (the arch of the glabella-inion part of the calvaria) in Hylobates. The profile outline of the skull of *Hylobates agilis* figured, directly from the bisected skull, on p. 8 of my memoir, is even somewhat higher than that of Pithecanthropus, of which I have an accurate bisected cast before me. In the latter the height of the said cranial arch is exactly equal to the one-third part of the glabella-inion line, and in the skull of a *Hylobates agilis* it is about 2 mm. higher than the third part of the corresponding line. If in the mentioned diagram in my memoir that line in the gibbon skull were drawn equal in length to that of the fossil calvaria, instead of the natural size, this would be more apparent there than it is even now. The said cranial arch of a *Hylobates syndactylus* in the same diagram is much lower than that of the other gibbon species, and the same arch in the chimpanzee would even be lower than in *Hylobates syndactylus*. It is easy to find skulls of Semnopithecus with a higher "cranial arch" than the chimpanzee has. Further, between different individuals of the same ape species and of man, we find great differences in the height of that arch.

All these facts tend to show that there is no reason for regarding the height *of the suprainial part* of the calvaria as of real importance in our judgment on the place which any human-like being should occupy in the genealogical tree.

(2) In my original memoir (p. 7), I have already pointed out that the occiput of the fossil skull is very ape-like, especially gibbon-like. But, nevertheless, the inclination of the planum nuchale on the glabella-inion line is very different from that of all the Old World apes. These accord very nearly with one another in the degree of this inclination, whilst the angle in Pithecanthropus approaches closely human conditions. I not only compared photographs of the median line of the skulls, but also the bisected skulls with the bisected exact cast of the fossil calvaria. The means which I have taken to determine the degree of this declination are therefore, I believe, entirely calculated to yield trustworthy results. EUG. DUBOIS.

An Anagram.

Is it too frivolous to suggest the accompanying anagram?

Pithecanthropus erectus.
Pursue the person, catch it!

Kew, December 10, 1895. E. H.

The Barisal Guns and Similar Sounds.

WITH reference to the letters that have appeared in NATURE on the above subject, I have read with interest that by Mr. G. B. Scott, of the Indian Survey, in your last issue. The question, I think, arises, Are we not dealing, in India at least, with two very different phenomena? Are these sounds like that of heavy ordnance, which are heard occasionally at the base of the Eastern Himalayas and the Garo and Khasi Hill Range,[1] the same as those longer known and more familiar as the "Barisal Guns"? Mr. Scott's description of the sounds he heard when on board the steamer moored in the narrow channels near the sea, are remarkably like wave action. He says: "Sometimes a single report, at others two, three or more in succession, never near, always distant, but not equally distant. Sometimes the reports would resemble cannon from two rather widely separated opposing forces, at others from different directions but apparently always from the southward, that is, seaward." This is precisely what one would hear on a still night, when an ocean swell was coming up the Bay of Bengal and breaking all along a low shore with an undulating outline stretching many miles east and west.[2] I have been twice round by Barisal in a river steamer, and once by native boat, which took many days; but I was not fortunate enough to hear the sounds.

Regarding the distant booming reports, that are heard further inland, I was, I think, one of the first to notice and put them on record. In the *Proceedings* of the Asiatic Society of Bengal, March 1869, *vide* "Notes from Asaloo, North Cachar, on the Great Earthquake of January 10, 1869," after giving some details of the daily shocks that were recorded up to the 17th of that month, I find the following on p. 98. "Very noteworthy is the distant report of a heavy gun on January 19, heard towards the west at 1h. 49m. 19s. p.m. (I was sitting at work at a table outside the office tent); the time I took immediately by chronometer, as I fully expected a shock to follow. Another very loud explosion was heard from Mahadeo Peak at midnight of the 29th, and again from the same peak at 7 a.m. the next morning, the 30th; but no shock came after, on either occasion.

"I may here mention that last cold weather, on several occasions when I was in the North Cachar Hills, I heard, at various times, the like distant reports, resembling exactly the firing of big guns at a great distance. In one or two places the country people had noticed it, and they even used the expression that it proceeded from the earth (*the earth speaks*).

"These subterranean explosions must be heard over large areas, and it would be interesting if they could be noticed, or rather if those hearing them would make the matter public; I have no doubt there are many individuals who will remember having heard such sounds." The reports like big guns, "top chalta," as the natives expressed the sound, heard at Asaloo in January, during a period of great seismic activity, were, I consider, intimately connected with it; and that the similar reports, solitary instances not continuous, heard in the previous year at different places in the same range, were also of a subterranean nature. Seismic sounds are not always accompanied by a disturbance of the earth conveyed to the senses. I find in my journal the following.

"*Nongtung, in Jaintia Hills, December* 21, 1887."

"While seated at dinner, a curious rumbling sound was heard in the west. Mr. Ogle immediately said, 'that is the rumble of an earthquake,' and we waited with intense expectation for several seconds for the shock, I with my watch out ready to take its duration; but it never came. We then thought it might have been a herd of elephants coming up the ridge, and, disturbed by our camp fires, had rushed off through the jungle; but on going into Jawai on Christmas Day, we learnt that a shock had been felt there on the same date and time, and that it apparently came from the west."

The best-defined unaccountable sound occurred when I was surveying the Bhutan Dooars in the spring of 1865. I have some remembrance of putting it on record at the time, perhaps in my annual report. I was standing at the plane-table in the forest twelve miles south-west of Buxa, when the report of a heavy gun was heard in the direction of the mountains, clear and distinct, yet a long way off, followed closely and at irregular intervals by two other discharges. The natives with me immediately said "the Bhutias have attacked Buxa," which was not unexpected, for they had only lately retaken Dewan Giri. A short time after, on reaching the main path from Buxa to Balla, an irregular cavalryman of the Jat Horse came by, carrying despatches for Buxa Fort. I wrote a hasty note to an officer there to ask what was going on, and I received in due course a reply saying not a shot had been fired there or anywhere else. These reports were louder and more distinctly like artillery fire than any I afterwards heard in the hills further to the east. These last had the nature of a very, very distant boom, coming from no well-defined direction. Particularly do I recall one occasion when we were going down a narrow spur on the southern face of the Jaintia Hills, on a glorious fine day, the view over the basal slopes all clothed in forest, and the plains and low hills of Sylhet beyond fading into the high horizon of the delta of the Brahmaputra. The sound seemed to come from out of the distance along the foot of the mountains—west and south.

As a primary cause, every possible kind of force has been suggested—fireworks, *i.e.* bombs, cannon, bursting bamboos in jungle-fires, thunder-claps, landslips, and the falling of river-banks. I am familiar with the sounds produced by all these causes, and the last-named was particularly brought under my notice when proceeding by boat on the Megua and Brahmaputra, and from Gowhatty on a raft made of two dug-out canoes to Doobri, 125 miles. I have often seen and heard the report which

[1] *Vide P. A. S.* Bengal. Mr. La Touche, of the Geological Survey, p. 201, in "Report on Barisal Guns."
[2] *Vide* same Report. Letter by Mr. A. Manson, p. 208.

a large long mass of sand, suddenly giving way and falling forward from the vertical face of a sand-bank or river-bank on to the water, will produce, and the very long distance it will be heard up and down the river.

In the vicinity of such great rivers, at such a spot as Chilmari Ghât, which I know well, we must be rather sceptical with regard to sounds being any other than of this nature. The reports are very likely to be repeated, for the wave produced on the water will set another mass falling some way off, and even the wave of air may do the same to a mass just tottering, and bring it all down together (see also Report in *Proceedings* of Asiatic Society, Bengal, p. 207, regarding the echo from one side of the river to the other, so well described by Mr. Manson).

Mr. W. T. Blanford has suggested to me landslips for the reports heard near Buxa; but this is a sound I have heard on the bursting of a landslip dam in the Himalayas: the sound was of the nature of a rumble, not a report. A fall of rocks into a valley from any height would produce, I think, a still more prolonged rumbling sound—more like that of the avalanche.

Shalford Park, January 7. H. H. GODWIN-AUSTEN.

ALLOW me to mention, for the information of those of your readers who take an interest in this subject—a considerable number, to judge from the correspondence that has lately appeared in these columns—that a very complete account of the phenomenon is now being published in *Ciel et Terre*, a review devoted to astronomy, meteorology, and terrestrial physics, published twice monthly at Brussels, from the pen of M. Ernest Van den Broeck, curator of the Royal Museum of Natural History of Belgium, who has devoted much time and labour to a study of the subject. The first article, containing a complete historical review of the subject, appeared on December 1; the second, on the 16th, dealt with the accounts of the phenomenon received by M. Van den Broeck from various observers in Belgium; and future articles will be devoted to a study of the facts as reported from Bengal, to the causes of the phenomenon, and to the methods employed in determining its origin.

I may mention that the true rendering of the word *mistpoeffers*, the name given to the sounds by the fishermen, is not *fog-dissipators*, but, as appears from a note on the etymology of the word by one of M. Van den Broeck's correspondents, it should more correctly be translated *fog-belchings* or *fog-hiccups*, the French rendering of the word *poeff* being *renvoi* or *hoquet*. The point is of some importance, since the sounds do not appear to have any effect, as one might imagine from the signification of the name, as it first appeared in NATURE, in the dispersal of fogs. T. D. LA TOUCHE.

Boring a Coral Reef.

WILL you be good enough to allow me to correct a somewhat important oversight in the note in last week's NATURE, on the work of the Coral Reef Committee of the Royal Society. You mention that the Royal Society has granted the sum of £800, and the Government a gunboat, for the expedition. Even with this help, however, it would have been impossible to undertake the work unless the Department of Mines of the New South Wales Government, largely through the good offices of Prof. Anderson Stuart, had granted to the Committee the use of a complete set of boring tools and appliances, with an engine and boiler. Further, the Department has relaxed the somewhat stringent restrictions usually placed on the use of the tools, owing to the difficulties which will be experienced in a waterless and sparsely inhabited island. For such generous assistance, and to Prof. Stuart, who has helped in many different ways, the Committee cannot be too grateful. W. W. WATTS,

(Joint-Secretary of the Royal Society's Coral Committee).

Sutton, Surrey, January 11.

Variability of Red Stars.

ACCORDING to a notice, which I found in NATURE's "Astronomical Column" of November 14, 1895, my theory of the variability of red stars should demand, that the bright lines of hydrogen should be produced there at a low temperature and in a condition never tested by experiments.

I will try to show that this objection is not valid.

The bright lines in red stars are considered by me as caused by the recently much studied phenomenon of luminescence, *i.e.* by a production of light not due to elevation of temperature, and thence not subjected to Kirchhoff's law of absorption.

In the cooled atmospheres of the red stars two causes of luminescence can be expected—two causes, which according to the relatively low temperature of the combinable elements and condensable vapours, with which these atmospheres are filled up, must act there much more energetically than in other stars. These two well-studied causes of luminescence are chemical action and electricity.

If we first consider chemical action, it may be stated, by the way, that the supposed chemical combination in a cooling star does not necessarily require a very low temperature. Acetylene, for instance, can be generated in the electric arc. Now we know that acetylene is a compound actually present in the atmospheres of some of the most cooled stars. It is abundantly absorbing in the stars III *b* and, according to Prof. Lockyer, not unlikely radiating in the stars of his Group II. (Vogel's Class III *a*).

If therefore we assume that it is principally acetylene, which is generated in the cooling atmospheres of the red stars, bright lines of hydrogen may be expected there. These lines are then precisely caused as those of sodium, potassium, lithium and thallium in the experiments of Pringsheim, being absent as long as the sodium vapour is only strongly heated, but appearing immediately as soon as in this heated vapour some chemical change occurs.

It must be conceded, however, that in the case of hydrogen this chemical luminescence has not yet been actually observed in our laboratories. But in the case of hydrogen we have another luminescence, which is daily experienced. It is the glow in Geissler tubes, where (whatever may be the heat of the individual shining molecules) the average temperature of the glowing gas does not necessarily exceed the common temperature of our atmosphere, and cannot therefore be considered as the cause of the glowing of the gas.

As this luminescence is caused by electric discharges, and as such discharges (according to what we know about the electrical phenomena connected with the formation of clouds and hail in our own atmosphere) are likely to be expected in atmospheres, which are filled up with vapourous matter ready to condense in clouds, the hypothesis of an electrical luminescence of the hydrogen in the atmospheres of red stars seems very plausible. That hypothesis demands that the bright lines should be especially conspicuous in stellar atmospheres, where the alternation of vapourisation and recondensation is also very conspicuous, *i.e.* (according to my theory explained in the November and December numbers of *Knowledge*) in the atmospheres of red variables and Novæ, where that intermitting condensation and vapourisation of dark obscuring cloudy matter is the very cause of the variability. Now we know that this demand is fully verified. Prof E. C. Pickering has stated as a rule that, with perhaps a single exception, every red star with bright hydrogen lines is *eo ipso* variable. And this rule has proved to be so sure, that Mrs. Fleming could discover numerous new variables from the bright lines of their spectra (*Astrophys. Journal*, I. p. 27, 411; II. p. 198).

Eventual bright lines in the stars of Vogel's Class I. and II. may be explained perhaps (as Prof. Scheiner has recently shown in his "Untersuchungen über Spectra der Helleren Sterne," p. 223) by the hypothetical presence of a gigantic incandescent atmosphere, whose radiation around the bundle of rays coming to us from the star's much smaller photosphere is greater than the absorption it causes in that bundle; but in the more cooled atmospheres of red stars the chemical compounds there present, attest a temperature relatively so low that we cannot conceive that atmospheres to be filled up to such a gigantic height with hydrogen so enormously heated as to become (if that still doubtful phenomenon is possible) bright shining by incandescence.

Such enormously heated hydrogen and chemical compounds cannot permanently coexist in a stellar atmosphere. The coexistence of chemical compounds and bright shining hydrogen is only possible if the brightness of the latter is due to luminescence.

The ideas here suggested may be considered as an instance of a likely fruitful application of the study of luminescence to stellar spectroscopy. If they are right, they give, I think, a plausible explanation (1) of the connection between the variability of a star and the frequent brightness of its spectral lines, and (2) of the very remarkable fact that both variability and bright lines are so often observed precisely in those stars, whose atmospheres, according to the chemical compounds of their spectra, are coolest. A. BRESTER.

Delft (Holland), November 30, 1895.

THE above amplification of Dr. Brester's views, as to the cause of variability in red stars, calls for a few remarks. Although opinions may differ as to the constitution of stars of Group II., it is generally agreed that those of Group VI. are in an advanced state of condensation, with cool, absorbing atmospheres, and it is in the latter group of stars that we find the full development of the fluted absorption spectrum which Dr. Brester ascribes to acetylene. Experimental evidence does not certainly indicate that this gas is responsible for the dark flutings observed, for other compounds of carbon give a similar spectrum; but, to whatever the flutings may owe their origin, they are a result of Kirchhoff's law. Notwithstanding that it is in these stars of Group VI. we should most expect the bright lines on Dr. Brester's theory, no bright lines have been recorded in variable stars belonging to the group; that is, there is no visible chemical luminescence.

