THURSDAY, MARCH 22, 1888.

THE REVENUE METHOD OF ESTIMATING AND CHARGING THE DUTY ON SPIRITS.

THIS subject has attracted some notice since Sir Henry Roscoe put a question to the Chancellor of the Exchequer the other night in the House of Commons, as to whether his attention had been called to the fact that, owing to the present faulty system of charging the duty on spirits, a loss to the Revenue of from £60,000 to £80,000 per annum did not occur, without any corresponding benefit to the trader, and whether he would appoint a Departmental Committee to inquire into an improved system of estimating the percentage of spirit, as proposed by Dr. Derham. To this the Chancellor replied that the above estimated loss was based on an erroneous assumption, and that the introduction of the suggested system would be attended with difficulties comparable with those which would accrue to the substitution of the decimal for the present system of coinage. The grounds of these objections could not of course be given in answer to a question, and therefore the public are not yet in a position to judge how far the Revenue Departments can make them good. The statements of Dr. Derham are, however, perfectly plain, and demand plain answers.

They are (1) That the essential defect of the present system is well known and acknowledged by the Inland Revenue Department.

(2) That this defect depends on the erroneous assumption made by Sikes in constructing his tables that any given quantity of spirit does not alter in bulk or in strength with variations of temperature from the normal of 51° F.

(3) That the only argument which can be advanced in defence of the present system is that deficiencies at temperatures below 51° F. are compensated by over-estimates above 51° F., so that on the whole the Revenue neither gains nor loses.

(4) That on the contrary it is a fact that at least five-sixths of the spirits paying duty are taken out of bond during the nine cooler months of the year when the temperatures in warehouses range from 51° F. downwards, so that in the case of these spirits a constant loss accrues to the Revenue, and also to the trader from under-estimation of his stock, which he must dispose of at that estimate. Whilst in the summer months, owing to the construction of warehouses, evaporation of spirits, &c., the temperature of the spirits does not often exceed 51° F., so that there is but a slight compensating gain to the Revenue from that source.

(5) That the objections to the present plan can be entirely removed by adopting the suggested system, which, without altering the standard of measure—the proof gallon—without introducing any change in the notation of over- and under-proof, or any alteration calculated to confuse the trader, substitutes tables founded on a correct principle instead of an erroneous one, a scientific and exact for an unscientific and inexact instrument, which not only will facilitate the work of the Government officials, but will give correct results at all temperatures.

In consequence of the "*non possumus*" reply of the Chancellor, Sir H. Roscoe gave notice that he should move for a return of the number of proof gallons taken out of duty free warehouses for *consumption* last year, specifying the number of proof gallons at each degree of temperature when the account was taken for payment of duty; all spirits taken out for methylation, exportation, ships' stores, and removal to other warehouses, which do not pay duty, and which may have recently been distilled, being excluded. Such a return would either confirm or disprove Dr. Derham's contention, and there seems no reason why such a return should not readily be obtainable. It appears to us that the comparison of the introduction of the decimal coinage made use of by Mr. Goschen was an unfortunate one. The introduction of the decimal coinage would obviously occasion a great amount of confusion and perplexity, for a time at least, and would in the end only substitute one correct and convenient system for another equally correct though less convenient. The adoption of the improved system of charging duty on spirits would occasion, on the contrary, no material change, none likely to cause confusion or perplexity, but would replace an incorrect and inconvenient system by one at once correct and more convenient. The Chancellor moreover hinted that the vested interests of the trade in the property of the present instruments must be safeguarded. If the new and correct tables became legalized and were adopted, Sikes's hydrometer could equally well continue to be used, or any instrument can be employed which furnishes specific gravities. Mr. Goschen also stated that Dr. Derham's instrument is too delicate for ordinary use. This appears to us to be the weakest part of his argument. The ball in the new instrument, the most vulnerable part of the hydrometer, happens to be of the same size and strength as that in the ordinary Revenue instrument. It is true that a somewhat different method of attaching the poises is adopted, but this is a mere detail, and more a question of taste and opinion than of principle, and it is certain that the form can, if desirable, be made so as to be indistinguishable from Sikes's instrument, for the characteristic feature of the new system is to be found in the bulks and specific gravities of the poises, and not in the shape or size of the stem or bulb.

The Revenue authorities can scarcely, we imagine, fail to admit that certain defects in Sikes's system exist, for these can be demonstrated by reference to Sikes's own tables. Hence we incline to the belief that the erroneous assumption to which the Chancellor referred consists in taking for granted that there is a general correspondence between the temperatures of warehouses and that of the mean shade temperature of the country, for this is the assumption made by Dr. Derham. The returns which have been asked for will decide this point. But meanwhile it may be of interest to see how the large figures of from £60,000 to £80,000 per annum have been obtained. The Customs and Excise deal annually with some forty million gallons of proof spirit or their equivalent, which for the most part lie for a longer or a shorter time in warehouse. If we assume that the average strength of the spirit when removed from warehouse for consumption is 25 overproof, then thirty-two million gallons by measure are equivalent to the forty million gallons upon which the duty is charged, so that, if the rate of removal be

constant, 2,700,000 gallons by measure at 25 overproof are removed each month from bond. Now, taking the mean shade temperatures for the months from November 1886 to April 1887, it appears that, owing to the contraction in these 2,700,000 gallons per month, no less a quantity than 97,268 gallons of 25 overproof or of 121,586 gallons of proof spirit for the six months would accrue in the estimation as now carried on, and the duty on this amounts to £61,000, now lost to the Revenue.

It is true that probably these shade temperatures do not exactly represent the temperatures of the warehouse, which will be more equable, but then the contents of a warehouse if they lose their heat slowly also regain it slowly, and the low temperature contracted during a long and severe winter is perpetuated for a long period throughout the year; so that in all probability the average temperature of the bonded spirit is below 51° not only during six but during nine months of the year, and assuming that the mean temperature did not exceed 47° during these extra three months, the additional loss to the Revenue would amount to £10,000.

The foregoing statements have been published for some time, and have not been confuted except in the usual official Parliamentary style. This, we urge, is insufficient. What the public wants to know, and has a right to learn, is, what, if the Revenue authorities dispute these assertions, are their grounds for so doing? Should this information not be forthcoming, the opinion will gain ground that another Government Department is trying hard "how not to do it."

PRESTWICH'S "GEOLOGY."

Geology: Chemical, Physical, and Stratigraphical. By Joseph Prestwich, M.A., F.R.S., F.G.S., Correspondent of the Institute of France, Professor of Geology in the University of Oxford. In Two Volumes. Vol. II. Stratigraphical and Physical. (Oxford: Clarendon Press, 1888.)

IT is just two years ago that we were called upon to notice the first volume of this important treatise; and the author of it has now signalized the completion of his labours at Oxford by giving to the world the second and concluding volume of the work. Its publication has long been eagerly looked forward to, and now that the book is before us, we may safely assert that it more than justifies the high expectations which have been formed concerning it; and we confidently predict that it will add to the already high reputation of the veteran geologist to whom we are indebted for it.

In reading the first chapter of the book, everyone must be struck by the fact that a distinct advance has been made in the mode of treatment of the great problems of stratigraphical geology. Speaking of the "order of succession" and "the breaks in continuity" in the series of stratified rocks, Prof. Prestwich writes:—

"The great time-divisions are of almost universal application; but the smaller 'breaks in continuity,' which are of frequent occurrence in all areas, are subject to constant differences of extent and value; consequently, in filling up the details of the several geographical areas, each one is found to have its own local stamp, and possesses its own special terms, some knowledge of which is as essential to the geologist as is the language of a country to the traveller, if he would pass through it with profit."

The author then proceeds to show how impossible is any universal scheme of geological classification, and to discuss the question, first raised by Edward Forbes and Prof. Huxley, as to how far geological equivalence is to be regarded as being identical with actual synchronism.

He insists that, in distant areas, strata cannot be correlated by identical *species*, but only by the presence of the same characteristic *genera*, and he fully admits the effects of migration of forms of life from one region to another in causing strata of different ages to present very similar faunas or floras. Such considerations as these, the author argues, must always prevent us from regarding the series of formations as being strictly contemporaneous in distant areas, or the breaks between them as being universal ones.

Prof. Prestwich points out some of the difficulties confronting geologists, in the following suggestive passage:—

"In Western North America the great break so conspicuous between the Cretaceous and Tertiary series does not exist, and there are passage beds having characters of the two periods in common. In a similar way the Carboniferous strata in America pass gradually into the Permian, without the unconformity which exists here. In India the Gondwána system forms a consecutive series from the base of the Permian to the top of the Jurassic strata. In New Zealand, again, no marked line can be drawn between the Cretaceous and Tertiary series, the Upper Cretaceous and Lower Eocene forming unbroken and continuous series."

He then proceeds to give not *one* table of classification for the sedimentary rocks, but *six* different ones, adapted respectively to Europe, India, North America, Australia, New Zealand, and South Africa. And having thus at the very outset shown what are the obstacles in the way of the exact correlation of distant deposits, and established a philosophical basis of classification for strata, he takes up the consideration in succession of the several great geological systems; he selects the method of beginning with the oldest, and passing upwards in the scale, candidly admitting, however, that the opposite plan is not without its merits and advantages.

The account given in successive chapters of the several formations, their typical development in this country, the groups of fossils by which they are distinguished, and their chief foreign representatives, is eminently clear and readable. This merit is the more conspicuous from the circumstance that the mass of detailed information to be selected from and arranged in writing a work on stratigraphical geology is so enormous and bewildering, that such works are very apt to suffer in their style, and to become heavy and encyclopædic in character. But Prof. Prestwich has admirably avoided this danger.

The author does not waste any time in discussing barren questions of nomenclature. In the case of the three systems of the older Palæozoic, he follows the common custom of calling the oldest "Cambrian," the second "Lower Silurian," and the third "Upper Silurian"; though pointing out in a footnote the significance of the term "Ordovician."

Very striking features in the book are the chapters in which are summed up the characteristics of the faunas

and floras of the Palæozoic, the Mesozoic, and the Kainozoic divisions respectively. In these reviews of the great geological epochs, the distinctive features of their life-history are ably summarized; and the subject is made clearer by the insertion of sixteen lithographic plates, the fossils represented upon these being very judiciously selected and admirably drawn.

Most readers will look with much interest to the later chapters, in which the author deals with the Tertiary and post-Tertiary deposits, the study of which has been so greatly advanced by the author's own researches. Prof. Prestwich has in several very important points modified some of the conclusions of his classic papers upon these questions. He now accepts, with most modern geologists, the term "Oligocene" as usefully embracing the strata known as the "Fluvio-marine strata" of the Hampshire Basin, and separates them from the Eocene proper. He also points out for the first time the close connection of the so called "Lower Bagshot Sands" with the London Clay, placing them in the Lower Eocene; while the Middle and Upper Bagshots of the London Basin, and the Bracklesham and Barton series of the Hampshire Basin, constitute his Upper Eocene. This view has recently been explained and defended in a paper which the author has read before the Geological Society, and is one which we think will meet with very general acceptance. In his account of the post-Pliocene (or, as he prefers to call them, the Quaternary or Pleistocene) deposits, it will also be seen that Prof. Prestwich has so far departed from his earlier published views as to admit the probability of some of the deposits which contain relics of human handiwork belonging to a period when glacial conditions prevailed in this country.

The work concludes with three chapters of a theoretical character. In the first of these Prof. Prestwich argues against the acceptance of any views, like those of Dr. Croll, which would define the exact date of the Glacial period by reference to astronomical events. Accepting the probability that man may have lived at the period of the greatest glaciation, the author boldly proceeds to challenge the common opinion that this period of glaciation must have been separated by an enormous interval of time from the present day. He even suggests that the Glacial period may not have had a duration of more than from 15,000 to 25,000 years, and the post-Glacial period he thinks may be restricted to 10,000 or 15,000 years!

The facts which seem to have had the greatest weight in leading Prof. Prestwich to these, at first sight, startling conclusions, are those connected with the movements of the great ice-sheets in Greenland. The recent observations of Rink and Helland seem to show that the data afforded by the diminutive Alpine glaciers are utterly inapplicable to the vast masses of ice which must have flowed over extensive areas during the Glacial period. While the Alpine glaciers progress at an average rate of a foot per day, the great Greenland ice-sheet advances 35 feet per day, and the effects produced in a given time by such rapidly moving masses must be proportionately great. There will doubtless be much difference of opinion among geologists upon the important suggestions made by Prof. Prestwich; but in any future discussions of the subject it must be admitted by everyone that the data upon which all our reasoning has to be based has been profoundly modified by the remarkable observations made by the Danish Scientific Commission upon the inland ice of Greenland.

In his penultimate chapter, the author points out the grounds for the view—of which he has long been one of the ablest advocates—that the earth's solid crust is a comparatively thin one; and he indicates the lines of argument by which the objections of mathematicians and physicists to such views can best be met. While demurring to the doctrine of the permanence of continental and oceanic areas, he justly points to the great effects which must result from the flow of ice-cold water over the bottom of the great oceanic depressions.