It is in the variables of Group II. that the bright line phenomena occur, but the associated dark flutings of metals, or their compounds, do not lead us to suppose that the temperature is lower than in the other group of stars with fluted spectra. Hence, luminescence does not seem to be more probable in Group II. than in Group VI., unless we accept the view put forward by Mr. Lockyer, that the physical constitutions of the two groups of stars are essentially different. If the stars of Group II. consist of uncondensed swarms of meteorites, it is certainly conceivable that the luminosity of the hydrogen in the interspaces may be partly due to electrical excitation; this view involves the supposition that these stars are becoming hotter.

It may be further remarked that there is abundant experimental evidence to show that the line spectrum of hydrogen can coexist with a fluted spectrum. Acetylene, for instance, exhibits such a mixture, and hence luminescence is not more necessary to explain the luminous phenomena in the case of hydrogen than in the case of the absorbing vapours which give the flutings associated with them in stars.

THE WRITER OF THE NOTE.

Mount Wosho.

As my name has been mentioned in NATURE for December 5, 1895 (p. 107), in connection with recent explorations in Africa, allow me to say that snow clothing on Mount Wosho must have been added by an outsider, for in page 110 of my work on Ethiopian geography, published five years ago, I have expressly said that snow does not exist in that country. In page 387 of the same volume, I have given up all Mount Wosho's claims to an immense height; but I still think it exists as a mountain, and that it ought not therefore to be wiped off the map.

Your criticism induces me to explain how I tried to sketch one in Upper Ethopia. I first employed the common method by recording hours of travel and bearings by compass; but I was then forced to suppose the variation of the needle. Disturbing attractions could not be eliminated, and it was seldom possible to check my road by observed latitudes. However, as a warning to my successors, I published this tedious work in my "Géodésie d'Ethiopie" (Paris, 1873), a volume of 502 quarto pages.

This first attempt to map the country being fruitless, I turned all my attention to using a theodolite, and collected in 318 stations more than 4000 bearings, besides 500 of the sun, taken at proper hours to get true azimuths, each of these being followed by an angular zenith distance. I obtained three base-lines from differences of latitudes observed on two heights situated near the same meridian and connected by azimuths. The northern base is nearly 51 miles long; I got there my longitude by eight occultations of stars. The second base is 52 miles calculated from a quadrangle, and the southern base, still more indirect, reaches 51 miles. I have thus carried a continuous chain of triangles from the Red Sea to the frontier of Kaffa, a distance slightly greater than from Calais to Bayonne. These triangles, mostly with only two observed angles, have been checked here and there by latitudes and independent longitudes. I got the latter by a few occultations, but chiefly according to the Russian method of lunar observations. By this method I have calculated 857 positions in Ethiopia. They are given in my pages 423-440, the heights being obtained by a *supposed* coefficient for terrestrial refraction.

In my "Géodésie" (page 195) I give the first mention of Mount Wosho as *probably* Wosho, and the following page says, "flat mountain which I suppose (*que je prends pour*) Wosho." Page 438 points in No. 805 to a note (p. 448) which adds, "placé pur renseignements et par ces azimuts réitérés." This hearsay evidence is taken from a list of days' journeys between Bonga and Wosho (published in my "Géographie") without details. The profile of the mountain measured from Falle is given in the collection of sketches belonging to my 325 *tours d'horizon*. Moreover, the zenith distance was 90° 21', nearly the very worst to be corrected by the ordinary rule for terrestrial refraction. In spite of all these drawbacks, I published the resulting enormous height in order to call attention to Wosho. Let us hope that some explorer, after throwing a net of triangles over Walamo, may put in its proper place and height the real Wosho.

ANTOINE D'ABBADIE.

Hendaye, December 13, 1895.—

I AM aware that M. d'Abbadie did not still maintain the exaggerated importance once attached to Mount Wosho, for which, indeed, he is by no means solely responsible. My remark was suggested by the fact that the great mountain reported by Grixoni's expedition had again called attention to Mount Wosho, and led to the idea that the earlier reports were possibly, after all, correct. But until Dr. Donaldson Smith's maps are published, it is no use attempting to reconcile the previous maps of this region. THE WRITER OF THE NOTE.

Cactaceæ in the Galapagos.

ALTHOUGH the Editor has kindly replied to that part of Mr. Agassiz's letter [*ante* p. 199] relating to the *Albatross* Expedition, I should like to say a few words on the other points raised by him. In the first place, I regret that my communication on the subject should have produced the impression of unfairness towards any person or persons. Such was not my intention. For the sake of my own reputation, as well as for the information of those who, like Mr. Agassiz, might, from my way of expressing myself, think otherwise, I may add that I did not intend to convey the idea that *Opuntia* and *Cereus* are limited to Chili on the west coast of America. The contrary is so well known, that it did not appear necessary to me to enter into particulars. Of course Mr. Agassiz will hold me guiltless of suppressing anything respecting the branches of *Opuntia* and *Cereus* which he says he collected, though he does not know what became of them.

Perhaps I may also be permitted to add that Dr. Baur has since sent me some very fine photographs of *Opuntia* and *Cereus*, on a comparatively large scale, together with some notes, which I laid before a recent meeting of the Linnean Society.

Herbarium, Kew. W. BOTTING HEMSLEY.

A Luminous Centipede.

IN Mr. Lloyd Bozward's letter on the above subject in this week's NATURE, he says that the light of the *Scolopendra electrica* "is the same as that of the glow-worm." My experience is that the light of the glow-worm is a clear little *spark* of light; whereas that of the *Scolopendra electrica* (which I have usually found in the autumn) is more of a phosphorescent light, and streaks of this light are left for a few seconds in the trail of the animal as it crawls about, so that it is often difficult to say exactly where the creature is. I have no doubt others have observed the same thing. T. PLOWMAN.

Enfield, N., January 11.

The Critical Temperature of Hydrogen.

WHAT I object to is not Mr. Bryan's reference to Wroblewski's work, but his statement (explicitly founded upon the absence of "fresh experiments") that my conclusions "are not results of independent original investigation." In his letter to NATURE of January 9, Mr. Bryan does not even attempt to justify this statement. My *Bulletin* paper was an abstract; in the full paper (*Trans. Crac. Acad.*, vol. xxvii. p. 375), published May 1895, Wroblewski's work was quoted and discussed.

Cracow University, January 12. L. NATANSON.

A Fog Scale.

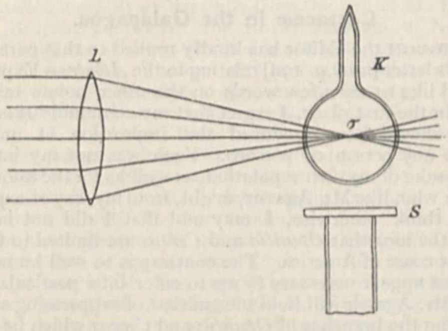
CONSIDERING the important part that fog plays in determining the character of a health resort, it is remarkable that no scale similar to those adopted for wind and cloud should have been hitherto used in meteorological reports. Like the above scales, it could only be approximative; but if observers fixed upon conspicuous objects, such as hills, churches, &c., at known distances for their observations, these ought to be at least as accurate as those for wind and cloud.

Nant-y-Glyn, Colwyn Bay. ALFRED O. WALKER.

FLUORESCENCE OF SODIUM AND POTASSIUM VAPOURS, AND THE IMPORTANCE OF THESE FACTS IN ASTROPHYSICS.[1]

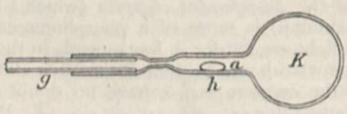
IN the case of unmixed vapours, E. v. Lommel (*Wied. Ann.*, p. 856, 1883) has proved a fluorescence for iodine vapour, and this has been shown also by us (*Wied. Ann.* 56, p. 18, 1895) to be true for the vapours of numerous organic substances. In our latest experiments we have studied the behaviour of the vapour of metals in this respect.

(1) *Order of Procedure.*—For the experiments the following arrangement was adopted. Rays of sunlight were made to fall on a double convex lens, L, of focal length 5 cm., which brought them to a focus at a point, σ, in the centre of a glass spherical bulb, K, filled with vapour.



To one side of the bulb was placed a spectroscope with the slit horizontal, the edge of the prism also being horizontal. The spectroscope was fixed by its legs on a board placed vertically, and could be revolved round its axis by means of a movable cone on the inside part of one of the feet. One was able also to adjust the collimating telescope on the cone of fluorescence proceeding from the inside of the bulb.

The bulbs, which were made principally of hard glass, were filled with sodium, potassium, and other metals in the following manner.



In the first place, a small quantity of the metal was placed in the bulb K, the neck then drawn out, and at its extremity connected with a tube of soft glass, leading to a mercury pump. The metal was then placed in position *a*, and warmed during continuous gentle pumping, in order to get rid of all water vapour and CO_2; each bulb was also several times cleaned out with hydrogen. The heating was then increased, and when a convenient quantity of the metal was distilled the tube was sealed off by means of the blowpipe. In most cases the diameter of the bulb was 5 cm., so that it could be easily enveloped in a flame. We have also employed bulbs made of soft glass and of various sizes, but the optical effects were exactly the same. Difficulties were met with when employing the alkali metals; for, as soon as the vapour began to be formed, the bulbs became browned and blackened, so that new ones had to be substituted.

(2) *Results.*—The experiments showed that the fluorescence of sodium and potassium vapour was bright—the former green, the latter intense red.

The fluorescence can also be beautifully seen by observing the vapours of these metals in the light of an arc lamp. In cases of the less volatile metals, we have not yet been able with perfect confidence to prove its presence, although the vapour of cadmium undoubtedly at the surface of the melting metal displayed a green fluorescence colour. The failure, however, of these experiments may be explained partly by the poor intensity of the rays of the winter sun. We shall, naturally, repeat them in summer.

The fluorescence spectrum of sodium vapour was made up as follows:

675.	Boundary of the red.
675—602·5.	Bright red band.
602·5—540.	Dark band.
540—496.	Green fluted band, composed of single dark and bright lines.

In the blue there is practically nothing visible.

At the less refrangible end of the dark band 602—540, the yellow sodium line appeared.

The appearance of the bright line of sodium was not caused by the presence of the flame used for heating, because when this was removed, the line remained still bright; nor could its presence be explained by the action of chemical processes taking place in the bulb, because the moment the incident light was cut off it disappeared.

The fluorescence spectrum of the vapour of sodium[1] is made up of three parts: (1) the non-fluted band in the red, (2) the fluted band in the green, (3) the bright sodium line in the yellow.

Whilst in the cases of solids and liquids which exhibit fluorescence the fluorescence spectra consist of broad ill-defined, continuous streaks, we meet here also fluted bands, as shown by other gases under the action of electrical discharges, and single lines.

The fluorescence spectrum of potassium displays at 695—615 an intensely red band.

Adjoining this band the dark interspace is relieved by the somewhat brighter appearance of the green, due, perhaps, to the presence of some sodium vapour.

The bright lines of potassium could not be proved, but their absence may be accounted for by the feeble intensity of the incident light.

The fluorescence spectrum of lithium could not be observed, because so soon as the lithium was placed in the bulb and heated, the glass exposed to the light-source became affected. By further heating, the vapour given off displayed only the green fluorescence light of sodium. For the same reason experiments to obtain in discharging tubes, the "elekroluminescenz" of lithium were unsuccessful.

(3) *Validity of Stokes' Law for the Fluorescence Light of Metallic Vapours.*—We have also made investigations to find out whether here the law of Stokes—that is, whether the *excited* rays of light are less refrangible than those *exciting*—holds good. To this end a spectrum was formed by means of a prism, but only a small strip of this was employed, and led by means of a lens into the bulb filled with vapour. In the case of the vapour of sodium the intense green light radiated was excited, in

[1] Translation of a communication to the "Sitzungsberichten der physikal. med. Societät zu Erlangen." By Eilh Wiedemann and G. C. Schmidt.

[1] A comparison of these fluorescence spectra with that which is obtained by the heating of sodium vapour exhibits certain relations (Evershed, *Phil. Mag.* (5), 39, p. 460, 1895); the same is the case with both sodium and potassium, if the positions of the fluorescence spectra be compared with the absorption-band-spectra investigated by H. E. Roscoe and A. Schuster (*Proc. Roy. Soc.* London, 22, 262, 1894). In both cases the radiation towards the red appears altered.

the first place, by the green-blue rays; and the red by the yellow and red rays. Potassium, when excited by red light, emitted light of a deep red colour.

These experiments show that at least no very marked deviations from Stokes' law exist.

(4) *Applications to Astrophysics.*—We wish to point out in a few words the importance, for astrophysical problems, of the preceding observations concerning the fluorescence of the metallic vapours.

We know that in the atmosphere of the sun there exist vapours of different metals which are radiated from the sun; these must also exhibit fluorescence, and that of a bright nature. We must also remember that the intensity of the exciting light in the region of the sun is much greater than that near the earth's surface, and also the same may be said of that of the fluorescent light. These rays of fluorescence do not follow Kirchhoff's law.

The radiated fluorescent light is made up of coninuous and fluted bands and single lines. By mixing several metals together the continuous bands grouped themselves and formed a continuous spectrum, the delicate, and sometimes less recognisable, fluted bands, however, of several substances neutralised each other, and so became invisible. Each of the sharp lines, on the other hand, remained visible. We have thus, for example, a very simple means of explaining the spectrum of the corona, which consists of a continuous spectrum and single bright lines. It is then unnecessary to assume that luminosity is produced by a continuous agitation depending on electrical oscillations; agitations which, nevertheless, play in many cases an important part. Applications of these results may also be found to be closely related to the theory of the chromosphere, certain forms of prominences, &c.

In all astrophysical and other light phenomena (*Strahlungserscheinungen*) special discussions will be necessary, not only from the point of view as to which portions of the ray are the result alone of an increase in temperature, and which depend on "luminiscence" (*luminescenz*), but it must be especially made clear when we have before us "photo-luminescence" and when "fluorescence." In this case the conditions are relatively simple, and for experiment easily accessible.

(5) *General Remarks.*—The case of the fluorescence of rarefied vapours of potassium and sodium as investigated by us, might be the simplest possible when once the light-producing molecules of the vapourous body under investigation are almost uninfluenced by the action of its neighbours, if we disregard the short spaces of time during which two or more molecules occupy in their respective reactions. Then they behave just like the molecules in bodies of a solid and liquid nature.

Further, the vapours of sodium and potassium consist of single atoms (*einatomig*), so far at least as can be judged from vapour densities established up to the present. The fact, that in these vapours not only band- but also line-spectra make their appearance, necessitates, for the theoretical investigation of fluorescence, the adoption of a new point of departure, more especially if the fundamental movements of the molecules among themselves in fluorescence be investigated.

(6) *Result.*—The fluorescence of sodium and potassium vapours is bright; the former green, the latter red. In the fluorescence spectrum of sodium vapour continuous and fluted bands appear, in addition to the bright sodium line.

Stokes' law is probably valid for the fluorescence of the vapours of metals. The fluorescence of the vapours of metals gives a means of explaining a series of astrophysical phenomena.

(Experiments with helium and argon are in process of investigation.)

NOTES.

M. CHATIN has been elected the new Vice-President of the Paris Academy of Sciences, in the place of M. Cornu, who has passed on to the presidency.

THE French Government has paid a graceful compliment to Prof. Virchow, by nominating him Commander of the Legion of Honour.

THE United States Congress has already made a good beginning as to matters scientific and educational. One of the first subjects to which attention was called, after the opening of the current session, was the proposed joint meeting of the three associations of English-speaking people for the advancement of science, at San Francisco in 1897, namely the Australasian, American and British, following the Toronto meeting of the British Association. A Congressman from Brooklyn presented a memorial and petition from one of the original Fellows of the American Association, setting forth the plan for such a meeting of these associations, and requesting aid from Congress to put the American Association on equal footing with the British in regard to transportation of members across the continent, which it is supposed that the Canadian Pacific Railway will furnish nearly or quite free to the latter. The same member a few days later introduced a resolution in favour of the metric system. Should the three science associations succeed in holding a joint meeting, this subject would well deserve careful consideration.

TWO appeals for funds to fit out Polar expeditions have lately been made—one for support of Captain Jackson's scheme for the exploration of the North-East passage, the other for means to equip a British Antarctic expedition. Captain Jackson proposes to determine whether the North-East passage from Europe to China and America is really practicable to merchant vessels properly fitted for the Northern Seas, and to make as many scientific observations as the equipment of his expedition will allow. If he cannot obtain funds to purchase and equip a suitable ship, he announces his intention to proceed to Polar regions in his yacht *Venture*, a boat only thirty-seven feet long. The Honorary Secretary of the Committee that appeals for support on behalf of Captain Jackson's scheme is Mr. E. R. Suffling, Blomfield Lodge, Portsdown Road, London, W.

THE Executive Committee for the British Antarctic Committee hope to obtain £5000 to be expended on outfits and supplies for twelve scientific men to spend a year in South Victoria Land. It is proposed that these investigators shall be conveyed to Cape Adair by a commercial expedition now being formed with the object of operating near Victoria Land. The party is expected to leave on September 1 next. After calling at Melbourne they will sail direct to Cape Adair, which, under favourable circumstances, should be reached in about fourteen days. There they will be landed with their outfit and instruments, and remain for one year, after which period they will be called for and brought back by the commercial party. The following is a general plan of the proposed investigations to be carried on at Victoria Land by the scientific members of the expedition: (1) A land party will work towards the South Magnetic Pole, there to make magnetical observations. (2) The coast-line of the open bay will be surveyed, fjords and bays explored and sounded. (3) Zoological, botanical, mineralogical and geological collections will be made. (4) Dredging. (5) Barometrical, thermometrical, meteorological and pendulum observations. (6) Air and water current observations. If this programme is only carried out in part, valuable additions to scientific knowledge will undoubtedly be obtained. There are many who are eager to labour in the unexplored fields of the Antarctic, and already a considerable proportion of the sum required to enable them to do so has been promised. All who are interested in the advancement of Antarctic researches are invited to send subscriptions to the Chairman of the Executive Committee, Royal London Yacht Club, 2 Savile Row, London, W.

MEMBERS of the engineering profession, who believe in the progress of industries through science, will be interested to learn that, according to *Science*, a movement is in progress, in the United States, having for its object the development of a system of mechanical engineering "experiment stations," on much the same basis as the existing agricultural experiment stations. It is anticipated that the outcome will be the organisation of such stations in all the agricultural and mechanical colleges of the country in which the agricultural experiment stations have been successfully organised and operated. The purpose of the movement is to secure the promotion of engineering research, and of the development of the scientific facts and principles which are of most value to the mechanical arts and to the profession of engineering. The headquarters of the central office, to which all will report, is thought likely to be the Bureau of Steam Engineering of the Navy Department; that being the largest, most important, and most generally suitable of the Government Bureaux to take cognisance of such work as is contemplated. A Department of Mechanical Arts was proposed years ago, probably earlier than the Department of Agriculture; but the importance of the former has not been as promptly or as fully recognised as that of the latter, and nothing has yet been done in that direction. Should such a department be founded, it will naturally become the centre of the work of mechanical engineering experiment stations.

A BILL "to establish the University of the United States," was recently introduced simultaneously in the United States Senate and House of Representatives. It provides for the representation at all times of twelve other institutions of the United States in the educational control of the National University. A National University Committee of one hundred has been formed, embracing the Chief Justices of the United States, ten ex-United States senators, certain ex-United States ministers and governors especially interested, the presidents of a number of colleges and universities, the State superintendents of thirty-seven of the States, and the heads of leading national organisations, scientific and patriotic, together with the chiefs of the Government bureaus at Washington. The measure provides for that higher instruction only which follows the work of graduate institutions, and for the induction of students of post-graduate rank into the many fields of original work in research and investigation. The business affairs are to be managed by a board of sixteen regents, with the President of the United States at its head, six members being such *ex officio*, and the remaining nine to be appointed by the President with the consent of the Senate. The educational officers are to be managed by a university council, composed of the regents, acting jointly with twelve eminent educationists representing as many leading institutions of as many States, holding office, like the Regents, for six years, and appointed on the principle that each of the States may in time have representation. The University is authorised to establish such co-operative relations with other institutions as shall be deemed advantageous to the public interests. Neither partisan nor sectarian preferences are to be allowed in any form. Admission is to depend on competency only. The Bill provides for only a few thousand dollars in each of the years 1897 and 1898, to enable the regents to organise, and for the necessary preliminary work.

IT is stated that the New York Pasteur Institute has purchased a farm of about two hundred acres near Tuxedo Park, to be used as an experiment station.

THE storm that visited New York on December 26-27 was attended by the most violent wind ever recorded there. A wind velocity of eighty miles an hour was noted.

MR. JOHN DONNELL SMITH is again in Nicaragua in pursuance of his botanical explorations, which have already been so fertile in additions to the Central American flora.

WE regret to notice the deaths of Prof. Teichmann, formerly Professor of Anatomy and Physiology at Cracow; and of Mr. Hugh Miller, Geologist on the Geological Survey of Scotland, and author of several geological memoirs.

THE vacancy in the Curatorship of the South African Museum, Capetown, caused by the retirement of Mr. Roland Trimen, F.R.S., has been filled by the appointment to that office of Mr. William L. Sclater, Assistant Master of Eton College, and Curator of Eton College Museum. Previously to his present appointment at Eton, Mr. Sclater was for several years Deputy Superintendent of the Indian Museum, Calcutta.

M. R. SCHLECHTER is intending shortly to start on a two years botanical exploration of the South and East of Africa. His programme includes a prolonged stay in Namaland, the Transvaal, Coud-Bockeveld, Limpopo, and Matabeleland as far as the Zambesi. Subscriptions for his collections will be received by Prof. Schumann, Botanical Museum, Grünewaldstrasse, Berlin. They will be at the rate of 35 marks the hundred.

MR. GEORGE W. VANDERBILT is establishing, on his estate at Biltmore, in North Carolina, a scientific collection of dried plants in connection with an arboretum and scientifically managed forest. As a nucleus he has recently purchased, as we learn from the *Botanical Gazette*, Dr. Chapman's herbarium of Southern American plants, which formed the foundation for his "Flora of the Southern States."

THE Fishery Board for Scotland has been reconstituted in accordance with the Sea Fisheries Regulation (Scotland) Act of last Session. Mr. A. Sutherland is reappointed chairman, Mr. R. W. Cochran Patrick is appointed deputy-chairman, Mr. Donald Crawford legal member, and Dr. John Murray scientific member. The other members are Mr. I. R. Welch, Dr. W. R. Duguid, and Mr. A. Jameson.

A REUTER telegram from Stockholm states that, at the instance of the Ministry for Foreign Affairs, notice has been sent to the Governments of Russia, Denmark, Great Britain, and the United States, of S. A. Andrée's projected balloon voyage to the North Pole, and co-operation asked for on behalf of the expedition. Furthermore, the authorities in the countries surrounding the Polar circle will be invited to distribute some thousands of leaflets, containing illustrations of the balloon, and asking for information as to the time at which the balloon is seen, and the direction of the wind at the moment.

ACCORDING to a Reuter telegram from Teheran, there have been two severe earthquakes in Khalkhal, north of Miana. The first occurred during the night of January 2. It was not felt outside the district, but completely destroyed the large village of Zanjabad and partially destroyed several other villages. Three hundred persons lost their lives. The second shock occurred early on the morning of the 5th inst., and was very severe, being felt more than a hundred miles away. The small town of Goi was completely destroyed, 1000 houses being laid in ruins, while great damage was done to many villages. The loss of life in Goi alone amounted to 800 persons. A sharp earthquake disturbance was also felt at Meshad and Kelat at 10.50 on the morning of January 8.

DURING last week an anti-cyclone lay over the British Islands, during which the barometer read higher than had probably been recorded before in this country. The *Daily Weather Report* issued by the Meteorological Office on the 9th inst. showed a barometer reading of 31·09 inches at Ardrossan, in the West of Scotland, and the readings over the whole of the northern and north-western parts of the kingdom reached or exceeded 31 inches. The nearest reading to this occurred in January 1820, again on the 9th, when the barometer in Scotland rose to 31·06 inches; which until now had been considered to be the highest on record in the British Islands. In January 1882, a reading of 30·99 inches was recorded in the South of England.

WE owe the following news to Mr. R. H. Scott, who received it from Caherciveen. "On Monday night, January 6, at about half-past seven o'clock, a large meteor fell from the sky and approached the earth from a north-east direction. As it approached near the earth with accelerated velocity, brilliant sparks or particles were shot out from it in all directions. The whole country was brilliantly illuminated for about ten seconds, that is, during the time occupied by the meteor in its descent. When the meteor was apparently within about two hundred yards of the earth, it burst or exploded, and the increased illumination was most remarkable. It was impossible for a person to estimate, even approximately, the place or neighbourhood where this meteor fell. Different persons, viewing it from various standpoints, give different locations, but they all agree that the descent was westward or seaward of this locality. The meteor was, apparently, of a globular form, with a tail about eight times as long as the diameter of the globular portion. All was of the same brilliant radiance, but a few seconds before the end of the fall, or when the meteor was extinguished, the half of the tail furthest away from the body became black."

THE Swiss National Exhibition begins at Geneva on May 1 and terminates October 15. Mr. Theodore Turrettini, Mayor of Geneva, is president of the exhibition, and it is expected that the electrical exhibit will be remarkably good. Mr. Turrettini has recently completed great engineering works near Geneva, whereby the river Rhone supplies 12,000-horse power, to be electrically transmitted six miles to the grounds. This power makes it possible for elaborate electrical works to be shown. There will be a travelling footpath, operated by electricity, traversing the great machinery hall; horseless cabs driven by electricity, appliances for aerial navigation, a multiplying valve-pump, processes for making paper and fabrics, tests of strength on metals, and many other appliances. Prof. Pictet will exhibit his apparatus for producing intense cold, and will demonstrate the uses of very low temperatures. Numerous other exhibits of scientific interest will be shown.

PROF. W. C. RÖNTGEN, Professor of Physics in Würzburg University, is reported to have discovered that a number of substances which are opaque to visible rays of light, are transparent to certain waves capable of affecting a photographic plate. It is alleged that he has been able to utilise his discovery to photograph metals enclosed in wooden or woollen coverings, and has succeeded in obtaining pictures showing only the bones of living persons, the explanation being that, while wood and flesh freely allow the newly-discovered actinic rays to pass through them, bones and metals are opaque to them. So far as we can gather from the reports, Prof. Röntgen uses as his source of light one of Mr. Crookes' high-vacuum tubes, electrically excited. If this is placed on one side of a box containing a metallic body, or if a hand is held in front of it, and a sensitive plate is arranged on the opposite side, a photograph of the metal, or of the bones of the hand, as the case may be, is obtained. The scientific world will look forward with interest to the publication of the details of Prof. Röntgen's work.

THE old question as to the influence of public libraries in disseminating infection is commented upon by the *British Medical Journal*, in the current issue. It is pointed out that an article in the last number of the *Annales de l'Institut Pasteur*, by Du Cazal and Catrin, is devoted to this question, and it is shown that the leaves of book soiled by streptococcus pus, pneumonic pus, and expectoration, or by diphtherial false membranes, were capable after several days of transmitting these maladies to animals inoculated by bouillon in which pieces of the leaves 1 centimetre square had been soaked. In regard to the question how far it is possible to disinfect books that have become charged with a contagium, these authors show that there are considerable difficulties in the way. Of chemical disinfectants they recommend the vapour of formic aldehyde in which calcium chloride has been dissolved. By means of this they obtained complete disinfection, except in regard to typhoid fever. By exposure to high-pressure steam, however, they got good results—the disinfection was perfect and complete. But in the case of bound books the steam had very destructive effects, the millboard being softened and the cloth wrinkled. Stitched books, however, were uninjured, no harm being done either to the paper, the ink, or even to coloured engravings.

IT speaks well for the extension of interest in science that steamships are advertised to proceed from London with passengers to view the total solar eclipse from Vadsö, in the Varanger Fjord, on August 9. The conditions of 1851, when a small expedition observed a total eclipse from Bue Island, Norway, has given place to a new state of things; and there seems every possibility that for every one who went out to see the obscuration of the sun then, fifty will witness the phenomenon next August. The Orient Steam Navigation Company will send out two of their steamships; Messrs. Cook and Son have made arrangements for special eclipse cruises; and Messrs. Gaze and Son announce a trip to Vadsö in the *Norse King*. This steamer is due at Vadsö on August 3, which leaves sufficient time for the average sightseer to settle down to a frame of mind suitable for observing a solar eclipse. But we notice with some astonishment, in a circular issued by Messrs. Gaze and Son, the statement that "an official party of observers, arranged by a joint committee of the Royal Society and of the Astronomical Society, are proceeding to Norway, and will travel by the s.s. *Norse King*." We can hardly think that this statement is authoritative, for scientific committees are not in the habit of advertising their intention to patronise any particular line of steamers; and, further, astronomers usually require more than five days to adjust and set up their instruments, if any work of real use to science is to be done. Of course, those photographers who merely wish to take snap-shots at the corona do not need to make any elaborate preparations, and if the steamship they travel by carries them into harbour two or three days before August 9, they will have ample time to point their cameras correctly.