The last chapter, on "The Primitive State of the Earth," is an attempt to link the geological history on to that arrived at by the studies of the astronomer. Due importance is justly attached to the evidence afforded by meteorites, and an excellent summary is given of Daubrée's admirable researches. But here, as the author freely admits, he is on less secure ground than in the earlier chapters of his book, and the utmost he aims at doing is to supply a working hypothesis.

Both Prof. Prestwich and the Delegates of the Oxford University Press are to be congratulated upon the manner in which the work has been got up. The printing is admirably clear, and the woodcuts, most of which are original, are of exceptional excellence. The plates, which have been very skilfully drawn on stone by Miss Gertrude Woodward, exhibit the characters of the fossils illustrated in a manner superior to what we have ever seen attempted in any geological text-book. The coloured geological map of Europe, which has been prepared under the supervision of Mr. W. Topley, is brought up to date, and is very clear and serviceable.

To the splendid work now so auspiciously completed at the termination of the author's professorial career at Oxford, we heartily wish all the success it so well deserves. J. W. J.

VACCINATION.

Cow-Pox and Vaccinal Syphilis. By C. Creighton. (London: Cassell, 1887.)

Vaccination Vindicated. By J. C. McVail. (London: Cassell, 1887.)

TWO new books have lately appeared on vaccination; one on the natural history of "Cow-Pox and Vaccinal Syphilis," by Dr. Charles Creighton; the other, "Vaccination Vindicated," by Dr. J. C. McVail.

The first mentioned, that by Dr. Creighton, is a very misleading work. The first four chapters are almost entirely devoted to a wholesale abuse of Jenner, and the fact that Jenner has called the cow-pox the "variolæ vacciniæ," is especially singled out for more than usual criticism; but the very virulence of the abuse will lead to its condemnation, and the memory of the man who deserves so well of his country will not therefore be unjustly thought of by his countrymen.

The whole burden of the rest of the book may be summed up in a passage that occurs on p. 155: "The real affinity of cow-pox is not to the small-pox but to the great-pox." Let it be remembered that these two diseases are placed together by the science of medicine

under the common order of zymotic diseases: is it wonderful that in some things they agree? The thistle and the sunflower both belong to the same natural order in botany, but are they identical? Dr. Creighton entirely suppresses every point in which the dissimilarity of the two diseases appears; but he insists upon nearly all those in which the similarity shows itself. In fact, his whole work is a piece of special pleading which anybody but a lawyer ought to be ashamed of.

It is easy enough to find some sort of resemblance between two inoculable diseases, and arguments of the kind found in Dr. Creighton's book might be multiplied greatly. We present him with another which we should have thought too good for him to have missed, but we will not promise him it will satisfy his readers more than those which he has himself adduced.

When the virus of the great-pox is taken early in the disease it will communicate its own specific characters, and will for a certain time render the individual to whom it is communicated immune from further contamination by the disease; but if the virus is taken in its later stages it will produce in the individual who is inoculated a sore which has often a tendency to ulcerate, to phagedena, &c., and this sore does not convey the constitutional symptoms of syphilis, nor does it render the individual immune from further manifestations of its own peculiarities. This similarity of the two poxes might, in Dr. Creighton's fashion, be shown in the behaviour of vaccinia, for if vaccine lymph is taken early it produces a constitutional disease of short duration which protects the individual from further vaccination for a time at least, and also from small-pox; but if the vaccine is taken late it produces a sore that has a tendency to ulcerate, to phagedena, &c., and which does not convey immunity to the individual against further vaccination or against small-pox. While referring to this point we may observe that all the bad results collected by Dr. Creighton following vaccination were from lymph taken at a too late stage, and the evils produced must be attributable to the ignorance of the vaccinator rather than the innate virulence of the lymph, or more fancifully still to any reversion to type.

Some of the points of dissimilarity he does not mention are these:—

Firstly, vaccination protects from small-pox when its virus is taken at the proper time, but it does not protect us against the great-pox.

Secondly, the microscopical appearances of a true chancre of early date are quite distinct from those of a vaccine vesicle.

Thirdly, the incubatory periods of the two diseases are utterly different.

It is easy to find points of similarity if we only look at the points of likeness. Thus with no great difficulty we might compare a man and a monkey, and it would not be difficult to argue that at a remote period of time they may have had a common ancestor; but now no one in his senses, except perhaps Dr. Creighton himself, would say that they are identical species.

Dr. McVail's book is altogether different. It is one of the most thoughtful works of the kind we have seen. We would commend it to everyone who is anxious to learn the truth about vaccination, especially to Members of Parliament and others who have a voice in the government of this great country, also to all medical men who neither have the time or inclination to dig deep into anti-vaccination literature. They will find complete answers to all the assumed evils of vaccination, as well as the evidences of the value of vaccination as a prophylactic against small-pox. There is also set forth what a fearful disease small-pox used to be, and how it has been robbed of its sting by vaccination.

Dr. Wallace's writing on this subject, whom we are ashamed as scientific men to find in the anti-vaccination ranks, are especially shown up and gibbeted. We may quote two passages in support of this assertion; they occur on pp. 70 and 87. Speaking of the possible errors in registration, Dr. Wallace instances three cases; of one of these Dr. McVail writes:—

"It is pitiful to think of Dr. Wallace as being driven to appeal for one of his three instances of incorrect registration to such ravings as those of Mr. Pickering. But the abuse of vaccination is so largely buttressed by the relation of 'cases,' that the examination of these samples specially selected by so able an author seems not without use as illustrating the character of the whole class."

And on p. 87 Dr. McVail says after careful reading: "I have been further forced to the conclusion that, in this matter, when Dr. Wallace says 'the point in question has been entirely overlooked,' *the statement is a misstatement*, and that when he says 'it is nevertheless a fact,' then *it is not a fact*." The book is throughout so carefully and faithfully written, and deals so well with the tactics of the anti-vaccinators, that it ought to have a wide circulation among those interested in the question. Many are interested in seeing conjuring tricks, and in witnessing optical delusions. So long as the tricks are not understood, there is an inclination in the minds of some to regard these tricks as more difficult of performance than they really are, and some may even attribute them to supernatural agency. The same kind of tricks are played by such men as Dr. Wallace on our literary pursuits. Dr. McVail's book may be taken as exposing the tricks, and showing the mechanism by which they are done.

ROBT. CORY.

OUR BOOK SHELF.

Animal Biology. An Elementary Text-book. By C. Lloyd Morgan. With Illustrations. (London: Rivingtons, 1887.)

THIS volume has been written to meet the requirements of those reading for the London Intermediate and Preliminary Scientific Examinations, as well as for the Oxford and Cambridge Local. In it special attention has been paid to embryology, and there can be little doubt that the information in this volume would enable the attentive student, with some preliminary assistance, to make very considerable progress in the study of both anatomy and physiology.

The author treats of the anatomy and physiology of the vertebrates as exemplified by the frog, the pigeon or fowl, and the rabbit, with occasional references to other types; and of the invertebrate types, the crayfish, cockroach, earthworm, snail, fresh-water mussel, liver-fluke, tapeworm, hydra, vorticella, and amœba, are selected.

The illustrations have been engraved after original outline sketches of the author's, chiefly from dissections or preparations made in the biological laboratory of University College, Bristol. They are all the better for

not being too pictorial; for a student, especially when left to his own resources, is often apt to be misled by over elaborated drawings.

In addition to the anatomical and physiological details given of each of the type forms selected, there is appended to each an excellent general summary of the life-history of the form; so that within the compass of a little over 350 pages we have a really valuable text-book of animal biology, which we would wish to place in the hands of all students. In Ireland, unfortunately, the Commissioners of Intermediate Education have omitted the subject of biology from the schedule for boys, and limited that for girls to the vegetable kingdom.

Practical Guide to Photographic and Photo-Mechanical Printing Processes. By W. K. Burton. (London: Marion and Co., 1887.)

IT is refreshing to find that the text of the second photographic work issued by these publishers is not made subservient to the advertisement of photographic specialties. The work before us is written by a gentleman well known for his practical rather than his theoretical acquaintance with photography. We thus have an account of the practical working of various processes, with a small modicum of theory. The chapters on silver printing and carbon printing are very clear and complete, and if followed out will lead the amateur to successful results. When we come to the photo-mechanical processes, however, there is at first sight presumable evidence of a lack of intimate knowledge of the subject. It may be, however, that there is a greater difficulty in describing these operations than in the ordinary printing processes to which we have alluded. We doubt very much if the descriptions given would enable a tyro to progress at a rapid rate. For the enthusiastic photographer who has time to experiment the directions would suffice to enable him to commence in the right way, and though at first he would inevitably blunder, yet he would after a sufficient number of disasters produce results which he might take a certain amount of pride in showing to his immediate friends, who would be likely to appraise them higher than at their market price.

In another edition we should recommend that the author should either expand the descriptions of his photo-mechanical processes, or omit them altogether. The work itself is nicely got up, the print is good, and the illustrations well executed.

A Treatise on the Diseases of the Dog. By John Henry Steel, M.R.C.V.S. (London: Longmans, Green, and Co., 1888.)

THOUGH the author of this manual does not claim to offer an original book on canine pathology, and though he assumes the modest *rôle* of compilator of canine literature—English and foreign—we venture to say that he is fully entitled to the claim of having produced an extremely useful work; useful in the first place to the veterinary profession, but not less useful to all those who, like sportsmen, dog-breeders, and dog-keepers, wish to possess a ready and authoritative book for study and reference.

All disorders to which the dog is subject are considered minutely, and in addition there are a great many useful data as to the anatomy and physiology of the canine organism well blended together.

The treatment of canine ailments, and the various methods of medical and surgical practice, form an integral part, and while the author's extensive practice enables him to speak with authority, he does not omit to mention the practice of others which he considers most commendable.

The numerous illustrations, copied from standard books, though not of the first order as regards execution and reproduction, nevertheless considerably enhance the text; this is particularly the case with those which illustrate the general appearance of the animal under the various severe internal disorders, as also those on medical and surgical practice.

But it must be regretted that in the illustrations on microscopic objects, of which there are a good many in this book, no statement is made in connection with the figures as to the amount of amplification under which the objects are supposed to be viewed. This is perplexing in itself, but becomes more so when we remember that there are other illustrations of anatomical parts which are represented smaller than natural size. But these minor details, which are easily corrected, cannot detract from the general usefulness of the work. E. KLEIN.

Management of Accumulators. By Sir D. Salomons. Third Edition. (London: Whittaker, 1888.)

THE author has considerably enlarged this edition of his work, and made it in some respects more complete.

The first part deals with accumulators, and principally with those of E.P.S., or Elwell-Parker type. The construction and principle of working of the cells is described, and hints are given as to the best method of setting them up and charging them. The ordinary causes of failure and the methods of guarding against them are discussed.

In the second part the arrangements of an installation for house-lighting are fully described, and hints, founded on the author's experience in lighting his own country-house for some years past, are given as to the management of engines, boilers, dynamos, lamps, switches, &c., as well as descriptions of the methods which he has adopted for so regulating the whole system by automatic appliances, that, as he says, "it is only needful to start and stop the engine, so that a man having no knowledge of electricity may be employed." He gives estimates for the capital expenditure and working expenses of installations of from 25 to 120 sixteen-candle power lamps. From these we learn that one of the latter size can be erected for £6 per lamp without accumulators, which latter add £3 per lamp to the cost, and the automatic regulating appliances bring up the cost to £10 per lamp. For fifty lamps the cost per lamp is about 50 per cent. greater, and for twenty-five lamps about twice as great. The annual cost, including interest and sinking fund, without accumulators, ranges from £2 16*s.* per lamp for 120 lamps to £4 4*s.* per lamp for twenty-five lamps, these figures being increased to £3 9*s.* and £6 respectively when accumulators and automatic regulators are used.

As was the case in the previous edition, there is much useful information in this book, but it is very badly written, so badly that the descriptions and explanations are often unintelligible. As an example we may quote from the chapter on the "Action of Cells with Dynamo" (p. 111). In discussing the relation between E.M.F. and current in machines of different types, he says, "Let us confine ourselves to the shunt dynamo, this has a falling curve, *i.e.* the E.M.F. falls as the current in the circuit is increased, due to two reasons, one is *the armature absorbs more power as the current is increased*" (the italics are ours); "and secondly the lowering of the outside resistance, to obtain an increased current, is in shunt with a fixed high resistance, viz. the shunt winding on the field-magnets, so that when the outside resistance is lowered to zero by short-circuiting the terminals, practically no E.M.F. exists, and no current passes."

Elementary Physiography. By J. Thornton, M.A. (London: Longmans, Green, and Co., 1888.)