IN a short note contributed to the Paris Academy of Sciences on December 30, Prof. Suess calls attention to the striking geographical results of the researches of his Vienna colleagues on the marine Triassic fauna. While to English geologists the Trias is the typical example of an unfossiliferous land-deposit, the work of Mojsisovics on the contemporaneous deposits of the Alpine region has been the starting-point for a series of discoveries in many parts of the world. A rich marine Triassic fauna is now known extending from Spain to Japan and California, and from Spitzbergen to New Zealand. Yet among the thousands of these fossils gathered together in Vienna from all parts, there is not a single marine fossil from the regions bordering the Atlantic or Indian Oceans. The conclusion is obvious, that the regions of these modern oceans were not covered by sea in Triassic times. On the other hand, all the districts bordering the Pacific and Mediterranean yield the marine forms, as does a great stretch of land extending from the Mediterranean to the Pacific through Central Asia, and another extending from the Pacific through Eastern Siberia to the Arctic Ocean. Thus the Pacific Ocean was the main ocean in Triassic times, and stretched out two arms across the continental region—the one called the *Tethyan* ocean, of which the Mediterranean is the last remnant, the other the Arctic branch. This distribution of the Triassic seas strikingly agrees with that of the structural features of modern coast-lines indicated by Neumayr: the oceans bordered by lands with marine Trias are the oceans of the *Pacific type*, of which the coasts are determined by the convex margins of earth-folds; while the oceans of *Atlantic type*, of which the margins cut across the mountain-folds, are those around which only the fresh-water Triassic strata are found. Thus is confirmed the opinion that the latter oceans are of comparatively recent origin, and have been produced by a process of wholesale depression, which has cut out the three great triangular upstanding masses (or *horsts*) of Greenland, Africa, and India, which form so striking a feature on the surface of our planet.

THE Geological Survey has generally been successful with its index maps, and the beautiful hand-coloured index of Wales, on the scale of four miles to an inch, has a great reputation for correctness of topography, clearness and accuracy of colouring, and beauty of appearance. After the lapse of a long period, the Survey, about two years ago, began the issue of an index map of England and Wales on the same scale, and of this several sheets have been already issued. These sheets were also coloured by hand; but on account of their complicated structure they were necessarily very expensive to produce, and hence, although sold with the barest possible margin of profit, or, indeed, with none at all, they could never become very widely used in consequence of their high price. Now, however, an important experiment has been tried, the issue of Sheet 12 printed in colours. This map includes the London Basin and the greater part of the Weald, and it is identical with the hand-coloured sheet; but whereas the price of the latter was 10*s*. 6*d*., that of the former is 2*s*. 6*d*. Printing the map in colours brings with it practically no disadvantage. The topography is clear and correct, the latest railways being inserted; the colours are transparent, clean, harmonious, and well-defined; each colour is lettered at all critical points; the registration is wonderfully exact, although such minute delineation is a very severe test of the workmanship; and the detail is quite as full as on the hand-coloured map, which, it will be remembered, contained many revisions not as yet shown on the original 1-inch sheets. On the other hand, printing in colours has two inestimable advantages, which those familiar with the hand-coloured maps will realise to the full; the inevitable omissions of the colourist will disappear, and, as the colour-proofs come to hand, there is every encouragement for the makers of the map to exercise the minutest care in delineations of details, which, once inserted, cannot again drop out by accidental omissions of the draughtsman, engraver, or colourist. It is to be hoped that this is only the beginning of good things, and that the Survey will persevere until it has the rest of the index similarly printed, thus providing an unequalled and authoritative map of the whole country. If this is successful, we cannot stop here, but must look forward to having reproduced by colour-printing at least such of the 1-inch sheets as are sufficiently used to justify the expenditure. Indeed, it would doubtless be wisest, and really cheapest in the end, to undertake this course with all the sheets of the new series as they come out, irrespective of the demand upon each particular one. If these could be produced at the price of 1*s*., instead of 4*s*., a brisk demand would be at once created. The public must, however, do its share. We have already stated that the index-sheet is issued as an experiment. If the issue is well supported, this will furnish a great encouragement to the Stationery Office to follow the good course it has begun.

A GRAPHIC method of determining the focal lengths of lenses and mirrors is described by Dr. E. H. Barton in the *Philosophical Magazine*. For a concave mirror, cut off the distances of the object and the image respectively on the two axes of Cartesian coordinates, and join the two points. Two separate observations will give two lines intersecting in a point equidistant from the two axes. The coordinates of this point are both equal to the focal length required. The measurements may be controlled by another observation, and the line now obtained should intersect the other two in the same point. A line passing through this point and rotating about it will cut off in succession all the possible values of the conjugate focal distances. For a convex lens, the point is situated in the right hand lower quarter, for a convex mirror in the left-hand lower, and for a concave lens in the left-hand upper quarter of the plane of coordinates.

ON no other frequented trade route are vessels so liable to be obstructed by drift ice as in that portion of the South Atlantic lying to the east of Cape Horn and the Falkland Islands. A chart just issued by the U.S. Hydrographic Office, to show the limits of the enormous ice fields encountered by mariners in those waters, will therefore be of great service. The chart also gives for the months of March, April, and May the isotherms or lines of equal temperature of the surface water. It is stated, however, that these lines are of doubtful value to the navigator in announcing the proximity of ice, as practical experience has shown that the temperature of the surface is little affected thereby. The report of Captain Macmillan, of the ship *Dudhope*, is especially interesting in this connection: "Careful thermometric observations of air and water were regularly taken, but our approach to ice, always from windward, was not once indicated by any appreciable change of temperature, in either air or water. On passing to leeward of the bergs, a fall of a few degrees was generally observed *in the air*. On one occasion we passed within a cable's length of a berg, and found the temperature to be the same there as at several miles' distance. This would go to show that in thick weather—or in any other—even temperature and thermometer at normal height should not be accepted as a trustworthy guarantee of immunity from ice. Care and a most vigilant look-out are the only trustworthy safeguards. To depend on the thermometer would mean disaster, as I am convinced that a ship would be too close to the ice to extricate herself by the time the thermometer would indicate its presence."

RECENT progress in the chlorination process for the extraction of gold from its ores lies mainly in the direction of improvements in the mechanical appliances which are used. The repeated efforts to prevent the oxidising action exercised by chlorine on the unroasted sulphides in ores, by adding salts such as nitre to the mixture, have now apparently been abandoned. Most chemists have always regarded the hopes of the experimenters in this direction as chimerical. Among the mechanical improvements of the last year have been the enlarging of the lead-lined steel barrels used in Western America. As now made, these barrels take a charge of ten tons of ore, instead of only five. The filter inside the barrel is retained, but the expensive asbestos cloth, which lasted for only a few charges, is replaced by a cheap sand-filter, which, it is stated, is not shifted by the rotation of the barrel, and does not become clogged until after it has been used for about 100 charges, or say a month. While the Americans are thus engaged in perfecting the barrel process, the Australians have abandoned it altogether. At the Mount Morgan Mine, where there is the largest chlorination plant in the world, the vats have been reintroduced, but are much enlarged, each having a capacity of twenty-five tons. Chlorine water is used, the consumption of chemicals being less, and the reagent more under control than if gas is pumped into the charge. The use of bleaching powder and sulphuric acid for generating the gas has been superseded again by manganese dioxide, salt and sulphuric acid, and the installation of chlorine stills, towers, and solution tanks. The extraction of gold at Mount Morgan is about 95 per cent. of the total amount in the ore, and the cost of treatment, now about 15*s*. per ton, is expected to be reduced to 12*s*. per ton by the more extended use of revolving furnaces. The total production at the mine is at the rate of over 100,000 ounces of gold per annum. The impetus given to the barrel chlorination process a few years ago seems, from the above facts, to have spent its force.

THE *Bulletin* of the Kansas Experimental Station records instances of the poisoning of cattle by eating the stalks of Indian corn, from the very large amount of potassium nitrate which they contain.

OUR attention has been drawn to two laborious investigations by E. Mazelle, of the Trieste Observatory, recently presented to the Vienna Academy of Science, relating to the daily and yearly range of variability of temperature, and to the relations between the usual mean value and the "most frequent" values of temperature, as deduced from the records of fifty years, 1841-90. The difference between the mean and most frequent values has been discussed by various authorities, notably by Dr. J. Hann in the second edition of his "Climatology." The observations for each month, or year, are grouped so as to show how often a certain value, or interval of temperature occurs, and from these a curve is drawn which differs, according to circumstances, from one showing the mean values, and, while not superseding the latter, is of considerable interest for comparison with it. For various interesting details we refer our readers to the original papers.

THE third edition of M. Faye's "L'Origine du Monde' (Gauthier-Villars, Paris) has lately been published. In this volume M. Faye states and discusses various theories and beliefs held as to the mode of the genesis of worlds, from the Mosaic record to the views of Kant and Laplace, and of their successors. Within the past ten years much work bearing upon the evolution of worlds has been done. Long-exposure photographs of nebulæ have given astronomers more information upon cosmical genesis than all that was known before their era, and photographs of spectra have enabled spectroscopists to arrange celestial objects in order from the youngest to the oldest. We naturally turned to the new edition of M. Faye's book expecting to find the work of recent years set down with the fulness which it deserves. But we were disappointed. Instead of a picture of Dr. Roberts' photograph of the Andromeda nebula, there appears a venerable cliche which ought to be banished from every book that pretends to represent astronomical knowledge of to-day. The same remark applies to the picture and the spectrum of the Orion nebula, of the spectrum of Sirius, and to most of those in the volume. When the first edition of the book appeared, such illustrations might have passed muster; but in these days of abundant photographs and cheap process-blocks, there is no excuse for offending the sight with them. We cannot see any difference between the third edition of M. Faye's book and the first edition, as regards illustration, and little difference as regards the text.

THE additions to the Zoological Society's Gardens during the past week include a Persian Gazelle (*Gazella subgutterosa*, ♂) from Persia, presented by Mr. F. Greswolde-Williams; two Polecats (*Mustela putorius*, ♂ ♀), British, presented by Mr. A. H. Cocks; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, presented by Lieut.-General Arthur Lyttleton-Annesley; two West African Love-Birds (*Agapornis pullaria*) from West Africa, presented by Mrs. Otto Fell; a Crowned Duyker-Bok (*Cephalophus coronatus*, ♀) from West Africa, two King Penguins (*Aptenodytes pennanti*) from the Macquari Islands, purchased.

ERRATUM.—In the article on "The Habits of the Cuckoo" (p. 176), for Dr. Reh read Dr. Rey.

OUR ASTRONOMICAL COLUMN.

HIND'S VARIABLE NEBULA.—Further confirmation of the variability of the nebula N.G.C. 1555, discovered by Dr. Hind in 1852, has been obtained by Prof. Barnard (*Monthly Notices*, vol. lvi. p. 66). It may be remembered that so recently as February 1895, the nebula was an easy object in the Lick telescope, while Struve's nebula, in the immediate neighbourhood, was absent, and the nebulosity round τ Tauri was imperceptible (NATURE, vol. lii. p. 180). Under the very best conditions of observation in September last, however, Hind's nebula seemed to have entirely vanished, although every means was tried to see it. This appears to definitely prove that the light of the nebula fluctuates, and it is therefore desirable that the place of this object should receive careful attention. τ Tauri was involved in a small hazy nebulosity, but the definite nebula in which it shone in 1890 did not exist four months ago.

o CETI.—The last two or three maxima of this well-known variable star have occurred considerably later than the computed times, and the present, or perhaps approaching, maximum is similarly behindhand. According to the ephemeris in the *Companion to the Observatory*, there should have been a maximum on December 9, but on January 8, the star had barely reached 4th magnitude. The star is now much more favourably situated for observation than during several preceding maxima; and, in view of the irregularity to which reference has been made, it is important that the magnitude should be recorded as frequently as possible. Spectroscopic observations will also be valuable, and it may not be out of place to suggest a special look-out for bright lines of helium and the associated gases, as well as observations of the varying relative brightness of the carbon fluting slightly more refrangible than the *b* group of magnesium.

STELLAR VELOCITIES WITH OBJECTIVE PRISM.—The great advantages of the objective prism over the slit spectroscope for photographing the spectra of stars have been abundantly demonstrated, but hitherto the latter form of instrument has been considered essential for precise determinations of velocities in the line of sight. An adaptation of the objective prism for the latter purpose is proposed by M. Deslandres (*Observatory*, January). In the arrangement suggested, the collimator of an ordinary spectroscope is placed in a direction perpendicular to the rays proceeding from the star, and the light passing through the slit from the comparison spark is reflected upon the objective prism by a small totally-reflecting prism. The collimator, objective prism, and photographic telescope, thus constitute a complete slit spectroscope. With the aid of the auxiliary visual telescope, the spectrum of the star is photographed with the objective prism in the ordinary way, and during the exposure the terrestrial spectrum is photographed nearly alongside that of the star, the adjustments having been so made that lines of equal refrangibility in the two spectra are in the same straight line. The spectrum of a star with which a comparison of velocity is desired, or may be that of the same star after an interval, is then photographed adjacent to the first, with the help of the visual telescope; and another terrestrial spectrum is photographed alongside the previous one, a different part of the slit being exposed to the spark. This comparison of terrestrial spectra enables the errors due to temperature and flexure to be determined, and the difference of velocity of the two stars is given by the displacement of the two stellar spectra minus that of the two terrestrial. Evidently the accuracy will depend very largely upon the precision in setting the two stars in the visual telescope; to secure this it is proposed to attach a small photographic telescope to the guiding telescope, and to photograph the two stars, together with a reticule, which will enable the deviation, if any, to be measured and allowed for. To get the absolute velocity of a star, it must be compared with a star of known velocity, or Orbinsky's method (NATURE, vol. lii. p. 155) of measuring the contraction or dilatation of the whole spectrum may be applied. In the latter case, the absolute velocity could be determined directly, since effects of temperature, &c., would be eliminated.

A NEW STAR IN CENTAURUS.[1]

A NEW star in the constellation Centaurus was found by Mrs. Fleming on December 12, 1895, from an examination of the Draper Memorial photographs. Its approximate position for 1900 is in R.A. 13h. 34·3m., Dec. − 31° 8′. Attention was called to it from the peculiarity of the spectrum on a plate taken at Arequipa on July 18, 1895, with the Bache Telescope, exposure 52 mins. The spectrum resembles that of the nebula surrounding 30 Doradus, and also that of the star A.G.C. 20937, and is unlike that of an ordinary nebula or of the new stars in Auriga, Norma, and Carina. This object is very near the nebula N.G.C. 5253, which follows 1·28s., and is north 23″. No trace of it can be found on 55 plates taken from May 21, 1889, to June 14, 1895, inclusive. On July 8, 1895, it appeared on a chart plate, and its magnitude was 7·2. On a plate taken July 10, 1895, its magnitude was also 7·2. On December 16, 1895, a faint photographic image of it, magnitude 10·9, was obtained with the 11-inch Draper Telescope, although it was very low, faint, and near the sun. On this date, and on December 19, it was also seen by Mr. O. C. Wendell with the 15-inch Equatorial as a star of about the eleventh magnitude. An examination with a prism showed that the spectrum was monochromatic, and closely resembled that of the adjacent nebula. Although the spectrum is unlike those of the new stars in Auriga, Norma, and Carina, yet this object is like them in other respects. All were very faint or invisible for several years preceding their first known appearance. They suddenly attained their full brightness and soon began to fade. Like the new stars in Cygnus, Auriga, and Norma, this star appears to have changed into a gaseous nebula.

The star which was photographed in 1887 in the constellation Perseus apparently belongs to the same class. Its approximate position for 1900 was in R.A. 1h. 55·1m., Dec. + 56° 15′. Eight images of it were obtained on the Draper Memorial photographs in 1887, all in exactly the same place. Its photographic spectrum showed the hydrogen lines Hβ, Hγ, Hε, and a line near 4060, bright, and from this property it was discovered by Mrs. Fleming and assumed to be an ordinary variable star of long period. The spectrum is so faint that it is impossible to decide from it whether it should be regarded as a new star of the class of Nova Aurigæ, or as a variable star of long period like o Ceti, as the hydrogen lines are bright in both these classes of objects. This star soon faded away and does not appear on 81 photographs taken during the last eight years. It has also been repeatedly looked for in the sky without success. No trace of this star appears on two photographs taken November 3, 1885, and December 21, 1886.

A list of the new stars hitherto discovered is given in the annexed table. Some changes would occur in it, if changes were made in the definition assumed for this class of objects. Early observations of several objects frequently called new stars, but which may have been comets, and whose positions are uncertain, have not been included. The stars T Bootis and U Scorpii have not been included, although they also may be new stars, as only one appearance of each has been noted. The name of the constellation is followed by the right ascension and declination for 1900, and the greatest brightness. The year of appearance is followed by the name of the discoverer; or, in the case of the earlier stars, of the principal observer.

[1] *Harvard College Observatory Circular*, No. 4.

NEW STARS.

Constellation.	R.A. 1900.	Dec. 1900	Mag.	Year.	Discoverer.
	h. m.	° ′			
Cassiopeia	0 19·2	+63 36	−5?	1572	Tycho Brahé
Cygnus	20 14·1	+37 43	3?	1600	Janson
Ophiuchus	17 24·6	−21 24	−4	1604	Kepler
Vulpecula	19 43·5	+27 4	3	1670	Anthelm
Ophiuchus	16 53·9	−12 44	5	1848	Hind
Scorpius	16 11·1	−22 44	7	1860	Auwers
Corona Borealis	15 55·3	+26 12	2	1866	Birmingham
Cygnus	21 37·8	+42 23	3	1876	Schmidt
Andromeda	0 37·2	+40 43	7	1885	Hartwig
Perseus	1 55·1	+56 15	9	1887	Fleming
Auriga	5 25·6	+30 22	4	1891	Anderson
Norma	15 22·2	−50 14	7	1893	Fleming
Carina	11 3·9	−61 24	8	1895	Fleming
Centaurus	13 34·3	−31 8	7	1895	Fleming

THE ETHNOLOGY OF THE BRITISH UPPER CLASSES.

IN "L'Anthropologie," tome v. (1894) Dr. Beddoe has published the results of his work on the cephalic index of the inhabitants of Great Britain and Ireland. Part of his work deals with the cephalic indices of the Cambridge undergraduates, which were placed at his disposal by J. Venn, F.R.S. He has also inquired into their height and weight, classing them in accordance with their place of origin; but he has taken no account of the colour of the eyes of these undergraduates, and so I thought it would be as well to continue his researches, now that there is more material to hand, paying especial regard to the colour of the eyes. It will be seen by a glance at the table appended that it is in a mere fraction of the total number that the eyes are described as "light." This is due to the standard of comparison afforded by the Anthropometrical Committee of the Cambridge Philosophical Society, and is a disadvantage which does not apply to the dark eyes, and it is therefore by confining our attention to the percentages of the dark eyes in the various groups that we get our best results.

I have examined, through the kindness of Dr. Venn, some 1400 more instances since Dr. Beddoe published his results in "L'Anthropologie." In the three special cases of cephalic index, height and weight, where my results are only a continuation of Dr. Beddoe's, I have, in the following table, incorporated his results in mine, so as to gain the advantage of having a larger number of instances to deal with. On glancing at the figures below, one is at first inclined to think that the upper classes of the various races, which have given rise to the present population of Great Britain and Ireland, have entirely fused with one another, as the differences between their respective indices are but small; but the following two points indicate, I think, that the fusion is still incomplete:—

(1) *Stature.*—The Welsh are about ·8 inch shorter than the English, and as much as 1·5 inches shorter than the Scotch. They are also a slighter race, they weigh less, are less strong muscularly, and have a smaller breathing capacity.

The English, again, are about ·7 inch. shorter than the Scotch, weigh about 4 lb. less, and are less strong.

(2) *Colour of Eyes.*—The greatest percentage of dark eyes is to be found in those undergraduates whose origin is in the west and south-west (34·76 per cent.). The smallest among those who come from the east and south-east (18·75 and 15·38 respectively).

The cephalic indices of the various groups do not show much difference. The chief point of interest is the fact that the dark-eyed English have broader and loftier heads than is the case elsewhere in England. This is just the reverse of what Dr. Beddoe found: "L'association," he says (p. 662), "de la couleur brune ou foncée des cheveux avec la dolichocéphalie parait être à peu près générale."

I may perhaps incidentally touch on a curious point, which is possibly due to nothing more than the instrument used, and that is, that one can, on the average, see further with the right eye than with the left. The average difference is fairly constant, and amounts to about two centimetres. Whether it is due to anything beyond external causes, I hardly like to say.

	Cephalic index.		Altitudinal index.		Height.		Weight.		Colour of eyes.			
	No. of cases.	Index.	No. of cases.	Index.	No. of cases.	Height in inches.	No. of cases.	Weight in pounds.	No. of cases.	Per cent. dark.	Per cent. medium.	Per cent. light.
North England ...	889	79.26	329	71.59	898	69.04	364	153.85	334	30.24	68.86	0.9
Midlands	309	79.1	113	71.63	315	68.84	319	153.4	120	30.83	68.33	0.83
West and South-West	207	79.17	99	72.2	207	68.97	207	154.7	98	34.7	64.28	1.02
East England ...	213	79.43	79	71.97	214	68.51	211	152.9	80	18.75	80.0	1.25
South-East England	59	79.4	28	72.22	60	68.64	58	153.5	26	15.38	84.62	0.0
South England ...	1125	78.96	398	71.91	1131	68.99	468	151.6	403	31.27	67.49	1.24
Total, England ...	3019	79.104	1046	71.819	3042	68.887	1627	153.1	1061	29.88	69.09	1.04
Scotland	211	71.972	76	71.09	212	69.53	213	157.1	75	30.66	69.33	0.0
Ireland	189	78.993	88	71.58	188	69.18	188	157.8	81	20.99	79.01	0.0
Wales	128	79.44	55	70.93	128	68.05	128	149.23	55	30.91	63.64	5.45
Total, British Isles..	3838	79.08	1265	71.72	3871	68.934	2159	153.67	1273	29.33	69.43	1.1
Dark-eyed English	93	79.93	80	72.46	93	68.7	85	152.9	93	100	0.0	0.0

	Span of arms, *i.e.* greatest distance between finger-tips.		Sight, *i.e.* greatest distance seen in centimetres.					Strength measured as pull by archer.		Strength measured by squeezing power of hand in pounds.					Breathing capacity, in cubic inches.	
	No. of cases.	Span in inches.	No. of cases.	Right eye.	No. of cases.	Left eye.	Mean of both eyes.	No. of cases.	Strength in pounds.	No. of cases.	Right hand.	No. of cases.	Left hand.	Mean.	No. of cases.	Cubic inches expired.
North England ...	351	71.55	355	61.9	328	60.4	61.65	356	83.7	329	86.5	353	80.6	83.55	356	259.6
Midlands	131	71.06	130	57.7	128	55.7	56.7	131	83	122	84	125	77.8	80.9	127	255
West and South-West	104	71.4	101	64.0	101	60.2	62.1	104	83.5	98	88.1	97	83.4	85.75	101	262.85
East England ...	90	71.41	85	54.6	87	51.5	53.05	87	79	84	82.8	86	76.6	79.7	89	250
South-East England	32	70.8	27	63	31	59.4	61.2	29	77.6	29	83.6	30	80.2	81.9	32	262
South England ...	467	71.03	445	60.4	451	58.4	59.4	459	81.3	455	84	451	78	81	461	258
Total, England ...	1175	71.25	1143	60.5	1116	58.3	59.4	1166	82.46	1117	85	1162	79.2	82.1	1164	258.1
Scotland	80	71.48	80	59.8	78	56.5	58.2	79	84.5	81	84.6	82	81.6	83.1	81	265
Ireland	90	71.48	85	61.6	86	61.1	61.35	88	83.1	85	85.3	84	81.8	83.6	91	259
Wales	60	69.98	60	62	59	58.5	60.25	59	82.5	60	82.9	58	77	80	60	249.2
Total, British Isles..	1405	71.22	1368	60.6	1339	58.38	59.49	1392	82.62	1343	84.9	1386	79.41	82.16	1396	258.2
Dark-eyed English	93	71	89	65.1	89	62	63.5	93	84.1	90	85.8	90	81.7	83.75	89	264

The table in the adjoining column shows, in each case, the number of instances examined, and the averages calculated from them.

R. J. HORTON-SMITH.

THE SMITHSONIAN INSTITUTION.[1]

I.

Promote, as an object of primary importance, *institutions for the increase and diffusion of knowledge*: in proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened.—GEORGE WASHINGTON, 1796.

I bequeath the whole of my property to the United States of America to found at Washington *an establishment for the increase and diffusion of knowledge among men.*—JAMES SMITHSON, 1826.

Let the trust of James Smithson to the United States of America be faithfully executed by their representatives in Congress: let this result accomplish his object—*the increase and diffusion of knowledge among men.*—JOHN QUINCY ADAMS, 1846.

THE name of the Smithsonian Institution is a household word in America, while in every centre of intellectual activity abroad, it is regarded as the chief exponent of the scientific thought of the people of the United States, thus representing that which is deemed in other lands to be a chief glory of our nation; for, whatever may be thought of American art and literature, or of American instituttons in general, the science of America is everywhere accepted as sound, vigorous, and progressive.

Its activities embrace every branch of human knowledge, for it was the intention of its organisers that art as well as science—the beautiful as well as the true—should receive its fostering care.

The Smithsonian Institution, although it bears the name of a foreigner, has for half a century been one of the most important agencies in the intellectual life of our people. It has been a rallying-point for the workers in every department of scientific and educational work, and the chief agency for the free exchange of books, apparatus of research and of scientific intelligence between this and other countries. Its publications, which include more than two hundred volumes, are to be found in all the important libraries in the world, and some of them, it is safe to say, on the work-table of every scientific investigator. Its great library constitutes an integral and very important part of the national collection at the Capitol, and its museum is the richest in existence in many branches of the natural history and ethnology of the New World. Many wise and enlightened scholars have given their best years to its service, and some of the most eminent men of science to whom our country has given birth, have passed their entire lifetime in working for its success.

The most important service, however, which the Smithsonian Institution has rendered to the nation—intangible, but none the less appreciable—has been its fifty years of constant co-operation with the Government, with public institutions, and with individuals in every enterprise, scientific or educational, which needed its advice, support, or aid from its manifold resources.

Visitors to the city of Washington carry away pleasant memories of the quiet group of buildings among the trees in the Mall, filled with the wonders of nature and art, and the trophies of scientific discovery. Few of them, however, have had the opportunity to visit the administrative offices and laboratories, or to gain any idea of the real significance and value of the work which is being carried on within those walls.

It is probable that no class of the American people appreciates the work of the Institution more fully than the members of Congress. This has been clearly shown by the uniform liberality with which, throughout many successive terms, regardless of changes in the political complexion of the administration, they have supported its policy; by the care with which they disseminate its reports; by the judgment with which they select their representatives upon its Board of Regents, and, above all, by the scrupulous care with which they protect the Institution in its independence of political entanglements. That the Institution has accomplished so much in the past is largely due to the support which it has received from these practical men of

[1] By Dr. G. Brown Goode. This paper was printed for distribution at the Atlanta Exposition, and has since been revised and extended for NATURE. It is based upon the author's essay on "The Smithsonian Institution," printed in 1885, in "The Chautauquan" (vol. v. pp. 275-79), and upon later writings, especially "The Origin of the National Scientific and Educational Institutions of the United States" (Report American Historical Association, 1889, pp. 53-100); "The Genesis of the National Museum" (Smithsonian Report, 1891, ii. pp. 273-380), and the article "Smithsonian Institution" in Johnson's Cyclopædia, new edition (vol. vii. 1895).

business, and through them from the people of the United States; since the comparatively small income of the Institution has been made a nucleus for very considerable annual appropriations granted by the United States Congress, for the support of the manifold interests the administration of which have been entrusted to it. It is to such support that it will owe its efficiency in the future, and it seems right that every opportunity should be taken to explain its operations to the public. No intelligent American can fail to appreciate the benefits which the highest interests of the American people receive through the proper administration of the Smithsonian bequest.

THE ORIGIN OF THE INSTITUTION.

The story of the foundation of the Smithsonian Institution sounds more like romance than fact. It seems like the fulfilment of some prophecy, and all the more so because of the promise of the future.

The father of the founder of the Smithsonian Institution, in early life known as Sir Hugh Smithson, was one of the most distinguished members of the English peerage. Upon the plate of his coffin in Westminster Abbey, where he was buried "in great pomp" in 1786, he was described as "the most high, puissant and most noble prince Hugh Percy, Duke and Earl of Northumberland, Earl Percy, Baron Warkworth and Lovaine, Lord Lieutenant and Custos Rotulorum of the Counties of Middlesex and Northumberland and of all America, one of the Lords of his Majesty's most Honourable and Privy Council, and Knight of the most noble Order of the Garter, &c., &c., &c."