THIS is an admirable introduction to the study of Nature by one whose experience in teaching must of necessity have indicated to him the requirements of beginners. The subjects are arranged according to the syllabus of the elementary stage of physiography, which will greatly extend the sphere of usefulness of the book. The treat-

ment is very detailed for an elementary book, but there is nothing beyond the capacity of those for whom it is intended. The author is of opinion—and we quite agree with him—that meagre accounts lead to inaccurate ideas, inasmuch as they are not of sufficiently general application. As far as desirable, and in accordance with the syllabus, simple experiments have been introduced. The main results of the *Challenger* Expedition are also explained, and illustrated by diagrams.

The astronomical portion leaves nothing to be desired.

In addition to 150 excellent diagrams, there are ten maps, illustrating the distribution of temperature and pressure, volcanoes and earthquakes, &c. The diagram of the geological formations shows the general physical appearance of the strata, along with the characteristic fossils of each.

The book is beautifully printed, and is sure to win the favour of all who use it, whether as students or teachers.

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.*]

Dr. Whewell on the Origin of Species.

IN his essay on the "Reception of the 'Origin of Species,'" Prof. Huxley writes:—

"It is interesting to observe that the possibility of a fifth alternative, in addition to the four he has stated, has not dawned upon Dr. Whewell's mind" ("Life and Letters of Charles Darwin," vol. ii. p. 195).

And again, in the article "Science," supplied to "The Reign of Queen Victoria," he says:—

"Whewell had not the slightest suspicion of Darwin's main theorem, even as a logical possibility" (p. 365).

Now, although it is true that no indication of such a "logical possibility" is to be met with in the "History of the Inductive Sciences," there are several passages in the Bridgewater Treatise which show a glimmering idea of such a possibility. Of these the following are, perhaps, worth quoting. Speaking of the adaptation of the period of flowering to the length of a year, he says:—

"Now, such an adjustment must surely be accepted as a proof of design, exercised in the formation of the world. Why should the solar year be so long and no longer? or, this being such a length, why should the vegetable cycle be exactly of the same length? Can this be chance? . . . And, if not by chance, how otherwise could such a coincidence occur than by an intentional adjustment of these two things to one another; by a selection of such an organization in plants as would fit them to the earth on which they were to grow; by an adaptation of construction to conditions; of the scale of construction to the scale of conditions? It cannot be accepted as an explanation of this fact in the economy of plants, that it is necessary to their existence; that no plants could possibly have subsisted, and come down to us, except those which were thus suited to their place on the earth. This is true; but it does not at all remove the necessity of recurring to design as the origin of the construction by which the existence and continuance of plants is made possible. A watch could not go unless there were the most exact adjustment in the forms and positions of its wheels; yet no one would accept it as an explanation of the origin of such forms and positions, that the watch would not go if these were other than they were. If the objector were to suppose that plants were originally fitted to years of various lengths, and that such only have survived to the present time as had a cycle of a length equal to our present year, or one which could be accommodated to it, we should reply that the assumption is too gratuitous and extravagant to require much consideration."

Again, with regard to "the diurnal period," he adds:—

"Any supposition that the astronomical cycle has occasioned the physiological one, that the structure of plants has been brought to be what it is by the action of external causes, or that such plants as could not accommodate themselves to the existing day have perished, would be not only an arbitrary and baseless assumption, but, moreover, useless for the purposes of explanation which it professes, as we have noticed of a similar supposition with respect to the annual cycle."

Of course, these passages in no way make against Mr. Huxley's allusions to Dr. Whewell's writings in proof that, until the publication of the "Origin of Species," the "main theorem" of this work had not dawned on any other mind, save that of Mr. Wallace. But these passages show, even more emphatically than total silence with regard to the principle of survival could have done, the real distance which at that time separated the minds of thinking men from all that was wrapped up in this principle. For they show that Dr. Whewell, even after he had obtained a glimpse of the principle "as a logical possibility," only saw in it an "arbitrary and baseless assumption." Moreover, the passages show a remarkable juxtaposition of the very terms in which the theory of natural selection was afterwards formulated. Indeed, if we strike out the one word "intentional" (which conveys the preconceived idea of the writer, and thus prevented him from doing justice to any naturalistic view), all the following parts of the above quotations might be supposed to have been written by any Darwinian. "If not by chance, how otherwise could such a coincidence occur, than by an adjustment of these two things to one another; by a selection of such an organization in plants as would fit them to the earth on which they were to grow; by an adaptation of construction to conditions; of the scale of construction to the scale of conditions?" Yet he immediately goes on to say: "If the objector were to suppose that plants were originally *fitted* to years of various lengths, and that such *only* have *survived* to the present time . . . as could be *accommodated* to it (*i.e.* the actual cycle), we should reply that the assumption is too gratuitous and extravagant to require much consideration." Was there ever a more curious exhibition of failure to perceive the importance of a "logical possibility"? and this at the very time when another mind was bestowing twenty years of labour on its "consideration." GEORGE J. ROMANES.

The Fog Bow.

THE complete theory of the rainbow, as developed by Sir George Airy (Camb. Phil. Trans., vi. p. 379, 1836), besides explaining the supernumerary bows, shows that the main bow has a radius somewhat smaller than that calculated on the ordinary geometrical theory. The smaller the drops the greater is the discrepancy. With the tiny drops composing a fog, the discrepancy is so marked that the bow receives a new name—the fog-bow, or "*arc-en-ciel blanc*." Mr. Mohn's (NATURE, February 23, p. 391) nearly simultaneous measurements of the fog-bow and Ulloa's rings afford a capital opportunity of putting the theory to the test, for from the latter phenomenon we can readily calculate the average size of the particles.

Not having Airy's paper within reach, I have had to be content with the incomplete account given by Verdet ("Leçons d'Optique Physique," tom. i. p. 414). Assuming $\mu = 1{\cdot}333$, I find for the angular discrepancy—

$$\beta = 0{\cdot}467\, m\left(\frac{\lambda}{a}\right)^{\frac{2}{3}},$$

where λ is the wave-length, a the radius of the drop, and m is determined by the condition that the integral—

$$\int_0^\infty \cos\frac{\pi}{2}(w^3 - mw)dw$$

should be a maximum. This integral was calculated by Airy for a series of values of m, but Verdet does not quote the results. Some rough approximations lead me to the conclusion that m lies between 1·0 and 1·3, and very much nearer the latter.

For the radius of the first Ulloa's ring we have

$$a = 0{\cdot}82\lambda/a.$$

Mr. Mohn measured this radius as 1° 31′. Using this value, and taking m as 1·25, I find β is the circular measure of 3° 24′. The geometrical theory gives the radius of the rainbow 42° 2′. So in this particular case the fog bow should have had the radius 38° 38′. Mr. Mohn gives two measurements, taken

shortly before that of the Ulloa's ring, 38° 48′ ± 48′, and 38° 28′ ± 22′ Thus the agreement between theory and observation is singularly perfect. JAMES C. MCCONNEL.

St. Moritz, Switzerland.

"The Teaching of Elementary Chemistry."

In reply to Prof. M. M. P. Muir's letter, I wish to say that, judging from his answer, Prof. Muir does not seem to consider it necessary in books of which he is senior author to secure that accuracy of which, from his criticisms of the writings of others, one would expect to find him the champion.

The first extract from the books mentioned sounds curiously to chemists. I consider the statement misleading inasmuch as it appears to convey an idea as to the constitution of caustic soda which is not that generally entertained by chemists; that this is not the intention of the authors, however, is manifest from p. 247 of the "Elementary Chemistry," where the usual view is stated.

It is utterly untrue and misleading to state that, "inasmuch as the result of passing chlorine over yellow mercuric oxide dried at about 100° is to evolve oxygen without forming chlorine monoxide, ... it may still be justly said that in making chlorine monoxide 'we carry out a reaction in which oxygen is produced in presence of chlorine.'"

The facts are briefly these:—

(*a*) When chlorine gas is passed at ordinary temperature over yellow mercuric oxide, which has been previously heated to 300°-400°, chlorine monoxide is obtained.

(*b*) When a large quantity of chlorine gas at ordinary temperature comes rapidly into contact with yellow mercuric oxide which has been previously dried at ordinary temperature, a violent reaction, accompanied with evolution of light and heat, ensues, and nearly pure oxygen is the only gaseous product. If both the chlorine and the mercuric oxide be kept cool by means of a freezing mixture, chlorine monoxide is the only gaseous product obtained. With intermediate conditions of temperature, &c., mixtures in varying proportions of oxygen and chlorine monoxide are obtained. (Pelouze, *Annalen der Chem. und Pharm.* Bd. xlvi. 196.)

The formation of oxygen in the second case must therefore be due to the decomposition of already formed chlorine monoxide, or to the occurrence of a reaction the conditions of which render the existence of part of the chlorine monoxide impossible. I think the majority of chemists will agree with me that the appearance of oxygen under conditions which insure the non-existence of (or as itself a product of the decomposition of) chlorine monoxide, can scarcely be admitted as in any measure explaining the *formation* of the latter.

I do not consider it a "verbal quibble" to object to the use of the term "volatilized" as applied to the mechanical removal of particles of a solid substance.

As to the chemical properties of chlorine, bromine, and iodine, I should indeed be open to the gravest charges of non-acquaintance with chemical classification, had I suggested anything so idiotic as that, say, potassium hypobromite and potassium hypoiodite (if the latter exists) could be *identical*.

I called the passages I quoted misleading, because some of them at least were inaccurate. What amount of inaccuracy is required to make a statement misleading may be a matter for difference of opinion. Apparently it is so.

Prof. Muir states that he will decline to take any notice of my anonymous communications. This, at least, is safe ground; but I can wait for the second editions of the two books, and see if the inaccuracies are eliminated. In the second edition of "Elementary Chemistry" I hope Messrs. Muir and Slater will also describe the methods (omitted on p. 19) for removing air from oxygen. Whilst these methods remain unpublished, I prefer to remain Z.

"Kinematics and Dynamics."

MAY I ask a short space in your columns to refer to a few points in Prof. Greenhill's review of my book on "Kinematics and Dynamics," published in your issue of February 16 (p. 361). I shall be as brief as possible.

(1) "In questions involving the size of the earth (pp. 74 and 80), it is the circumference and not the diameter which should be given in metres, the circumference being 40,000,000 metres," the reason being, I suppose, that in illustrative problems round numbers should be employed as data, with the object of facilitating arithmetical calculation. There are doubtless advantages in this course, and in many problems I have adopted it. But should it be made an invariable rule? Problems based on exact data, such as the ones referred to, on pp. 74 and 80, have for many students a greater interest than those based on approximations.

(2) "The expression 'knots an hour' (p. 60) is irritating to a sailor." But the expression "knots" simply would be either misleading or puzzling to a student unacquainted with nautical abbreviations.

(3) "The formula $\frac{1}{2}v^2 = \frac{1}{2}v_0^2 + as$ is to be preferred to that on p. 34, $v^2 = v_0^2 + 2as$; in all cases the factor $\frac{1}{2}$ should go with the v^2 in the equation of energy." The formula quoted is not an equation of energy, but a kinematical equation. Equations of energy (see pp. 253, 256, 328) have in all cases the form approved by Prof. Greenhill.

(4) "In dealing with rotation, the author would do well to study Maxwell's geometrical representation of the direction by means of the screw, right-handed or left-handed." I have done so; but I find that students more readily grasp a specification of the direction of a rotation when it is made by reference to the face of a clock; probably because few of them are so familiar with right-handed and left-handed screws as they are with clock-faces.

(5) "In a linear strain the increment of distance of two points in the line of the strain is properly their *elongation*; while the ratio of the elongation to the original distance is called the *extension*, not the *elongation*, as on p. 167." And yet Thomson and Tait ("Elements of Natural Philosophy," § 139), Clifford ("Elements of Dynamic," p. 158), Minchin ("Uniplanar Kinematics of Solids and Fluids," § 78), and Ibbetson ("Mathematical Theory of Elasticity," § 53), all define elongation exactly as I have done.

(6) "The author, disregarding the vernacular use of the word 'weight,' defines the weight of a body as the force with which it is attracted by the earth" [I don't (see § 290); but let that pass], "but is at variance with his own definition in the statement of the majority of the subsequent examples, relapsing into the language of ordinary life." No references are given to these instances of backsliding. I have looked pretty carefully through the subsequent examples, and can find no case in which I have used the term referred to in any other sense than that given it by definition. I should be glad to have such slips pointed out to me, if there are any.

(7) "A collection of 500 different ways of spelling the name of the town of Birmingham has been made, and a similar collection could be made from the present treatise of different ways of expressing the simple ideas of the pound *weight* and the pound *force*." It is true that these ideas are expressed by English writers in various ways. And it seems to me desirable that a student should be made acquainted with them. Surely in holding that I should choose one phrase and stick to it, your reviewer is blaming me for not being one of the "mathematical precisionists" at whom he sneers.