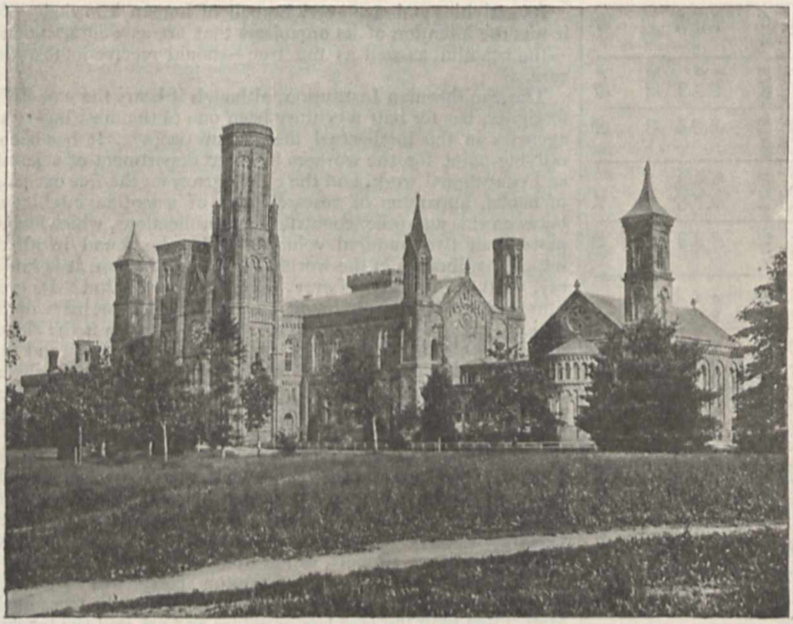


FIG. 1.—The Smithsonian Building.

While his aged father was supporting this overwhelming burden of honours and dignities, and while his half-brother, Earl Percy, was serving as a Lieutenant-General in the war against the rebellious British colonies in North America,[1] James Smithson, a youth of modest fortune, was acquiring the rudiments of a scientific education in English schools and colleges. He received the degree of Master of Arts from Pembroke College, Oxford, in 1786, the year of his father's death. He was then known as James Lewis Macie, for he did not assume the name of Smithson until several years later, after he had attained to some reputation as a man of science. His mother was not the Duchess of Northumberland, but her cousin, Elizabeth Keate Macie, of Weston, near Bath (widow of James Macie), great-granddaughter of Sir George Hungerford of Studley, and his wife, Lady Frances Seymour, sister of the sixth Duke of Somerset and aunt of Algernon Seymour, Lord Percy, whose daughter Sir Hugh Smithson married, and was thus enabled to assume the name of Percy and the title of Duke of Northumberland.[1]

[1] Lord Algernon Percy, afterwards Duke of Northumberland, commanded the reinforcements at the battle of Lexington in 1775, and led the column which reduced Fort Washington, near New York, in 1776.

The Smithsons were an old Yorkshire family; Sir Hugh, the great-grandfather of James Smithson, having been created baronet by Charles II. in 1660.

James Smithson was undoubtedly proud of his illustrious ancestry, for in his will he described himself as "son of Hugh, first Duke of Northumberland and Elizabeth, heiress of the Hungerfords of Studley, and niece of Charles, the Proud Duke of Somerset."

He was, however. a man of broad, philosophic mind, and his training in the best scientific methods of his day, and association with leading investigators in Germany and France, and with his brother Fellows of the Royal Society of London, had developed in his mind a generous appreciation of the value of scholarship and scientific culture, and of the still greater importance which these were to have in coming years.

"The best blood of England flows in my veins," he once wrote; "on my father's side I am a Northumberland, on my mother's I am related to kings,[2] but this avails me not. *My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten.*

These words seem little less than prophetic. The founder of the Smithsonian Institution has already earned perpetual fame.

The names of the successive Dukes of Northumberland, his kinsmen, have, as a rule, been little known outside Great Britain, though several of them have been munificent patrons of science.

Smithson seems, early in life, to have come fully into harmony with the scientific spirit of his time. In 1784, while still an undergraduate at Oxford, he made a scientific exploration of the coasts of Scotland in company with a party of geologists. In 1787 he was admitted a Fellow of the Royal Society, and during the remaining forty-two years of his life, in Berlin, Paris, Rome, Florence, and Geneva, he was an associate of the leading men of science, and devoted himself to research. He made an extensive collection of minerals, which was destroyed by the burning of a portion of the Smithsonian building in 1865, and he always carried with him in his travels a portable laboratory for chemical research.

His contributions to science are included in twenty-seven memoirs, chiefly upon topics in mineralogy and organic chemistry, though some of them relate to applied science and the industrial arts. His work, though not of an epoch-making character, was remarkable for its minute accuracy.

Smithson was a greater man than is indicated by his published writings alone. Berzelius declared that he was one of the most accomplished mineralogists in all Europe.

He was a man of generous culture who understood thoroughly the needs of the world in the direction of scientific endowment,

[1] Smithson was born in France in 1765. The date 1754 usually given for his birth and engraved upon his tomb is wrong, as is shown by his Oxford matriculation records. The source of his fortune is not certainly known. At Oxford, where he was entered as a Gentleman Commoner, he was understood to have succeeded to the estate of his mother's husband, Macie, and in 1794 he received a bequest of £3000 from his half-sister, Dorothy Percy. The major portion of his estate, however, came to him by the bequest of his half-brother, Colonel Henry Louis Dickinson, of the 84th Regiment of Foot, who died in Paris in 1820. The statement of Smithson that his mother was "heiress of the Hungerfords of Studley," probably indicates the source of a considerable portion of the wealth of which that document made disposition.

[2] Smithson was of royal descent, through his maternal ancestor, the ill-fated Lady Catharine Grey, great-granddaughter of King Henry VII., grandniece of Henry VIII., and cousin of Elizabeth. His ancestor in the ninth generation, Edward Seymour, the first Duke of Somerset and Protector of England, was the brother of Queen Jane Seymour and the uncle of King Edward VI.

and his action in bequeathing his estate to the people of America was deliberate and well considered.

In that admirable little monograph entitled "Smithson and his Bequest," Mr. W. J. Rhees has pointed out that the tendency of the time of Smithson was towards the establishment of permanent scientific institutions. Between 1782 and 1826, over twenty of the most important academies and societies now in existence were organised. "This period," he writes, "was not less marked by the gloom occasioned by long, protracted and almost universal war, and the extent and rapidity of its social changes, than by the lustre of its brilliant discoveries in science, and its useful inventions in the arts. Pure science had many illustrious votaries, and the practical application of its truths gave to the world many of the great inventions by means of which civilisation has made such immense and rapid progress." In support of these statements he quotes the words of Lord Brougham, who said that "to instruct the people in the rudiments of philosophy would of itself be an object sufficiently brilliant to allure the noblest ambition."

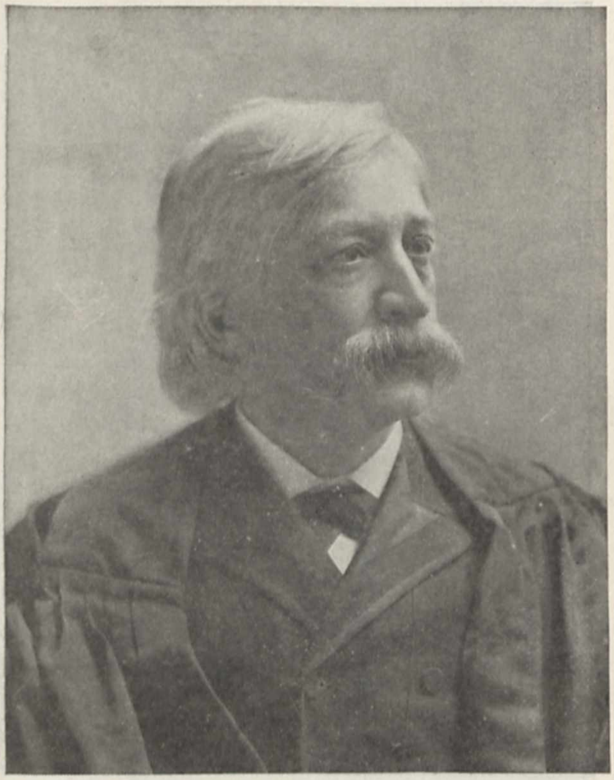


FIG. 2.—Chief Justice Fuller, Chancellor of the Smithsonian Institution.

Brougham forcibly recommended this idea to the wealthy men of England, pointing out that by the promotion of such ends, a man, however averse to the turmoil of public affairs, might enjoy the noblest gratification of which the most aspiring nature is susceptible, and influence by his single exertions the fortunes of a whole generation.

Very closely do these thoughts correspond to those expressed by Smithson in various passages in his note-books, and especially with that which is used for a motto upon the publications of the Institution:—

"*Every man is a valuable member of society, who by his observations, researches, and experiments, procures knowledge for men.*"

Another sentence of his is still more pregnant with meaning. It is this:—

"*It is in his knowledge that man has found his greatness and his happiness, the high superiority which he holds over the other animals who inherit the earth with him, and consequently, no ignorance is probably without loss to him, no error without evil.*"

It was with a mind full of such thoughts as these, with perhaps the support and inspiration of Lord Brougham's words quoted above from his "Treatise on Popular Education," printed in 1825, with such models in mind as the Royal Society, whose object is "the improvement of natural knowledge," the Royal Institution "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching the application of science to the common purposes of life," and the Society for the Diffusion of Useful Knowledge, established in London in 1825, that in 1826 Smithson drew up his will, containing this most significant provision:—

"I BEQUEATH THE WHOLE OF MY PROPERTY TO THE UNITED STATES OF AMERICA TO FOUND AT WASHINGTON, UNDER THE NAME OF THE SMITHSONIAN INSTITUTION, AN ESTABLISHMENT FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN."

There is no reason known why he should have selected the United States as the seat of his foundation, though it is certain

FIG. 3.—Joseph Henry, First Secretary of the Smithsonian Institution, 1846-78.

that he was in full sympathy with republican governments and the liberty of the people. His library contained only two books relating to America. Rhees quotes from one of these, "Travels Through North America," by Isaac Weld, secretary of the Royal Society, a paragraph concerning Washington, then a small town of 5000 inhabitants, in which it is predicted that "the Federal city, as soon as navigation is perfected, will increase most rapidly, and that at a future day, if the affairs of the United States go on as prosperously as they have done, it will become the grand emporium of the West, and rival in magnitude and splendour the cities of the whole world."

It is probable that he knew Joel Barlow in Paris, and was familiar with his plan for a realisation of Washington's project for a great national institution of learning in the Federal city.

Inspired by a belief in the future greatness of the new nation, realising that while the needs of England were well met by existing organisations such as would not be likely to spring up for many years in a new, poor, and growing country, Smithson founded in the new England an institution of learning, the civilising power of which has been of incalculable value. Who can attempt to say what the condition of the United States would have been to-day without his bequest? Well did John Quincy Adams say:—

"*Of all the foundations of establishments for pious or charitable uses which ever signalised the spirit of the age or the comprehensive beneficence of the founder, none can be named more deserving the approbation of mankind.*"

In 1835, six years after Smithson's death, the United States legation in London was notified that his estate, amounting in value to about £100,000, was held in possession of the accountant-general of the British Court of Chancery.

As soon as the facts became public, great opposition to the acceptance of the gift arose in Congress. Eminent statesmen, led by Calhoun and Preston, argued that it was beneath the dignity of the United States to receive presents, and that the donor was seeking immortality for too moderate an equivalent. The wise counsels and enthusiastic labours of John Quincy Adams, who seems to have had from the first a thorough appreciation of the importance of the occasion, finally prevailed, and the Honourable Richard Rush was sent to England to prosecute the claim. He entered a friendly suit in the Courts of Chancery in the name of the President of the United States, and obtained, in less than two years, an event unparalleled in the history of Chancery, a favourable decision. The legacy was brought over in the clipper ship *Mediator*, in the form of 104,960 gold sovereigns. These were delivered September 1, 1838, to the Philadelphia Mint, and immediately recoined into American money, yielding 508,318.46 dols. as the first instalment of the legacy. This was soon after increased to 515,169 dols., and in 1867, by a residuary legacy of 26,210.63 dols., the total sum derived from the founder's beneficence, which by careful management had been in 1867 increased to 650,000 dols., a sum which, as has already been shown, derives its significance, not from its own magnitude, but from the manner in which it has been utilised to stimulate the interest of the Government, and to draw to itself larger amounts through special appropriations from Congress. At one time in the early history of the Institution a large portion of its fund was in certain State bonds which became worthless. Congress appropriated money to make good the loss, and the permanent fund, which, swelled by recent bequests, now amounts to 911,000 dols., is held as a deposit at 6 per cent. in the United States Treasury.

For eight years the original legacy lay in the Treasury, while the wise men of the nation tried to decide what to do with it. At the time, the adage that in a multitude of counsellors there is wisdom, did not appear to be applicable; yet the delay, though irksome to those who desired to see immediate results, proved to be the best thing for the interests of the trust. Every imaginable disposition of the legacy was proposed and discussed in Congress; the debates fill nearly three hundred and fifty pages of Rhees' compilation of Smithsonian documents. Hundreds of letters advisory, expostulatory, and dissuasive were received from representative thinkers and from societies at home and abroad. Every man had a scheme peculiar to himself, and opposed all other schemes with a vigour proportionate to their dissimilarity to his own. Schools of every grade, from a national university to an agricultural school, a normal school and a school for the blind, were proposed. A library, a botanical garden, an observatory, a chemical laboratory, a popular publishing house, a lecture lyceum, an art museum, any and all of these and many more were proposed and advocated by this voluntary congress of many men of many minds.

THE THREE SECRETARIES.

The successful organisation of the Institution has been the result of long-continued effort on the part of men of unusual ability, energy, and personal influence. No board of trustees or regents, no succession of officers serving out their terms in rotation could have developed from a chaos of conflicting opinions, a strongly individualised establishment like the Smithsonian Institution. Especially effective in this respect has been the influence of the three men who have in succession held the office of "Secretary." The name of "Secretary," it should be stated, is that which in Washington designates the highest grade of executive responsibility. The Secretary of the Institution makes all appointments on the staff, is responsible for the expenditure and disbursement of all funds, is the legal custodian of all its property, and, *ex officio*, its librarian and the keeper of its museum.

The names of Henry and Baird are so thoroughly identified with the history of the Institution during its first four decades, that their biographies would together form an almost complete history of its operations. A thirty-two years' term of uninterrupted administrative service was rendered by one, thirty-seven years by the other. Perhaps no other organisation has had the benefit of so uninterrupted an administration of forty years, beginning with its birth and continuing in an unbroken line of consistent policy a career of growing usefulness and enterprise.

The first meeting of the Board of Regents took place on September 7, 1846, and before the end of the year the policy of the Regents was practically determined upon, for, after deciding upon the plan of the building now occupied, they elected to the secretaryship Prof. Joseph Henry, and thus approved his plan for the organisation of the Institution which had previously been submitted to them.

Henry was a man greatly distinguished in science through his epoch-making discoveries, which had already given to the world the electro-magnetic telegraph, and which form the foundation

Fig. 4.—Spencer Fullerton Baird, Second Secretary of the Smithsonian Institution, 1878-87.

of all systems of electric lighting and power.[1] From the age of forty-seven to that of seventy-nine, he merged his life in that of the Institution. Prof. Asa Gray has shown so clearly the deep impression which he made upon the organisation while it was yet plastic, that I quote his words as the best explanation of the character of this element in its history:

"Some time before his appointment," writes Prof. Gray, "he had been requested by the members of the Board of Regents to examine the will of Smithson, and to suggest a plan of organisation by which the object of the bequest might, in his opinion, best be realised. He did so, and the plan he drew was in their hands when he was chosen Secretary. The plan was based on the conviction 'that the intention of the donor was to advance science by original research and publication; that the establishment was for the benefit of mankind generally, and that all unnecessary expenditure on local objects would be violations of the

[1] Self-induction, and the intensity magnet, with which Henry and Faraday subsequently discovered magneto-electricity

trust.' His 'Programme of Organisation' was submitted to the Board of Regents in the following year, was adopted as its governing policy, and has been reprinted in full or in part in almost every annual report. If the Institution is now known and praised throughout the world of science and letters, it is fulfilling the will of its founder and the reasonable expectations of the nation which accepted and established the trust, the credit is mainly due to the practical wisdom, and the catholic spirit, and the indomitable perseverance of its first Secretary, to whom the establishing act gave much power of shaping ends, which as rough-hewn by Congress were susceptible of various diversion. Henry took his stand on the broad and ample terms of the bequest, 'for the increase and diffusion of knowledge among men,' and he never narrowed his mind, and to *locality* gave what was meant for mankind. He proposed only one restriction, of wisdom and necessity, that in view of the limited means of the Institution, it ought not to undertake anything which could be done,

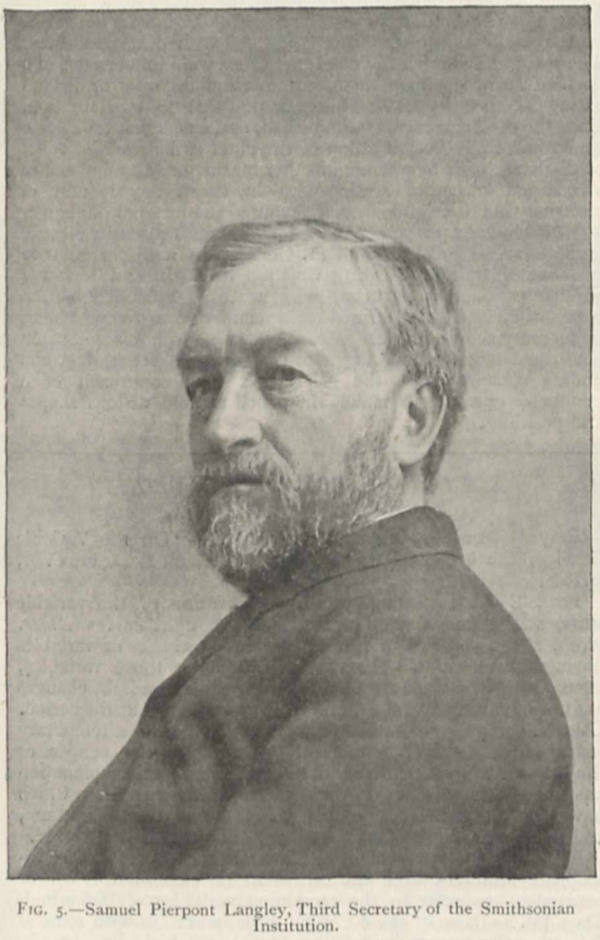


FIG. 5.—Samuel Pierpont Langley, Third Secretary of the Smithsonian Institution.

and well done, by other existing instrumentalities. So as occasion arose he lightened its load and saved its energies by giving over to other agencies some of its cherished work."

His statue, erected by order of Congress, stands in the Smithsonian Park.

Henry was succeeded in the office of Secretary by Prof. Spencer Fullerton Baird, then the leading authority on the mammals, birds, fishes, and reptiles of America, the founder of the U.S. Fish Commission, and of "public fish culture," elected in 1878; and he in his turn, by Samuel Pierpont Langley, pre-eminent as physicist and astronomer, the inventor of the bolometer, the discoverer of a great portion of the infra-red spectrum, and a high authority upon the physics of the atmosphere, elected in 1887.

Each of the three Secretaries, in addition to his general administrative work, has made some feature of the general plan peculiarly his own. Secretary Henry gave especial attention to the publications, the system of international exchanges, and the development of that great system of meteorological observation and weather prediction which has since become the Weather Bureau.

Secretary Baird continued the development of the museum, which had been under his special charge during his twenty-seven years of service as assistant secretary, secured the erection of the new museum building, gave much attention to zoological and ethnological explorations and, in connection with his special work as Commissioner of Fisheries, secured the construction of the exploring ship *Albatross*, and carried on extensive investigations in American waters.

To Secretary Langley is due the establishment of the Nationa Zoological Park and the Astro-physical Observatory, renewed activity in the library and exchange work, and a new system of encouragement of original research in the physical as well as the biological sciences. Under his administration, also, important donations and bequests have been added to the permanent fund of the Institution. The limit of 1,000,000 dols. which may by law be permanently deposited in the United States Treasury at 6 per cent., having nearly been reached, Congress has recognised the authority of the Institution to receive and administer other funds beyond this limit, thus making it possible for it to undertake the administration of financial trusts for any purpose within the scope of its general plan.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A memorial is being circulated for the signature of members of the Senate, asking the Council of the Senate to sanction the formation of a Syndicate to consider on what conditions and with what restrictions, if any, women should be admitted to degrees in the University. It states that "for nearly fifteen years, since February 1881, the University has formally admitted the students of Girton and Newnham to its Honour examinations, and has practically co-operated in their instruction by permitting them to attend the lectures of its teaching staff, and to share the advantages of the University Library and other institutions. At the present time, eight out of the ten universities of Great Britain—viz., the University of London, the Victoria University, the new University of Wales, the four Scottish Universities, and the University of Durham—admit women to degrees. The result is that the women to whom Cambridge now awards only certificates, feel the inferiority of their position in this respect as compared with that of women who pass the examinations of these other Universities. Further, a committee of the Council of the University of Oxford was appointed some months ago to consider the desirability of granting degrees to the women students at Oxford, whose position is now somewhat similar to that of the students of Girton and Newnham. There seems, in short, to be a danger lest Cambridge—which twenty years ago was acting as pioneer in the movement for extending the advantages of academic education to women—should be actually the last to grant them the traditional and customary recognition of their work. The conditions under which degrees should be granted require very careful consideration. It is hoped that the syndicate of which we desire the appointment may be able to frame proposals which will command the assent of all who are interested in the academic education of women."

WE are informed that Mr. N. Busch has not been appointed Director of the Botanic Garden of the University of Dorpat, but assistant to Mr. N. Kuznetzov, formerly Assistant Secretary of the Imperial Russian Geographical Society, who has been also appointed Extraordinary Professor of Botany at the same University, instead of Dr. Russow retired.

DR. G. P. GRIMSBY has been appointed to the chair of Geology and Natural History in Washburn University; Dr. W. B. Rankin and C. F. W. McClure have been appointed to Professorships of Biology in the College of New Jersey; Dr. W. S. Strong has been called to the chair of Geology in Bates College, Lewiston, Maine; and Dr. R. de Girard, privat-docent in Geology at the Zürich Polytechnikum, has been promoted to an Extraordinary Professorship.

At the annual meeting of the Incorporated Association of Headmasters of Secondary Schools, held on January 8, two resolutions were passed with regard to science teaching, which it is to be hoped may bear fruit in the form of an improved method in many of our schools. At the previous annual meeting a discussion had taken place on the subject; and as a result of this a memorial was sent, in July of last year, to the authorities controlling the Local examinations of Oxford and Cambridge Universities, setting forth the desire that "examining bodies should encourage a more rational method of teaching science" by framing the syllabuses on different lines. A committee was also appointed to consider the subject, and this committee, consisting of men possessed of considerable experience in science teaching in secondary schools, has now presented its report. They agree with all scientific educationists in saying that a large proportion of the time given to science in schools should be occupied by the pupils in performing actual measurements themselves, and that the object should be to impart not only information but chiefly the knowledge of method, and with this object in view, that the instruction should be given in strictly logical order. To serve as a basis of discussion with the University authorities, the committee has put forth an admirable syllabus, which includes the more fundamental portions of physics and chemistry, and (an important point) which indicates what experiments can easily be performed by beginners. The syllabus represents a practical scheme of elementary science which will be appreciated by teachers, and which cannot be too widely adopted. It indicates the manner in which the study of science in schools may be made of true educational value, and in the interests of science it is to be hoped that examining bodies will give it full consideration. Examinations at present dominate our educational system, and it is almost hopeless to attempt to introduce into schools a scheme of instruction that does follow the lines laid down by examiners. But if a syllabus is rational, the teaching which follows it will possess good features. If, therefore, the logical syllabus drawn up by the Committee of the Headmasters' Association be adopted by the Delegacy for Local examinations of Oxford and Cambridge, an important step will have been taken in the advance of scientific education in this country.

SCIENTIFIC SERIALS.

American Journal of Science, December 1895.—How to find the key-note of auditoriums, by E. Cutter. If a speaker uses the key-note of his auditorium, the audience shows by attitude and attention that it hears what is said. The speaker speaks with ease, and feels his voice impinge upon the farthest walls. The key-note may be found by means of a siren, or by singing, and observing which note resounds most powerfully. The paper contains practical hints of some value to public speakers, but is unscientific in tone and substance.—Stratigraphy of the Kansas coal-measures, by Erasmus Haworth. The different formations lie one above the other in regular order, similar to the order found in other parts of the world. The general character of the shales throughout the whole of the coal-measures is such that they must have been deposited, in the main, in shallow water, probably ocean-water, as evidenced by the frequency of ripple-marks and other physical properties. The coastal area must have progressed westward as geological time advanced. The thickness of the Kansas coal-measures cannot be much less than 2500 feet.—Igneous rocks of Yogo Peak, Montana, by W. H. Weed and L. V. Pirsson. Yogo Peak is composed of a core or stock of massive, granular, igneous rock, composed chiefly of augite and orthoclase. The mass shows a progressive differentiation along its east and west axis, with a continual increase in the ferromagnesian elements over the felspathic ones.—A new alkali mineral, by Warren M. Foote. This mineral, named Northupite, after its discoverer, crystallises in regular octahedra, whose diameters rarely reach 1 centimetre. It is brittle, shows uneven fracture, and a hardness of 3·5 to 4. In powdering the mineral a fœtid odour is distinctly perceptible. It is easily fusible before the blowpipe, and its analysis indicates it to be a double chloride and carbonate of sodium and magnesium, with traces of phosphoric acid, silica, iron, calcium, and organic matter. It was found in the neighbourhood of the Borax Lake, California.—On the affinities and classification of the Dinosaurian reptiles, by O. C. Marsh. Twelve restorations of Dinosaurs are given, and a relation is traced between them and the Crocodilians.

Wiedemann's Annalen der Physik und Chemie, No. 12.—On the origin of frictional electricity, by C. Christiansen. Differences of potential created by contact between two metals were investigated by means of "drop electrodes," one terminal of the electrometer being connected with the upper reservoir of mercury, and the other with the lower, in which plates of a different metal were immersed. The gas through which the drops fall is of considerable influence. Platinum becomes more positive in hydrogen, and more negative in oxygen. Other metals become more negative in hydrogen.—Dielectric constants of mixtures and solutions, by Ludwig Silberstein. Given two perfect insulators, like benzol and phenylethylacetate, which mix in all proportions and do not contract in the process, the specific inductive capacity of the mixture may be found by taking the sum of the products of the two separate volumes into their specific inductive capacities and dividing by the total volume. This proposition was experimentally proved by Nernst's method, with induction coil and telephone.—On the passage of electricity through gases, by A. Paalzon and F. Neesen. This is the continuation of a highly-interesting paper on various obscure phenomena connected with discharge tubes. The medium in which the discharge tubes were immersed had a decided influence upon them. Immersion in water or alcohol extinguished the glow. This was not due to condensation, since the total current was diminished, and extinction took some time to set in. Electrification of the outer surface of the tube, or discharge of it by a flame or other means, or the approach of a charged piece of sealing-wax—in short, any motion of electricity in the neighbourhood, favoured the internal discharge. —Movable light phenomena in rarefied gases, caused by electric oscillations, by J. Ebster and H. Geitel. In a discharge tube surrounded by a conducting ring put to earth, and touching another conductor connected with a strong induction coil, a pencil of bluish light is formed at a vacuum of 0·01 to 0·001 mm. of mercury, ending in an intense green phosphorescent patch next the conductor, tapering as it passes through the ring, and ending somewhere in the gas space. The approach of a conductor or a magnet makes the pencil assume various shapes and positions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21, 1895.—"On the Variable Stars of the δ Cephei Class." By J. Norman Lockyer, C.B., F.R.S.

Prof. E. C. Pickering, in his classification of the variable stars, which is based on a study of the light curves (*Amer. Acad. Proc.*, vol. xvi. p. 17), recognises two classes of variables having short periods. His Class IV. includes those variables, exemplified by δ Cephei and β Lyræ, in which the light changes are not of very great range, and continue throughout the period. Class V. comprises those like Algol in which there is a temporary reduction of light at minimum, produced by the eclipse of the bright star by a relatively dark companion; this explanation has since been established by spectroscopic investigations, which have shown that there is no change in the spectrum at minimum, and that there is an orbital movement of corresponding period.

Excluding β Lyræ, which, as shown in the paper, is spectroscopically different from the others so far examined, it will be convenient to refer to the remaining variables of Pickering's Class IV. as those of the δ Cephei class, and it is with some of these that the present paper is concerned.

The available spectroscopic data with regard to the δ Cephei class were very meagre, and I therefore determined to investigate the spectra photographically, so far as the means at my disposal would permit. Five stars were studied, namely, η Aquilæ, ζ Geminorum, δ Cephei, T Vulpeculæ, and S Sagittæ.

Five very definite results have been arrived at:—

(1) The spectra of the five variables of this class which have been photographed are practically identical.

(2) The five variables in question are stars of increasing temperature.

(3) There is a general weakening of the continuous spectrum as the light of the star decreases.