(8) "This terminology culminates in the solecisms that on p. 477 we must suppose pressure to be measured in poundals on the square foot in hydrostatical problems; and that if the equation $w = mg$ is supposed to be used with absolute units, the weight of a body is measured in poundals; as if a mathematician asked in a shop for 'half a poundal of tea, or tobacco.'" It is not quite correct to say that, in the hydrostatical equations referred to, pressure must be supposed to be measured in poundals per square foot. In fact it may be supposed to be measured in terms of the unit of pressure of any derived system, as, *e.g.*, the dyne per square centimetre, or even the pound-weight per square foot, provided only the density be measured in terms of the corresponding unit. I am aware that this mode of expressing hydrostatical equations is unusual, but it seems to me to have great advantages, and it was adopted both for this reason and for the sake of making the section on hydrostatics uniform with the rest of the book. With regard to the units in which weight should be measured, the practice of the tobacconist or the tea merchant is surely not our best guide.

(9) "Thus a mathematical precisionist, to express the simple idea of a force of 10 pounds, to be consistent should call it 'a force equal to the weight of the mass of 10 pound weights,' the absurdity of which is evident." The phrase inclosed in quotation marks is not quoted from my book. In my terminology the most precise of mathematicians would express the idea referred to

by the phrase "a force equal to the weight of 10 pounds," which is neither clumsy nor absurd.

(10) "Except for the parts criticized above, on the units of weight, mass, and force, the present treatise shows that the author has read with profit and discrimination the most recent treatises on dynamics." I have been under the impression that in my treatment of these units I had, in the main, followed the most recent treatises on dynamics. May I ask in which of them units are treated in what Prof. Greenhill considers the proper way?

I would like to say also that the elementary proofs of the chief properties of the common catenary, which are given by me, are, with slight modifications, those given in Prof. Goodeve's "Principles of Mechanics." My indebtedness to his book is acknowledged generally in the preface.

I fear my desire to be brief may have made me appear curt. Let me express, therefore, my appreciation of the trouble Prof. Greenhill has taken to form a just estimate of the merits of my book, and of the kindly way in which he has spoken of it.

J. G. MACGREGOR.

Dalhousie College, Halifax, N.S., March 1.

Coral Formations.

I AM glad to see the theory that the internal lagoons of coral atolls are excavated by the chemical action of sea-water and the removal of carbonate of lime in solution is now being brought to the test of figures.

Mr. J. G. Ross (NATURE, March 15, p. 462) calculates from his experiments that in this way a sheet of carbonate of calcium half an inch thick can be removed annually from the surface of a lagoon, but strangely adds, "In other words at the same rate it would require about a century to deepen the lagoon one fathom." According to this method of calculating, 144 years is "about a century."

These figures no doubt suit the theory of the formation of coral lagoons very well, but they appear to me quite destructive of the other and co-relative view that the platforms upon which atolls have been formed have been built up by the accretion of the dead shells of pelagic organisms showered down from the surface of the ocean together with the shells of those organisms which have lived on the bottom. I believe that at no place on the surface of the globe are such dead shells being supplied at a rate that would even balance this supposed rate of chemical destruction.

Yet if these figures be correct we shall have to reckon upon the removal from such platforms of more than half an inch annually in consequence of the quicker action which it is said takes place through greater pressure at greater depths.

If, therefore, we accept the dissolution theory of the origin of coral lagoons, it seems impossible to believe in the building up of platforms of calcium carbonate on volcanic or other peaks from varying and unknown depths to the levels necessary for the growth of reef corals. If, on the other hand, we believe that platforms are so built up, it appears equally destructive of the dissolution theory of the lagoons.

Dr. Darwin indicated this difficulty in his letter to me, published in NATURE, November 17, 1887, p. 54, but the figures we are now supplied with enable us to realize it much more vividly. T. MELLARD READE.

Park Corner, Blundellsands, March 16.

The Movements of Scree-Material.

I PERUSED with interest the abstract of a paper on the above, read by Mr. Davison at the meeting of the Geological Society on the 29th ult.

The phenomenon seems somewhat akin to the movements in the "Stone Rivers" of the Falkland Islands, though another reason has been suggested by Sir Wyville Thomson as the cause of their progress.

Might it not be possible for motion to be produced in loose materials, and in the molecules of certain coherent substances situated at a high angle of slope, by continual though imperceptible vibrations in the earth's crust?

Apart from the changes wrought by alternating temperature, might not the "downward creep" in the lead on the roof of Bristol Cathedral—as observed by Canon Moseley—be due to a "settling down" of the molecules by the constant vibrations of sounds transmitted through the structure, and having their origin within and without? CECIL CARUS-WILSON.

Bournemouth, March 15.

Were the Elephant and Mastodon contemporary in Europe?

MR. HOWORTH asks this question in NATURE for March 15 (p. 463). Perhaps this extract from a translation of a note from Prof. d'Ancona, of Florence, will satisfy Mr. Howorth: "The soil of the upper Val d'Arno is ascribed to formations of the Pliocene period." In it have been found "*Mastodon avernensis*, *Elephas meridionalis*." Twenty-four other animal remains are identified, all differing from the remains of the bone-caves. In both places respectively these relics belong to contemporary animals.

9 Sinclair Road, W., March 15. H. P. MALET.

EXPERIMENTS IN MOUNTAIN BUILDING.[1]

THE primary object of these experiments was to explain on what mechanical principles the remarkable rock-structures recently discovered by the Geological Survey in the North-West Highlands might have been produced. In experimenting on the behaviour of strata when subjected to horizontal pressure, it has been usual to regard large rock-masses as practically plastic bodies, and to imitate in the laboratory the great flexures and plications of Nature by compressing layers of clay, cloth, and other plastic or flexible substances. It was, however, evident, as soon as the true structure of the North-West Highland area was unravelled, that the rocks had, to a very large extent, behaved like rigid bodies under the enormous lateral pressure to which they had once been subjected. Instead of following the usual method of using plastic materials, the author therefore set to work to devise strata sufficiently rigid to snap rather than bend and become folded on the application of lateral pressure. It is to this peculiarity in the character of the materials, rather than to any great novelty in the methods, that the interesting results obtained are mainly due.

The experiments were of three distinct kinds. The first series was designed to explain the behaviour of strata when thrust horizontally over an immovable surface, and thus to throw light on the phenomena of "thrust planes," such as are now known to occur abundantly in the North-West Highlands between Loch Eriboll and Skye (see NATURE, vol. xxxi. p. 33). To simulate natural strata, layers of damp sand, foundry loam, or in a few cases clay, with laminæ of dry stucco powder between, were employed. In a few minutes the anhydrous powder absorbed enough moisture from the damp beds to enable it to "set" into tolerably rigid sheets. The rock which had thus solidified *in situ*, was next compressed horizontally, by pushing in, by hand, or with the help of a screw, the movable end of the long box in which the strata were formed. One side of the box could be removed at pleasure, and at the end of each experiment it was lifted off, and the section inside revealed, so that it could be photographed or copied if desired.

Fig. 1, which is drawn to a scale of $\frac{1}{12}$ of the original, shows the character of the section produced after the end had been pressed in 20 inches. The central light-coloured band, bounded by stiff stucco laminæ, has undergone no folding, but has become heaped up by means of a series of slightly inclined reversed faults, along which the constant pressure from the right found relief. For this structure the author has proposed the name "wedge structure," as the advancing mass is really raised by being forced over a series of wedges of undisturbed rock.

After pushing the piled-up mass a certain distance

[1] Abstract of a Paper by Henry M. Cadell, B.Sc., F.R.S.E., H.M. Geological Survey of Scotland, read before the Royal Society of Edinburgh, February 20, 1888.

forward, the whole heap always showed a tendency to rise and ride forward *en masse* over the less disturbed beds in front. Fig. 2 shows a typical section produced at this more advanced stage of the movement. This new plane of shear may be called a "major thrust," as distinguished from the "minor thrusts" shown in Fig. 1, and in the upper part of this figure. The structure of these artificial rock-masses bears a remarkable resemblance to that of the great thrust areas of Sutherland

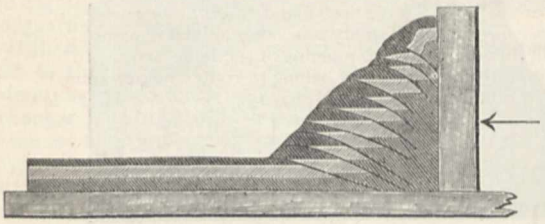

FIG. 1.

and Ross. Everywhere along that great region of earth movement major thrust planes are found truncating sets of minor thrusts, just as has taken place in this experiment. The extraordinary heaping up and local thickening of Silurian strata, and the superposition across their upturned edges of huge slices of Archæan gneiss and Cambrian sandstone, are phenomena which, before the thrust-plane theory had been originated, were quite inexplicable.[1]

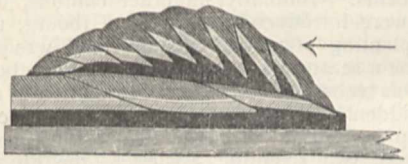

FIG. 2.

The second series of experiments was intended to ascertain how such great thrusts might have originated, and to trace their connection with folds and great terrestrial movements of upheaval and mountain building.

Stratified beds, similar to those employed before, were formed on a band of stout wax-cloth, about 2½ feet long, and 7 inches broad, secured at the ends to vertical blocks of wood. When pressure was applied to the ends, the wax-cloth was thrown into folds, but the folds did not

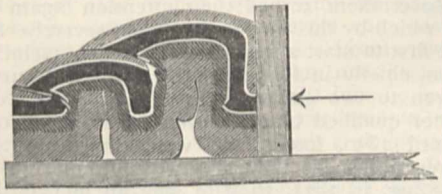

FIG. 3.

in all cases reach the surface, but found relief in thrusts, as shown in Fig. 3.

In this experiment an anticline was first formed at the end of the wax-cloth nearest the pressure. A thrust appeared at the surface, and, on examining the section, this was found to bend down and bury itself in the left monoclinal member of the fold. A second anticline was next started in advance of the first, and, on continuing the push, a second thrust, similarly situated with regard to the underlying fold, was produced. By this means it may be possible to explain how thrusts are connected with movements of deep-seated parts of the earth's crust, and also how, as in the Highlands, they occur over broad areas all inclined in the same general direction. If this section affords the true explanation of their origin, it is clear that thrusting is only a surface phenomenon, and that the complex structures of the North-West Highlands are structures which can only originate at the outer edge of a great mountain-system of elevation.

Fig. 4 represents a section produced with the same apparatus, but here the pressure was applied from both sides. An anticline was started at the centre of the

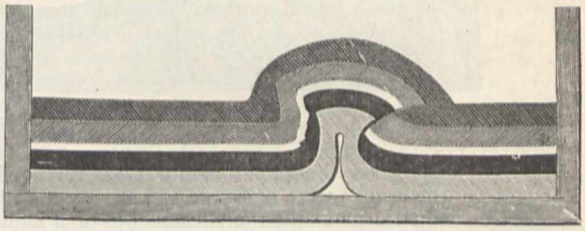

FIG. 4.

wax-cloth, and as the pressure was continued the strata were squeezed into a form closely resembling that known as "fan structure." Two small arches were next formed, one on each side of the original fold, and the pressure was continued. A second fan made its appearance outside the first, and at each side there was a tendency for thrusts to be produced, as shown in Fig. 5. Throughout the experiment the lowest stratum of damp sand next the wax-cloth was compressed and distorted, till, at the last stage of the movement, it became very much "staved together" above the synclinal folds of the wax-cloth on either side, and was completely "nipped out" at the crown of the central fold. During the movement in the mass it was, in fact, made to flow like a viscous body, along a series of approximately vertical planes, which in

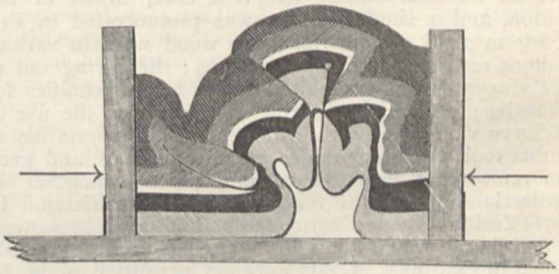

FIG. 5.

Nature would be described as planes of foliation. This experiment, then, may help to explain not only the origin of the fan structure of the Alps, &c., but also the common occurrence in the centre of the fan of a core of crystalline rock with vertical foliation.

The experiments of the third series were modifications of those of Prof. A. Favre, of Geneva (see NATURE, vol. xix. p. 103), who covered a band of stretched caoutchouc with beds of adhesive clay, and on allowing the elastic sole to contract, observed the wrinkling up of the surface of the clay into a series of miniature Alpine ridges. The author modified Favre's experiments by separating the upper and lower portions of the clay with sheets of paper, so that the former could be stripped off at the end of the experiment without disturbing the lower part of

[1] The effect of major and minor thrusts is well seen in the section of the Durness and Eriboll district above the map in the second edition of Dr. A. Geikie's "Scenery of Scotland."

the section. After removing the superficial folded layer, the paper covering the lower bed was found to be covered with minute corrugations like those often seen on beds of mica-schist. On stripping off the paper, and again stretching the elastic substratum, the clay adhering to it did not become smoothed down to its original form, but split along a multitude of vertical rents, transverse to the direction of pressure, each of which corresponded to one

Section at head of Loch Eriboll.

of the little ripples on the paper before it was removed. The sides of the cracks were observed to be covered with minute vertical striations like the slickensides of a fault-fissure.

This experiment, the author suggests, may explain the vertical cleavage and foliation found in the deep-seated parts of many old mountain-systems.

SWISS FOREST LAWS.

THE Report of Mr. Conway Thornton to the Foreign Office, on the Swiss Forest Laws, is a careful and interesting piece of work. He divides his subject into two parts: in the first he treats of the history of forestry prior to 1875, the year in which the Act now in force, the Forestry Act of 1875, was proposed; and in the second part he deals with that Act, its provisions and its effects, and the measures taken under the "Règlement d'Exécution," which followed the Act, for the advancement of technical education amongst foresters in Switzerland. It is evident that from a very early date the various cantons endeavoured to preserve the forests. Thus, in 1314 the authorities of Zurich forbade "the felling, floating, or selling" of timber from the Sihlwald; in 1339, Schwyz forbade charcoal-burning near the chief towns of the canton, and a similar decree was promulgated in Fribourg in 1438. Industries using wood were in various cantons restricted in their operations; the laying out of new vineyards was prohibited under heavy penalties for centuries; and finally, during last century, the use of uncloven vine-props was forbidden. The exportation of timber took place only under great difficulties, and even the removal of timber from one place to another in Switzerland was, until 1848, very much restricted. In 1376, Zurich forbade clearings to be laid down in pasture, and Fribourg would not allow sheep-pastures to be established in clearings. Goats were not permitted to be let loose in the woods; and rosin-scrapers were excluded from many of the forests. None of these numerous decrees appear to have had much effect, the very number of them testifying to their powerlessness to check the evil. In many cases the general prohibition against wood-cutting gave way to a partial permission, as, for example, in Zurich, where the number felled was not permitted to exceed a stated total. This instance of Zurich gives us the first scientific treatment of the question, when the felling of the Sihlwald and other woods in the fourteenth century was regulated both as to the amount and the system of cutting.

In 1702, prior to which date attention was paid solely to the maintenance and protection of the timber, the Government appointed a Commission to inquire how the forests might be best preserved, enlarged, and improved; and subsequently issued a decree carrying the recommendations of the Commission into effect. In 1725, Berne followed the example of Zurich, and published forestry orders, which, like those of the latter, contained directions for the cultivation of timber and for permanent improvements. Similarly, in other cantons, improved systems were introduced; thus, in Fribourg, the compulsory planting of marshy meadow-land was decreed; in Lucerne a season was set apart for felling, the growth of oaks was recommended, and the formation of clearings was forbidden. In 1755 an excellent forestry code was drawn up by Joseph Wilhelm, Prince-Bishop of Bâle. About 1760, two scientific Societies—the Physical Society of Zurich and the Economical Society of Berne—made great efforts to introduce improved knowledge of woodcraft into Switzerland, and with this object they made strong representations to their respective Governments, and the Forestry Decrees of 1773 and 1786 were the results of their interference. The substance of these decrees may be stated to be the surveying of forests, the appointment of officials who would supervise planting, experiment on exotics, and help in teaching a more scientific system of wood-cutting. By means of these measures some real progress was made, which, however, was stopped by the general confusion during the beginning of this century; but, immediately peace was restored, the Helvetic Government turned their attention again to the forests, which by this time had suffered severely. Soleure was the first to start a system under which technical instruction, chiefly in forestry and geometrical surveying, was given to two citizens from each woodland district, the better qualified being chosen foresters. From this time until 1830, forest laws were drawn up universally, prescribing the modes in which timber was to be felled. Zug, in 1821, tried to give an increased value to her forests by endeavouring to extend scientific teaching among the people. In consequence of the disastrous floods in Switzerland in 1830, from this time we find that forest laws were more generally enacted and more rigidly enforced than they had ever been before. The number of officials was increased, and great attention was paid to their training. In fact, the spread of the science of forestry in Switzerland dates from this period. At first the people thwarted the officials in every way, but, becoming gradually enlightened as to the utility of the Government measures, they ceased from actual opposition. Even the most backward of the cantons began

to realize that their true interests lay in the preservation of the forests, both as a commercial speculation, having regard to the advancing price of timber, and as a support for precipitous ground, and on account of its domestic and national uses. With regard to the latter, it is worthy of note that the respective cantons, from the earliest times, supervised the numerous public woods; and that the frontier forests were always better looked after than any others, on account of their importance as a defence in time of war, and at the commencement of the eighteenth century woods were protected, as being safeguards against avalanches and landslips.

Hitherto the students trained in forestry had been sent to the schools in Germany, but in 1855 the Confederation took the matter up and established a Forestry School, in which henceforth Swiss students were educated in the art of wood-cutting and the kindred sciences. In 1858 a long and searching inquiry was made into the supposed connection of the forests and the course of the mountain torrents, and, as a consequence, the State aided the School of Forestry in their efforts to plant anew the ground where springs abounded, and officials were appointed for this purpose. With regard to these officials, mention of whom occurs in all the forest laws of Switzerland, we first hear of them in 1314, when, as in subsequent centuries, they were supposed to be aided by the inhabitants, every one of whom in a woodland district was sworn to disclose any breach of the decrees which came to his knowledge. For centuries these officials were mere guardians, commonly called *Bannwärte;* but the punishment of offenders rested with councils of magistrates, &c. The ordinary forest-keeper was generally nothing more than an intelligent wood-cutter; but when it was seen that some technical teaching was necessary, the skilled man, and, later still, the man with a knowledge of natural science and mathematics, was always preferred. In 1868 the disastrous floods gave a fresh impetus to the spirit of inquiry into the action of the forests on the rainfall and the course of the torrents; and we find in the revised Federal Constitution of 1874 an article inserted, giving the Federation control over the forests and waterways, and authority to interfere in any way they might think fit. Under this article two officials were appointed—the Federal Inspector of Forests, and also a Sub-Inspector. The Forestry Societies unanimously adopted a programme which, being presented to the Federal Council, was embodied in the Forest Law proposed by the Council in 1875. This proposed enactment led to much discussion in the Assembly, but was finally passed by both Houses on March 24, 1876. The district to be subject to the law included not only the high mountain ranges, but also the hills bordering on the plains, as sharing in the protection afforded against floods and avalanches by the works which were intended to be undertaken in the former. The district was bounded by a line starting from the east of Lake Leman along the south of the plain between the Alps and Mount Jura, thence to the north of Lake Constance—that is, a tract of country in all about 60 per cent. of the whole of Switzerland, or 6,750,000 acres, about 15·8 per cent. of which was forest land. It was decided that the rights of private owners should not be infringed except in case of necessity—that is to say, where the woods of private owners were "protecting" woods; in other words, where, on account of their position, they might have an influence on the climate, avalanches, landslips, &c. Each canton was required to maintain an efficient staff of officials; and to each individual who had received technical training an area of about 17,500 acres was assigned if in the plains, and 25,000 acres on the mountains. All the woods under official supervision, including, of course, private woods which came under the class "protecting" woods, were to be demarcated, all clearings were to be immediately planted afresh, and where necessary new forests were to be created, the Federal treasury bearing from 30 to 70 per cent. of the cost, or, in the case of replanting protecting woods, from 20 to 50 per cent., according to the difficulty and the importance of the works, which were always required to receive the approval of the Inspector-General before the Federal subvention was granted. All servitudes or easements in "protecting" woods were to be redeemed within ten years, and no new ones were permitted to be created. Anything which might endanger the utility of the forests was strictly forbidden; cattle were not allowed to graze, nor could leaves be collected except in fixed spots. To this enactment was added a "Règlement d'Exécution," which provides, among other things, for the course of education to be given to each student of forestry by the canton to entitle it to the Federal subsidy. The time of the course is not to be less than two months, which may be divided into two half-courses of a month each, but the whole course must be taken within a year. Instruction must be given in the following subjects:—(1) Forest-surveying and measurement in detail; calculations of the dimensions and value of single trees, and of outlying tracts of wood; road-making; safeguards against avalanches, &c. (2) Study of the different kinds of timber and of noxious plants. (3) Elementary knowledge of soils, and of their component parts. (4) Fundamental notions of the laws of climate and meteorology. (5) Cultivation and care of forests. (6) Book-keeping and other general branches of instruction valuable for under-foresters. A preliminary and a final examination are prescribed, and no license is granted except on good answering in the latter. The Federal Government pay the teachers, who are appointed by the canton subject to the approval of the Federal Government.

At the outset there were great difficulties in carrying out this law. Some of the cantons had not their codes of regulations drawn up till 1881, and, with the exception of the cantons of Zurich, Fribourg, and Vaud, the survey was not quickly completed. In 1886, however, the Army Staff finished the triangular survey intrusted to them. In 1886 the redemption of servitudes prescribed by the Act was not ended, and up to that time £9150 had been thus expended. There is not in the cantons an uniform organization for carrying out the Forest Law, and Dr. Fankhauser, one of the highest officials of the Forest Department, does not think that such an organization is possible, having regard to the differences in position and ideas of the various cantons. At the present time each canton possesses in a measure its own scheme of forestry organization. There are, however, two main systems in existence in the Federal district, the first of which prevails in the central, eastern, and southern parts of Switzerland. Each canton is divided into districts of from 17,500 to 35,000 acres each, and over each district the canton places an officer who has received scientific training; under him are the keepers and deputy-foresters, chosen by the owners from among the students of the local forestry school, and paid by them. Each deputy has about 3000 acres to take care of, and has but to carry out the orders of his superior as to felling, clearing, and replanting. In the next, however, a different system obtains. Here the country is far less mountainous, and the inhabitants industrial rather than agricultural in their pursuits. In these cantons the district forester has from 7500 to 17,500 acres under him, and in this district he marks out all the fellings to be performed, and in fact does everything but the manual labour, which he leaves to his inferiors. This district includes, among other cantons, Zurich, Berne, Lucerne, and Neufchâtel, where timber being very high in price, and the opportunities of sale being numerous, the country is frequently reafforested by private individuals, while in the other cantons the State is forced to do nearly everything. The cantons not within the control of the

Federal law differ from those here spoken of in their organization. In Bâle Campagne with its 37,000 acres of forest, 75 per cent. of this being public, has no officials whatever. Laws have been passed, but the people set them at naught; and similarly in Thurgovie there is the greatest opposition to any interference with what the people consider to be their ancient rights; and here also there are no officials, except one who has the care of 300 acres of State forest.

The salaries of the forest officials vary very much in the different cantons, but even in the best-paid districts the remuneration is very modest. Under-foresters receive sometimes a fixed salary, sometimes only daily wages when employed. If the former, the sum varies from £24 to £48; occasionally it reaches £60. If the rate of pay is per day, which is unusual, it is generally fixed at 4*s*. District foresters usually receive from £88 to £112 a year. In Uri, however, £120 is given, and in Glarus and a few other places as high as £160 per annum. Cantonal forest inspectors receive from £120 to £180 a year, besides allowances, which are always given to the higher officials when travelling on duty, ranging from 5*s*. to 8*s*., with the cost of the journey.

NOTES.

WE regret to announce the death of Signor Giacomo di Brazza, brother of the Governor of the French Congo Settlements, also an African traveller well known by his investigation of the Ogowé River. He died at Rome, aged thirty.

HERR ANDOR SEMSEY has presented the sum of 8000 florins (£800) to the Natural Science Society of Budapest, for the printing of a work by Herr Otto Hermann on Hungarian birds.

THE International Congress of Americanists, which met in 1886 at Turin, proposes holding its seventh session at Berlin early in the month of October. The Organizing Committee already includes such well-known names as Virchow, Reiss, and others.

MR. A. W. PICKARD-CAMBRIDGE has taken first place in Classics among the senior students at the last Cambridge Local Examination, and has been offered, in consequence, an Exhibition at St. John's College, Cambridge. He has won this honour at an almost unprecedentedly early age, being only fourteen years old. He has been a pupil of Weymouth College for the past four years, and is the son of the Rev. O. Pickard-Cambridge, F.R.S., the well-known naturalist.

A REPORT of the Cambridge Local Examinations and Lectures Syndicate laying down a scheme for the examinations for commercial certificates has been confirmed by grace of the Senate. The examination is to be wholly separate from the local examinations, there being no papers of questions common to the two, and no common classification of successful students. The standard set by the Syndicate is that suitable for well-prepared students of seventeen. Amongst the compulsory subjects are arithmetic, and physical and commercial geography, whilst the optional subjects include algebra and one of the following five subjects in elementary science: (1) inorganic chemistry, theoretical and practical; (2) organic chemistry, theoretical and practical; (3) mechanics, including hydrostatics and pneumatics; (4) sound, light, and heat; (5) electricity and magnetism.