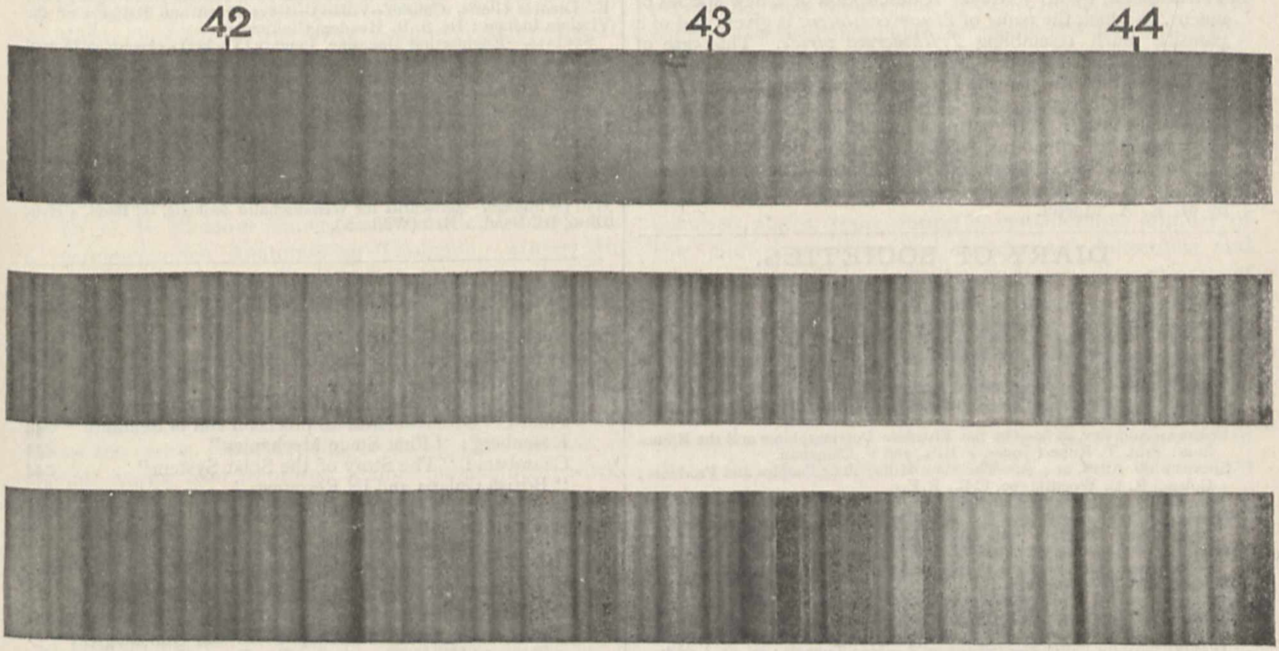
(4) There are no indications of bright-line radiation at the positions occupied by the lines of hydrogen or helium at any part of the period in the case of these variables.

(5) There is no visible doubling of the lines in any of the photographs.

A portion of the spectrum of δ Cephei, at the time of maximum, is compared with the spectra of γ Cygni and Arcturus in the accompanying diagram. These have been enlarged about ten times from the original negatives taken at Kensington.

Taking Arcturus as a representative star of the solar type (*Phil. Trans.*, 1893, vol. 184, A, p. 699), it will be seen that although the spectra of γ Cygni and δ Cephei resemble it in showing a large number of dark lines, they differ considerably from it in point of detail.

Since the greater part of the foregoing was written, the results of a photographic study of the spectrum of δ Cephei, with special reference to its movement in the line of sight, have been published by Belopolsky (Imp. Acad. Sc., *St. Petersburg Bull.*, November 1894). Belopolsky differs from me in classing the star as a solar one, although he draws attention to numerous differences between the spectrum of the star and that of the sun. He also finds, as I have found, that there is probably no change of spectrum corresponding to the light changes, except a general change of intensity.



1. δ CEPHEI 2. γ CYGNI 3. ARCTURUS

Linnean Society, December 19, 1895.—Mr. W. P. Sladen, Vice-President, in the chair.—Mr. William Scott was elected, and the Rev. T. R. Stebbing, Rev. H. P. Fitzgerald, and Mr. A. W. Geffcken were admitted Fellows of the Society.—Mr. W. B. Hemsley exhibited specimens and photographs of *Cacteæ* from the Galapagos Islands, and gave an account of some of the more remarkable species.—Mr. George Brebner exhibited and described, with the aid of microscope and lantern slides, several new and rare Algæ.—Mr. J. E. Harting exhibited a living specimen of the Snow Bunting (*Emberizu nivalis*), which had been captured, with several others, off Cape Race on board the s.s. *Ottoman* in October last, during the voyage from Boston to Liverpool, as mentioned at a former meeting (November 7). —Mr. R. A. Rolfe gave an abstract of a paper entitled "A Revision of the Genus *Vanilla*," in which some fifty species were enumerated, seventeen of which were new, though five of them had been previously confused with older forms. The plants in this genus were described as tall forest climbers, some of them leafless, found almost throughout the tropics, though generally somewhat local in their distribution. Of the species described, 29 were American, 11 Asiatic, and 10 African — Mr. E. S. Goodrich communicated a report on the collection of Cephalopoda in the Calcutta Museum. He explained that this collection had been forwarded from Calcutta to Prof. Ray Lankester, at whose request he had undertaken to examine and report upon the species. It contained 162 specimens, almost all of which were collected in the Indian Seas, from the Persian Gulf to the coast of Australia, during the cruise of H.M.S. *Investigator*. Fifteen genera were represented, and several new species were described belonging to the genera *Chairotenthis*, *Histiopsis*, *Abralia*, *Loliolus* and *Faonius*. The paper was illustrated by original drawings.

PARIS.

Academy of Sciences, January 6.—M. A. Cornu in the chair.—M Chatin was elected Vice-President for 1896.—The retiring President (M. Marey) announced to the Academy how the vacancies arising in 1895 amongst the members and corresponding members had been filled up.—Note on the works of Mr. John Russell Hind, late correspondent of the Astronomical Section, by M. F. Tisserand.—An aneurism of the neck, face, and mouth treated by the sclerogenous method, by M. Lannelongue. An account of the successful treatment of a widespread aneurism by injections of zinc chloride solution (10 per cent.).—On the Calendar, by M. Flamant. A criticism of an alteration of the Gregorian rule for finding leap-year, suggested by M. Auric. The alternative proposed by the author, not to consider as leap-years the dates $(32)^n \times 100$, that is, 3200, 6400, &c., has the advantage of postponing any departure from the Gregorian rule for 1200 years. The length of the mean solar year deduced from this is only two-millionths of a mean solar day in excess of the truth.—On integral invariants, by M. G. Kœnigs.—On a method of splitting up some definite integrals into simple elements, by M. M. Petrovitch.—On the absolute values of the magnetic elements on January 1, 1895, by M. T. Moureaux. The absolute values and secular variation during 1895 of declination, inclination, horizonal and vertical intensity, and total force are given for the two observatories of Parc Saint-Maur and Perpignan.—The action of nitrogen peroxide on the halogen salts of tin, by M. V. Thomas. The reaction was studied in chloroform solution. Tin tetrachloride gave a crystalline substance of the empirical composition $Sn_4Cl_{14}.N_2.O_6$. This is hygroscopic, and is decomposed on heating. Tin tetrabromide gave $Sn_4.Br_6.N_2O_{10}$ as a white powder. The product obtained from the tetraiodide contained no iodine, and had the composition $Sn_5O_{11}(NO_3)_2+5H_2O$.—On a mode of decomposition of some amides and amido-compounds, by M. Œchsner de Coninck. An account of the results obtained on treating some aromatic amides and amidoderivatives with an alkaline solution of sodium hypochlorite.—The *rôle* of the fever in the evolution of an infectious disease, by M. Cheinisse.—On serotherapy of tuberculosis, by MM. V. Babes and G. Proca. In the case of the animals used, chiefly dogs, immunity to virulent tuberculous injections was effected by treatment with tuberculin in increasing doses for several months, followed by subcutaneous injection in increasing doses of the dead bacilli that had already served for the preparation of the tuberculin.—On the embryonic membranes of the *Molgulæ*, by M. A. Pizon.—On the gills of the *Tetraclita porosa*, by M. A. Gruvel. The oxygenising surface of the gills is enlarged in a peculiar manner; instead of only one lamella, there are from eight to ten, of different sizes, according as they are at the ends or the middle of the gill, each of which is folded on itself in the most irregular fashion.—Note on *Mucor* and *Trichoderma*, by M. J. Ray. A description of a new species of mucor, to which the name of *Mucor crustaceus* is given, and of a parasite much resembling *Trichoderma viride*. This case of parasitism is accompanied by important modifications, both of the host and of the parasite: in the former, the mineral coating being largely increased, and its spores reduced in number; in the latter, appearance of a continuous structure, and reduction of the fructiferous apparatus.—On the yield of flour from wheat, and on whole-meal bread, by M. Balland.—On some French lakes, by M. A. Delebecque.—On the abyss of Gaping Ghyll, by M. E. A. Martel.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—The Rotation of an Elastic Spheroid: S. S. Hough.—On a Type of Spherical Harmonics of Unrestricted Degree, Order, and Argument: Dr. Hobson, F.R.S.—Memoir on the Theory of the Partitions of Numbers. Part I.: Major MacMahon, F.R.S.—Some Physical Properties of Argon and Helium: Lord Rayleigh, Sec.R.S.

LONDON INSTITUTION, at 6.—Experiments with Incandescent Lamps: Prof. Fleming, F.R.S.

LINNEAN SOCIETY, at 8.—On the Fistulose Polymorphinæ and the Ramulinæ: Prof. T. Rupert Jones, F.R.S., and F. Chapman.

SOCIETY OF ARTS, at 4.30.—The Shan Hills: their Peoples and Products: Colonel R. G. Woodthorpe, C.B., R.E.

SOCIETY OF ANTIQUARIES, at 8.30.

CHEMICAL SOCIETY, at 8.—The Acetylene Theory of the Luminosity of Hydrocarbon Flames: Prof. Vivian B. Lewes.—And other Papers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation of Premiums.—Inaugural Address of the President, Dr. John Hopkinson, F.R.S.

NUMISMATIC SOCIETY, at 7.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 9.—More about Argon: Lord Rayleigh, Sec.R.S.

QUEKETT MICROSCOPICAL CLUB, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Iron Tunnels: W. O. Leitch.

EPIDEMIOLOGICAL SOCIETY, at 8.—Experiences in Relation to Cholera in India from 1842–79: Surgeon-General C. A. Gordon, C.B.

SATURDAY, JANUARY 18.

ROYAL INSTITUTION, at 3.—To the North of Lake Rudolf and among the Gallas: Dr. A. Donaldson Smith.

MONDAY, JANUARY 20.

SOCIETY OF ARTS, at 8.—Alternate Current Transformers: Dr. J. A. Fleming, F.R.S.

VICTORIA INSTITUTE, at 4.30.—On Newly-deciphered Inscriptions: Mr. Pinches.

LONDON INSTITUTION, at 5.—Cambridge University; its History and Development: E. J. C. Morton, M.P.

TUESDAY, JANUARY 21.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. C. Stewart.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—On Irregular Grained Screens: E. Sanger Shepherd.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Sanitary Works of Buenos Ayres: Sewerage, Drainage, and Water-Supply: Hon. R. C. Parsons.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual Meeting.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, JANUARY 22.

SOCIETY OF ARTS, at 8.—Supply of Sea-Water to London: Frank W. Grierson.

GEOLOGICAL SOCIETY, at 8.—On the Speeton Series in Yorkshire and Lincolnshire: G. W. Lamplugh.—On Cretaceous Podophthalmata from Vancouver and Queen Charlotte Islands: Dr. Henry Woodward, F.R.S.—On a Fossil Octopus from the Cretaceous of the Lebanon: Dr. Henry Woodward, F.R.S.—On Transported Boulder Clay: Rev. Edwin Hill.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.

CHEMICAL SOCIETY, at 8.—Helmholtz Memorial Lecture: Prof. G. F. Fitzgerald, F.R.S.

LONDON INSTITUTION, at 6.—Unexplored Glaciers of Vatna Jökul: F. W. W. Howell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 9.—Ludwig and Vitalism: Prof. Burdon Sanderson, F.R.S.

PHYSICAL SOCIETY, at 5.—Exhibition of some Geometrical Instruments; E. Scott and Signor Monticolo.—On Resultant Tones: Prof. J. D. Everett, F.R.S.—Experiments with Incandescent Lamps: Sir D. Salomons.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Object Lessons for Infants: V. T. Murché, Vol. 2 (Macmillan).—Ethnology: A. H. Keane (Cambridge University Press).—Popular Telescopic Astronomy: A. Fowler (Philip).—Journal of Microscopy and Natural Science, third series, Vol. 5 (Baillière).—The Steam Engine: Prof. J. H. Cotterill, 3rd edition (Spon).—Folk og Natur i Finmarken: H. Reusch (Kristiania, Brogger).—A New View of the Origin of Dalton's Atomic Theory: H. E. Roscoe and A. Harden (Macmillan).—Types of American Character: G. Bradford (Macmillan).—Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt, Band ii. (Berlin, Springer).—Beobachtungen der Russischen Polar Station an der Lenamündung, 1 Theil, 1882-84.—Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles, Band xxxiv. (Williams).—The Koh-i-Nûr Diamond: E. W. Streeter (Bell).—Ostwald's Klassiker der Exakten Wissenschaften, Nr. 67 to 71 (Leipzig, Engelmann).—The Life and Letters of George John Romanes (Longmans).—Discoveries and Inventions of the Nineteenth Century: R. Routledge. 11th edition (Routledge).

PAMPHLETS.—Some Factors in the Evolution of Adaptations: G. D. Haviland (Porter).—La Théorie Atomique et la Théorie Dualistique: Prof. E. Lenoble (Paris, Gauthier-Villars).—Government and Religion of the Virginia Indians: Dr. S. R. Hendren (Baltimore).

SERIALS.—Engineering Magazine, January (Tucker).—American Journal of Science, January (New Haven).—Journal of Anatomy and Physiology, January (Griffin).—Verhandlungen der Naturhistorischen Vereins der Preussischen Rheinlande, &c., 52 Jahrg. 1 Hälfte (Bonn).—Psychologische Arbeiten, Erster Band, 2 and 3 Heft (Leipzig, Engelmann).—Strand Magazine, January (Newnes).—Strand Musical Magazine, January (Newnes).—American Naturalist, January (Philadelphia).—Journal of the Chemical Society, January (Gurney).—Himmel und Erde, January (Berlin).—Berichte der Naturforschenden Gesellschaft zu Freiburg i.B., June, September, 1894; September 1895 (Williams).—Morphologisches Jahrbuch, 23 Band, 3 and 4 Heft (Williams).—Zeitschrift für Wissenschafte Zoologie, lx. Band, 4 Heft; Ditto, lxi. Band, 1 Heft (Williams).

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