ACCORDING to the *Oldham Evening Express* of March 16, what is described as a full-grown summer butterfly took refuge from a blinding snowstorm in a dwelling-house at Lusley Brook, near that town. The wings are said to be beautifully variegated; and on obtaining shelter in a warm room the butterfly thoroughly revived.

AT the last meeting of the Calcutta Microscopical Society a paper was read by Mr. Simmons on the mango weevil, a pest which is spreading rapidly in India. He has devoted much attention to the weevil, and in this paper he gives much useful information as to its geographical distribution, the extent of the damage done by it, with the observations of English and American entomologists on its ravages among fruit. This lecture is believed to be the first attempt made in India to systematically study the habits of the weevil.

THE Fund which has been established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to $25,000. As accumulated income is again available, the Trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the Trustees to give the preference to those investigations *which cannot otherwise be provided for*, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this Fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points:—(1) Precise amount required. Applicants are reminded that one dollar is approximately equivalent to four English shillings, four German marks, five French francs, or five Italian lire. (2) Exact nature of the investigation proposed. (3) Conditions under which the research is to be prosecuted. (4) Manner in which the appropriation asked for is to be expended. All applications should be forwarded to the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass, U.S.A. It is intended to make new grants at the end of 1888. The Trustees are disinclined, for the present, to make any grant exceeding $500.

THE following is a list of the grants already made from the "Elizabeth Thompson Science Fund":—(1) $200 to the New England Meteorological Society, for the investigation of cyclonic movements in New England. (2) $150 to Mr. Samuel Rideal, of University College, London, England, for investigations on the absorption of heat by odorous gases. (3) $75 to Mr. H. M. Howe, of Boston, Mass., for the investigation of fusible slags of copper and lead smelting. (4) $500 to Prof. J. Rosenthal, of Erlangen, Germany, for investigations on animal heat in health and disease. (5) $50 to Mr. Joseph Jastrow, of the Johns Hopkins University, Baltimore, Md., for investigations on the laws of psycho-physics. (6) $200 to the Natural History Society of Montreal, for the investigation of underground temperatures. (7) $210 to Messrs. T. Elster and H. Geitel, of Wolfenbüttel, Germany, for researches on the electrization of gases by glowing bodies. (8) $500 to Prof. E. D. Cope, of Philadelphia, Penn., to assist in the preparation of his monograph on American fossil vertebrates. (9) $250 to Mr. W. H. Perkin, Jun., for experiments on the synthesis of uric acid. (10) $125 to Mr. Edw. E. Prince, of St. Andrews, Scotland, for researches on the development and morphology of the limbs of Teleosts. (11) $250 to Mr. Herbert Tomlinson, of University College, London, England, for researches on the effects of stress and strain on the physical properties of matter. (12) $200 to Prof. Luigi Palmieri, of Naples, Italy, for the construction of an apparatus to be used in researches on atmospheric electricity. (13) $200 to Mr. Wm. H. Edwards, of Coalburg, W. Va., to assist the publication of his work on the butterflies of North America.

THE latest reports received by the Hydrographic Office of the United States about the logs of the great raft abandoned south of Nantucket about three months ago, prove that,

though they are now widely separated, their general drift has been in an east-south-east direction, the logs being found a little to the southward of this line. That they were not carried more to the northward and eastward by the Gulf Stream, as would be expected, was probably due to the strong north-west winds which prevailed during the latter part of December and the first part of January. Fortunately, no vessel has been disabled by collision with them, although the German bark *Bremen*, which was in company with the logs for five days, in latitude 39° north, longitude 62° west, had her sheathing torn and rudder injured.

WE have received from Mr. R. T. Rohde, of the New Oriental Bank, a well-known authority on questions connected with currency and banking, a pamphlet entitled "A Practicable Decimal System for Great Britain and her Colonies." In criticizing the Report on Decimal Coinage of the Parliamentary Committee of 1853, he proposes, amongst other things, to preserve the sovereign as the standard unit of the country, but to call it five dollars British sterling, each dollar being divisible into 100 cents, a cent thus being nearly one halfpenny in value; the sovereign and half-sovereign to remain, as before, the only gold coins in the country, the latter to be legal tender for an amount not exceeding £5, and the former for any amount. In the silver and copper coinage he would not make any alteration. He also advises the allowing of the use of the cental of 100 avoirdupois pounds, divisible into any decimal subdivision of such pound avoirdupois; the using of the foot as the standard measure, such foot being divisible into 100 equal parts, ten of which make one decimal inch. As a measure of capacity, he would suggest a vessel equal to one-tenth of an Imperial gallon, such vessel to contain one pound avoirdupois of distilled water at a temperature of 60° F.

AN interesting experiment in the planting of waste saline tracts in India has been carried out by Mr. Maries, superintendent of the gardens of the Maharajah of Durbhunga. The results have been communicated to the Agricultural Department, Bengal, and are contained in the last report of the Director. Mr. Maries says that six years ago, when he went to Durbhunga, he did not know what to do with patches of saline soil, on some of which not even weeds would grow. He dug the soil to the depth of two feet, and planted it thickly at the commencement of the rainy season with trees which had been grown in pots till they were about three feet high. In three years the ground was filled with roots, and to all appearances the salt had gone. When the trees were thinned out last year, leaving only the best, the ground was found to be in good condition. Similar experiments have been carried out in other places, and now Mr. Maries has splendid plantains growing on soil which a few years ago would not even grow a weed. He employed various kinds of trees in his reclaiming operations, but he says that the best were the *Inga Saman*, or rain trees, and the *Albizzia Procera*. The former is valuable as producing an enormous quantity of surface-feeding roots, and these decaying yearly leave a rich vegetable deposit on the soil. The trees soon completely change the character of the soil. The timber is excellent for fuel, and the trees bear lopping well. It is such an enormous water-absorber that it would most probably be very useful in swampy places as a fever preventive, like the willow which is planted in China around the villages in the rice districts.

M. LÉOTARD, Secretary to the Scientific Society of Marseilles, describes, in a recent issue of *La Nature*, the appearance of certain peaks of the Pyrenees as seen from Marseilles and its neighbourhood. Every year, about February 18 and October 31, Mount Carrigou, situated in the Eastern Pyrenees, and 2765 metres above the level of the sea, may be distinguished from Notre-Dame de la Garde in Marseilles, projected on the disk of the sun as the latter is about to set. From the top of Marseille-Veyre, 8 kilometres south of the town, the same observations may be made about February 13 and October 28. A straight line drawn from Notre-Dame de la Garde to the summit of Carrigou is 253 kilometres. Both Carrigou and the peak of Treize-Vents have been seen frequently since 1808, and this year M. Léotard and some of his colleagues made observations on the subject, and secured illustrations.

REFERRING to a journey of exploration in Australia which M. Ernest Favenc proposes to take, the *Colonies and India* says that no group of colonies in the world have taken more interest in exploration than those in Australia. In Melbourne especially, scientific Societies have given attention to this subject. It appears that the design in respect to a trip which M. Ernest Favenc proposed to take has now assumed a definite shape, and that he will pursue his object if only the Victoria and New South Wales branches of the Royal Geographical Society of Australasia will subscribe the necessary funds to send a surveyor with him. His intention is to start for Western Australia, there to inspect a large area of unstocked country, and subsequently to undertake a trip into the unexplored region between the tracks of Forrest and Warburton. If he finds the season favourable, then he proposes to make south, cutting the tracks of the other explorers at right angles. It should be mentioned that the explorer makes it a condition that the surveyor shall also be a fair mineralogist and know something of botany. Horses, saddlery, and rations will be found by the leader, but the passage, instruments, and salary of the surveyor selected are to be provided by the Societies named. When the matter came before the Victorian branch, at a meeting of the Council, a sub-committee was appointed to deal with the applications for the post of surveyor, which, it is believed, will be numerous.

THE storm which was experienced on the Atlantic coast of the United States on the 11th and 12th inst. was apparently due to a disturbance which was situated over Georgia on the 10th, and which subsequently moved rapidly up the American coast. The storm apparently commenced with a warm southerly wind and heavy rain, which changed very suddenly to a north-westerly gale and violent snowstorm. The character of the storm was that common to the blizzard of the United States, and the intense cold of the north-westerly wind was evidently due to the rear of the disturbance stretching for a long distance over the cold continent of America. The loss occasioned by the storm, both to life and property, is immense.

THE Italian Meteorological Office has issued a report on the climate of Massowah, based upon the observations made with standard instruments by the officers of the Italian expedition, between May 1885 and September 1887. The discussion is divided into two periods (1) May 1885 to May 1886; and (2) June 1886 to September 1887. The results show that the mean monthly temperature is above 86° in the months May to October. The maximum occurs in August: 108° in 1886, and 101°·8 in 1887. The minimum occurs in February; in two ten-day periods the thermometer fell to 66°, but there is little difference between January and February. Rainfall is very scarce and erratic, the fall of a few days may exceed that of the rest of the year. In the first twelve months 4·1 inches fell on thirty-four days; in the second, 4·3 inches on twenty-six days. The prevalent winds are northerly and southerly. The latter predominated from June 1885 until the end of the year; from January 1886 until September 1887, northerly winds prevailed. The above temperatures, while showing that Massowah is very hot, are lower than those sometimes quoted, apparently owing to more careful exposure in the present investigation.

THE New York Academy of Sciences (says *Science*) was organized in 1817 as the Lyceum of Natural History. It is fourth in point of age among American scientific Societies. The name and constitution were changed in 1876. The Annals, begun in 1824, have been distributed in all lands, and have given world-wide reputation to the Society. The Transactions, begun in 1881, give a record of the meetings, papers, and discussions, are published in monthly or bi-monthly numbers, and make an octavo volume each year. The library now numbers over eight thousand titles, and is especially rich in sets of the publications of foreign Societies. It is now on deposit in the Library Building of Columbia College, and is accessible to the public from 8 a.m. to 10 p.m. every day of the year except Sundays. The cabinet was destroyed by fire in 1866. Previous to that date it was the principal collection in the city, and did a noble work. The Academy has long looked forward to the time when it could secure a building of its own, such as the corresponding Societies in Boston and Philadelphia have long enjoyed. It is not to the credit of New York that its oldest scientific organization, after nearly three-quarters of a century of steady and persevering activity, should be still unprovided with a building, while many other cities can show noble monuments of scientific interest and public spirit. Why should not the recent meeting of the American Association in this city be permanently commemorated by the erection of a fire-proof building for the accommodation of the Academy, or perhaps of several other Societies under the same roof—a building which should be at once a benefit and an honour to the metropolis of America? The interest of the community has been aroused and quickened in the direction of science by the meeting of the Association, and the Academy of Sciences would now invite the citizens of New York to take a greater interest in its work.

PURE trichloride of nitrogen has at last been prepared and successfully analyzed by Dr. Gattermann, of Göttingen. The first result of these researches upon this terribly explosive substance brought to light the fact that the chloride of nitrogen prepared as usual by the action of chlorine gas upon ammonium chloride is by no means a homogeneous substance, that it really consists of a varying mixture of several chlorides. Moreover, it was found that the longer the time during which the chlorine was allowed to act, the more nearly the composition of the product approached NCl_3; but pure NCl_3 can never be obtained in this way, owing to the excess of ammonium chloride always present. Dr. Gattermann, however, prepared a quantity of this crude product, as richly chlorinated as possible, washed it well with water until all the sal-ammoniac was removed, drained it as free as might be from the water, and then led over it a rapid stream of chlorine. The resulting oil was again washed, carefully dried, happily without accident, and finally analyzed. The percentage of chlorine found was almost identical (89·17) with that required for NCl_3 (89·10). The success of these dangerous operations is all owing, it appears, to the fact that they were performed upon dull wintry days, when the sun's actinism was very low; indeed, Dr. Gattermann was almost led to believe that the disasters which have imparted to the history of this compound so tragical a character must have been owing to some fault of the experimenters. But at last—it was about the thirtieth preparation—the oil quietly reposing in the chlorinating apparatus suddenly exploded with its usual detonation. At the same moment Dr. Gattermann noticed that the sun had broken through the clouds, and was shining upon his apparatus. Here then was the cause of these apparently spontaneous explosions: chloride of nitrogen is violently dissociated by the wave-motion of light. Following this up, it was found that the burning of a piece of magnesium ribbon in proximity to the oil was quite as effective in producing an explosion. Finally, Dr. Gattermann has determined the temperature of dissociation of the compound. About half a gramme was heated in a thin-walled tube placed in a beaker of liquid vaseline, the thermometer being read off by means of a telescope placed at a safe distance. As high as 90° C. the oil remained unchanged, but at 95° it exploded with such violence that the whole apparatus was destroyed. One feels much regret on reading Dr. Gattermann's concluding observations, in which he states that his eyes and nerves have been so much affected that he is obliged temporarily to give up all further work upon this interesting substance.

MESSRS. CROSBY LOCKWOOD AND SON are about to publish the following books:—"Waterworks: being Notes on the Storage of Water in Reservoirs, &c.," by Charles Slagg; "Practical Surveying: a Text-book for Students preparing for Examinations or the Colonies," by George W. Usill; "Granites and our Granite Industries," with numerous illustrations, by G. F. Harris; a treatise on "Asbestos, and the Asbestos Mines of Canada," by Robert H. Jones; "The Mechanic's Workshop Handy-book," by P. N. Hasluck; and the fourth edition of "A Treatise on Metalliferous Minerals and Mining," by D. C. Davies.

IN a recently-published Report on the Fisheries of New South Wales, Mr. Griffin, the American Consul at Sydney, refers to the great wealth of the colony in this respect, which is totally neglected. Up to the present, no attempt has been made to develop an export trade in fish. In fact, there are only eleven hands employed in the whole colony in fish-curing, with a capital of no more than £250, and the output does not annually exceed £200 in value. Yet the amount of tinned fish imported by the colony last year exceeded 2000 tons, of which about one-half was from the United States, and almost all the remainder from Great Britain. With regard to the species of fish suitable for preserving which are to be found in the waters of the colony, the mullet (*Mugil grandis*) is there in abundance, and when well cured is superior to anything of the kind in the world. Generally, it may be said that the fish fauna of Australia differs very little from similar species in Europe and America. The most remarkable fish in Australia is the *Phyllopteryx*, described as "the ghost of a sea-horse with its winding sheet all in ribbons about it; and even as a ghost it seems to be in the last stage of emaciation, literally all skin and grief."

THE resistance of pollen to various external influences is the subject of a recent inaugural dissertation by Herr Rittinghaus in Bonn (*Naturf.*, 1, 1888). As to temperature, he found most pollen able to bear 90° C. half an hour, without losing the power of germination. A temperature-maximum was reached at 104°·5 for ten minutes. In conditions favouring germination, pollen does not bear such high temperatures as in the air-dry state. A moderately raised temperature (32°) accelerates growth of the pollen tubes. Low temperatures (*e.g.* under 9°) prevent germination, though a cooling to 20° for forty minutes can be borne without injury. As to *liquid* chemical reagents, the plasma of pollen proved very sensitive to antiseptics (more so, as a rule, than micro-organisms), but the resisting power is pretty different in different sorts of pollen. Chloroform *vapour* acting for twenty minutes was fatal, bromine vapour in five minutes, ammoniacal vapour in ten to twenty minutes. Rotation, several hours, of a spherical vessel holding pollen with nutritive solution, did not prevent free germination. The retention of the power varies widely in different plants. Thus, *Cyclamen* lost it soonest, in seventeen days; while *Clivia*, a narcissus, still had it on the sixty-sixth day (*Pæonia* fifty-eight, *Camellia* fifty-one, *Azalea* forty-two). The average is thirty to forty days.

A RECENT number of the *Indian Agriculturist* contains a notice of a little book written in Bengalee, by a Hindoo gentleman, Nidhiram Mookerjee, and published at the Bangabasi Press, Calcutta. The work is on pisciculture, and gives us the results of the labours of an ardent student of fish and their

habits. He established a fish-farm on his own estate, and watched over it for many years. He divides his subject into five parts. In the first place, he discusses the fish supply of Bengal, and in doing so shows that the supply is frequently not equal to the demand—a fact due chiefly to the absence of skilled fishermen. And so it happens that at various seasons breeding and unmatured fish are brought to market to meet the demand. The second chapter treats of the best food for fish; the third of hatching and breeding, and the proper precautions to be taken at those times. The fourth part deals with the question from a commercial and speculative point of view. A little capital, the author says, if wisely invested in pisciculture and in fisheries produces a greater return than in any other industry; for while, as Prof. Huxley says, an acre of land will produce in the year a ton of grain or two or three hundredweight of meat, the same extent of water in a good fishing-ground will yield a greater weight of fish in a week. The author begs of his countrymen to pay attention to this much neglected subject; he puts his practical experience before them, and thinks, that in a country like Bengal, where fish forms a large portion of the dietary of the people, it is a pity that more is not known of this subject. One of the most valuable portions of this little work is the fifth, in which he gives a scientific description and classification of almost all the known fish in the waters of Bengal, with their Bengalee equivalents.

THE additions to the Zoological Society's Gardens during the past week include two Stock-Doves (*Columba œnas*), British, presented by Lieut.-Colonel W. G. Dawkins; a Gayal (*Bibos frontalis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

DISTRIBUTION OF THE SUNSPOTS OF 1886 AND 1887.—Prof. Spoerer points out in a short note in the *Astronomische Nachrichten*, No. 2828, that the predominance of the southern hemisphere over the northern as to the numbers and areas of sunspots which they have displayed has continued throughout the two years just past. It would seem, indeed, as if the maximum for the southern hemisphere had fallen later than for the northern, for after the last return of the great group of November 12–25, 1882, the latter hemisphere became comparatively quiescent for a considerable time, and from that date the predominance of the southern hemisphere has been almost uninterrupted, the displays it exhibited during the latter part of 1883 and the earlier months of 1884 being so considerable and so numerous as to make the date of maximum the same for the sun as a whole as for the southern zone. So in the decline since the maximum, not only has the mean spotted area of the northern hemisphere been scarcely more than half that of the southern, but the running down in latitude has been more marked in the former than the latter. Thus in 1884, the northern zones above lat. 25° were already free from spots, whilst in the south the zone 25° to 30° was still occupied. In 1886 spots had ceased to be seen in the zones north of N. lat. 20°, but were still seen in the corresponding southern belt; whilst in 1887 they had almost vanished from the zone N. lat. 15° to 20°, though still fairly numerous at a like distance from the equator on the other side. The actual distribution of the spots is shown by Prof. Spoerer in the following table:—

Year.	+20°	+15°	+10°	+5°	0°	−5°	−10°	−15°	−20°	−25°	Totals. N.	S.
1886	17	30	40	14	50	45	68	47	5		101	215
1887	2	22	15	14	19	56	27	14			53	116

THE TOTAL ECLIPSE OF THE MOON, JANUARY 28.—By the kindness of Dr. E. Lindemann we are enabled to give the following further list of occultations observed during the total eclipse of the moon on January 28:—Amherst, U.S., 7; Clinton, U.S., 3; Copenhagen, 25; Harvard College, U.S., 23; Madrid, 20; Montreal, 6; Moscow, 15; Nice, 24; Princeton, U.S., 8; Toulouse, 13; Utrecht, 15; Washington, 11; West Point, U.S., 2. The weather was also favourable at the Birkdale Observatory, Southport, and at Berlin and Dun Echt; but at the last two Observatories, and also at Lord Rosse's, the occultations were not observed. The sky was cloudy at Herény, O'Gyalla, Quebec, Rio Janeiro, Stockholm, and Vienna.

SPECTROSCOPIC DETERMINATION OF THE ROTATION PERIOD OF THE SUN.—Mr. Henry Crew, Assistant in Physics at the Johns Hopkins University, has recently published (*American Journal of Science*, February 1888) a series of observations made with a fine Rowland grating of 14,436 lines to the inch, of the relative displacement of certain lines in the solar spectrum, as given by the opposite limbs, with a view to determine the rotation period of the sun. The result which he obtained from 455 settings in the course of observations ranging over four months and a half, gives, for the mean equatorial velocity, $v' - v'' = 2{\cdot}437 \pm {\cdot}024$ miles per second, corresponding to a true period of 25·88 days. But an unexpected and remarkable circumstance was brought out by the investigation, in that the observations seemed to show a gradual *increase* of daily angular motion with higher heliographical latitude, whilst, as is well known, Carrington found a *decrease* of such motion for the spots. Mr. Crew gives for the equation of this change—

$$v = 1{\cdot}158 \cos \chi^\circ \, (1 + 0{\cdot}00335 \, \chi^\circ),$$

whence we have for the daily angular motion of any point in the reversing layer—

$$\theta = 794' \, (1 + 0{\cdot}00335 \, \chi^\circ),$$

whilst Carrington obtained for the sunspots—

$$\theta = 865' \, (1 - 0{\cdot}191 \sin^2 \chi^\circ).$$

The greatest irregularities in the value of $v' - v''$ occurred between the latitudes 15° and 25°, *i.e.* in the chief spot zone.

It should be added that different lines gave different values of $v' - v''$, with nearly as large a range as the different latitudes did, but there appeared to be no connection between the order of the velocities and the order in which the elements causing the lines observed are generally supposed to be distributed in the solar atmosphere. The double line, 1474 K, of which one component is due to iron, and the other is the line of the corona, gave no evidence of variation in width on one limb, as compared with the other, so if the two lines be produced by absorption from different layers, those layers cannot be drifting with respect to each other at a higher rate than one-third of a mile per second.

The spectrum of the fourth order was used throughout. Attempts were made to measure the relative displacement of the D_3 line, as given by opposite limbs, but with this dispersion the definition was not sufficiently good to permit satisfactory measures of the line to be made.

NEW MINOR PLANET.—A new minor planet, No. 273, was discovered on March 8, by Herr Palisa at Vienna. This is Herr Palisa's sixty-first discovery.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 MARCH 25–31.

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

At Greenwich on March 25

Sun rises, 5h. 51m.; souths, 12h. 5m. 54·3s.; sets, 18h. 20m.: right asc. on meridian, 0h. 19·4m.; decl. 2° 6′ N. Sidereal Time at Sunset, 6h. 34m.

Moon (Full, March 27, 22h.) rises, 15h. 12m.; souths, 22h. 28m.; sets, 5h. 29m.*: right asc. on meridian, 10h. 43·4m.; decl. 10° 51′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	5 10 ...	10 27 ..	15 44 ...	22 40·8 ...	9 9 S.
Venus ...	5 10 ...	10 23 ..	15 36 ...	22 36·7 ...	9 59 S.
Mars ...	20 12*...	1 34 ...	6 56 ...	13 46·0 ...	8 10 S.
Jupiter ...	23 54*...	4 6 ...	8 18 ...	16 18·6 ...	20 25 S.
Saturn ...	11 54 ...	19 53 ...	3 52*...	8 7·6 ...	20 48 N.
Uranus...	19 12*...	0 47 ...	6 22 ...	12 58·8 ...	5 32 S.
Neptune..	7 49 ...	15 30 ...	23 11 ...	3 44·1 ...	18 6 N.

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

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

March.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
28 ...	80 Virginis ...	6 ...	19 49 ...	20 43 ...	10 230
31 ...	η Libræ ...	6 ...	1 20 ...	2 30 ...	61 234

March.	h.	
28 ...	2 ...	Mercury in conjunction with and 0° 2′ north of Mars.
29 ...	2 ...	Mars in conjunction with and 2° 35′ south of the Moon.
31 ...	1 ...	Mercury at greatest elongation from the Sun 28° west.
31 ...	2 ...	Saturn stationary.
31 ...	19 ...	Jupiter in conjunction with and 3° 32′ south of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4	81 16 N.	Mar. 28,	5 3	*m*
S Piscium	1 11·7	8 20 N.	,, 31,		*M*
Algol	3 0·9	40 31 N.	,, 26,	22 33	*m*
			,, 29,	19 21	*m*
R Canis Majoris...	7 14·5	16 12 S.	,, 25,	19 8	*m*
			,, 26,	22 24	*m*
S Cancri	8 37·5	19 26 N.	,, 25,	20 14	*m*
δ Libræ	14 55·0	8 4 S.	,, 27,	23 48	*m*
U Coronæ	15 13·6	32 3 N.	,, 30,	21 15	*m*
U Ophiuchi... ...	17 10·9	1 20 N.	,, 26,	4 32	*m*
			,, 27,	0 40	*m*
W Sagittarii ...	17 57·9	29 35 S.	,, 28,	3 0	*M*
R Scuti...	18 41·5	5 50 S.	,, 25,		*m*
R Delphini	20 9·5	8 45 N.	,, 28,		*M*
T Vulpeculæ ...	20 46·7	27 50 N.	,, 30,	20 0	*M*
			,, 31,	22 0	*m*
δ Cephei	22 25·0	57 51 N.	,, 27,	1 0	*m*

M signifies maximum ; *m* minimum.

Meteor-Showers.

	R.A. °	Decl. °	
Near β Draconis	263 ...	49 N.	
,, ζ Draconis	260 ...	63 N. ...	March 28. Rather slow.

GEOGRAPHICAL NOTES.

In a previous number we referred to the return of M. Edouard Dupont, Director of the Brusse's Natural History Museum, from his visit to the Congo for the purpose of scientific exploration. Some of the results of his visit he described the other day to the Belgian Society of Engineers. M. Dupont pointed out that the African interior is drained mainly by four great rivers—the Nile, the Niger, the Zambezi, and the Congo—each of which has to break through the low range that bounds the interior somewhat saucer-shaped table land. The Congo, before making its great final effort, is to some extent dammed back into the reservoir known as Stanley Pool. M. Dupont's journey extended from the mouth of the river to the *embouchure* of the Kassai. The subsoil of the Lower Congo he found to be a soft and impure limestone covered with sand and clay. The mountainous region begins before arriving at Boma, and may be divided into three sections, according to the composition and aspect of the rocks. There is in the first place granite, gneiss, mica-schist, quartzite, and amphibolic rocks, in strongly inclined beds, and extending from Fetish Rock, below Boma, to the neighbourhood of Isanghila. The river from Vivi rushes in a series of cataracts through a gorge 55 miles long. Then follow schists and sandstones ; and a little beyond Isanghila, at the great bend of the Congo, appear masses of limestone, very similar to those of the Meuse, and which alternate with the schists for about 35 miles. Then follow schists and red sandstones to beyond Manyanga. At Isanghila the banks rise into walls, some 700 feet high, of rough-grained, almost horizontal sandstone. This ends at Stanley Pool, where begins the Upper Congo. There is an immediate change in the strata. Some coherent sandstones show themselves at the base of the new deposits, and are topped by a great mass of soft sandstone, of the whiteness of chalk. M. Dupont traced these new rocks to the mouth of the Kassai, where there was nothing to indicate that they soon came to an end. He believes, on the contrary, that they constitute the subsoil of the greater part of the Upper Congo. M. Dupont is convinced, from his observations on the Congo, that the waters in the interior of Central Africa were at one time accumulated in a great lake, of which Stanley Pool is the last remnant. Gradually rising to the height of the mountains that bordered the plateau, they at last overtopped them, and, rushing down towards the Atlantic, gradually scooped out the channel now occupied by the Lower Congo. Stanley Pool, he considers, is the final stage of this supposed great internal lake.

A Brussels telegram announces that Lieut. Van Gele has at last succeeded in tracing the connection between the Mobangi and the Wellé, proving that the latter flows into the Congo, and is not the upper course of the Shari, thus solving one of the few remaining hydrographical problems in Africa.

In Ergänzungsheft No. 89 of *Petermann's Mitteilungen*, Prof. R. Credner concludes his very valuable monograph on "Reliktenseen,"—lakes which have remained behind after the departure of the sea from a particular area, as contrasted with continental lakes, which have from their origin been altogether independent of the sea. In the present instalment Prof. Credner deals in detail with the geological evidence, and with the various classes of "Reliktenseen" and the mode of their formation. He divides such lakes into three great classes : (1) such as have been formed through the damming up and isolation of parts of the sea through the elevation of the land above sea-level, as in the case of Lake Pontchartrain and the Kurische Haff ; (2) such as are due to the isolation of basin-formed depths of the ocean-bed as a result of "negative changes in level"—emersion lakes, as Loch Lomond and Lakes Wetter and Wenner ; (3) those caused by the retirement or shrinking of mediterranean seas, as the Caspian and Lake Aral.

At the last meeting of the Royal Geographical Society, Mr. Douglas W. Freshfield read a paper giving the results of his visit to the Caucasus last summer in company with M. de Dechy. Mr. Freshfield dealt at great length with the orography, the glaciation, geology, and ethnology of the Caucasus, and it is impossible to give an adequate idea of his important paper in a note. We can only refer to one or two important corrections which he made in the prevalent statements about the Caucasus. Some existing misconceptions are due to the fact that the Russian staff map embraces only the lower features, the higher ranges being unmapped. Mr. Freshfield dealt mainly with the part of the chain between Elbruz and Kazbek—the Central Caucasus. The geological structure of the chain has been represented with general accuracy by M. Ernest Favre, a son of the well-known Genevese geologist, who visited it in 1868. The backbone, composed of two or more ridges closely parallel, with many short spurs, is in great part gneiss or granite mixed up with crystalline slates. By what seems a strange freak of Nature, it is, east of Adai Choch, rent over and over again to its base by gorges, the watershed being transferred to a parallel chain of clay slates ("Palæozoic schists"), which has followed it from the Black Sea. There are clay-slate formations north as well as south of the granite backbone ; but on the north they take the form of rolling downs—of any peaks they ever had they have long been denuded. What the mountain climber looking out from any northern outlier of the granite chain sees is a limestone crest, turning its precipitous face towards the snows, sinking gradually to the low foot-hills which fringe the steppe. It is pierced by deep romantic defiles through which the glacier torrents make their escape. South of the Caucasus, parallel to, but much further from the main chain, runs a line of limestone heights, the most conspicuous summits of which are the Quamli, close to the Rion, and the Nakerale range, the limit of the Radsha. At the foot of the latter lie the coal-mines of Khebouli, recently connected with Kutais by a railway. Over the summit plateau spreads one of the noblest beech forests in the world, varied by an undergrowth of azaleas, laurels, and box, such as we try vainly to imitate in our English parks. Parallel chains and longitudinal valleys characterize this portion of the chain. In the most reputable treatises it is stated that there are not 50 square miles of glaciers in the Caucasus altogether. Mr. Freshfield shows that such a statement is ludicrously absurd. The glaciers of the main chain are many, and some of them are enormous. Among those that have the largest basins Mr. Freshfield mentions, between the Djiper Pass and the Mamisson on the south side, the Betsho, the Ushba, the Gvalda, the Thuber, the Zanner, Tetnuld, and Adish, the Sopchetura at the western and at the eastern source of the Rion. On the north side there is a great glacier in every glen ; the Karagam and the Bezingi are the largest ; next come the Dychsu, the Zea, the Adyrsu, and Adylsu, and a host of others lying not only on the main chain, but on its spurs, which are glaciated to an extent of

which the Ordnance map gives no hint. On the "Palæozoic schist" range, south of Suanetia, there are glaciers not very inferior to those of the Grand Paradis group, near Aosta. Dismiss for ever, Mr. Freshfield says, that preposterous fiction about the 120 square kilometres of ice in the Caucasus. It is too soon to say how many square kilometres there really are. One estimate, Von Thielmann's, would make the extent covered by ice close upon 2000 square kilometres, or equal to that in Switzerland—political Switzerland, not the Alps. Mr. Freshfield dwelt on many other points in connection with this interesting range, his notes on the inhabitants of the Caucasus being specially valuable, correcting as they do many prevalent errors.

OUR ELECTRICAL COLUMN.

CONSIDERABLE attention has been drawn to the peculiarities of manganese steel by a paper read before the Institution of Civil Engineers, by Mr. Hadfield. Not only is such steel entirely non-magnetic, but its electric resistance is extremely high. Prof. Fleming (*Electrician*, March 9) gives the following figures:—

German silver ...	...	20·9	... ·044
Platinoid ...	...	32·8	... ·021
Manganese steel	...	68	... ·122

The first column gives the resistance in microhms per cubic centimetre at 0° C., and the second column the average percentage variation of resistance per 1° C. between 0° and 100° C. These figures agree very well with those given by Prof. Barrett at the British Association meeting at Manchester.

HEIM has been investigating the electro-positive character of magnesium, with the view of replacing zinc in primary batteries. He finds that in a Daniell cell its E.M.F. is 2 volts, in a Grove cell it gives 2·9 volts, and in a Leclanché cell 2·2 volts. In a bichromate cell it gives as much as 3 volts.

MAGNESIUM can now be produced for about 8*s*. per lb., but local action is considerable, and its constancy uncertain. Hence, except for exceptional circumstances, its practical use is still questionable.

PROF. OLIVER LODGE has been giving some admirable lectures on lightning-protectors at the Society of Arts, and has pronounced the use of copper for such purposes as doomed. He argued that the supposed area of protection was mythical, and that the true way to protect a building was Maxwell's cage. He advocated iron, and showed copper to possess "inertia" to such an extent as to render its use dangerous. He also found that under certain circumstances, such as sudden violent discharges, untempered by time, points were of no use, but he suggested the use of barbed wire along the ridges and eaves of roofs.

THAT careful and accurate worker, Prof. Roberts-Austen submitted a paper to the Royal Society on the 15th inst., in which he narrated his recent inquiries into the mechanical properties of certain alloys that will have an important bearing on the metallic conductors employed in electrical enterprises. He has found that the tenacity of pure gold is very much diminished by the smallest admixture of impurities, and that this follows the order of the atomic volumes of the elements. Those elements the atomic volumes of which are higher than gold greatly diminish its tenacity. Doubtless the same principle is applicable to copper and other metals. The abnormal price of copper has raised a great demand for some better conductor than iron, or some improvement of iron in this respect.

DERHAM'S HYDROMETER.

THE Revenue system of estimating the duty on spirits consists of hydrometer, and tables of strengths for each degree of temperature from 30° to 80° F. When constructing the present Revenue tables of strengths, Sikes ignored the expansion and contraction of spirits due to variations of temperature from the standard temperature of 51° F., and assumed that the strength of any given sample of spirits remained the same at all degrees of temperature. From this false assumption it follows in practice, for example, that 100 gallons 40 overproof at 51° are estimated at 98·9 gallons at 30°, and 101·6 gallons at 80°, of the same strength as at 51°; reducing these quantities to the standard of proof strength, we have—

$$\begin{aligned} \text{At } 30^\circ \ \ldots \quad & 98{\cdot}9 \times 1{\cdot}40 = 138{\cdot}5 \text{ gallons of proof,} \\ 51^\circ \ \ldots \quad & 100{\cdot}0 \times 1{\cdot}40 = 140{\cdot}0 \quad ,, \quad ,, \\ 80^\circ \ \ldots \quad & 101{\cdot}6 \times 1{\cdot}40 = 142{\cdot}2 \quad ,, \quad ,, \end{aligned}$$

showing a discrepancy of over 3½ gallons, although the same actual quantity of spirit is present in each case.

In its original construction, Sikes's hydrometer was not intended to furnish specific gravities, but simply so many indications, respectively corresponding to the strengths in his tables. But it has since been found necessary to supply a table of specific gravities corresponding to the indications of the instrument. It is well known that scientific precision cannot be attained in experiments with the hydrometer, consequently the specific gravities in this table are far from accurate: for example, the specific gravity at the proof point, to the accurate definition of which the Inland Revenue attaches so much importance, is given as ·9233, instead of ·9236. The whole specific gravity table is in fact incorrect, the error sometimes amounting to two subdivisions of the stem. The errors, however, arising from this source are trifling compared with those inherent in the tables of strengths. For the purpose of constructing correct tables of strengths, the best data and those susceptible of the most accurate determination are the specific gravities of the spirits and the percentage by weight of alcohol they contain. The specific gravity of proof spirit, as defined by the Spirit Act is ·9236; therefore the weight of one gallon is 9·236 pounds. Proof spirit contains 49·3 per cent. by weight of alcohol, of specific gravity ·79385 at 60°; therefore one gallon of proof spirit contains—

$$\frac{9{\cdot}236 \times 49{\cdot}3}{100} = 4{\cdot}553 \text{ pounds of alcohol.}$$

To determine the true ratio of any spirit to proof spirit nothing more is required than to ascertain the weight of alcohol in one gallon of the spirit, and to divide that weight by the pounds of alcohol in a gallon of proof spirit; for example, spirit having a specific gravity of ·825 at 60° weighs 8·25 pounds per gallon; its percentage by weight of alcohol is 89·13; therefore one gallon contains—

$$\frac{8{\cdot}25 \times 89{\cdot}13}{100} = 7{\cdot}353 \text{ pounds of alcohol,}$$

equivalent to

$$\frac{7{\cdot}353}{4{\cdot}553} = 1{\cdot}615 \text{ gallons of proof spirit.}$$

Or 100 gallons are equivalent to 161·5 gallons of proof spirit, and the spirit is said to be 61·5 overproof. It is obvious that although the bulk and specific gravity of a spirit vary with the temperature, the percentage by weight of alcohol it contains does not vary from that cause. The specific gravity of the spirit in the preceding example is ·839 at 30°; the weight of one gallon therefore is 8·39 pounds; its percentage by weight of alcohol is 89·13 as before; therefore one gallon contains—

$$\frac{8{\cdot}39 \times 89{\cdot}13}{100} = 7{\cdot}478 \text{ pounds of alcohol,}$$

equivalent to

$$\frac{7{\cdot}478}{4{\cdot}553} = 1{\cdot}642 \text{ gallons of proof spirit.}$$

The strength of the spirit, therefore, at 30° is 64·2 overproof.

It should be here pointed out that the diminished bulk of the spirit at 30°, as compared with its bulk at 60°, is exactly compensated, in estimating the equivalent value in proof gallons, by the increased strength at the former temperature; for 100 gallons of spirit 61·5 overproof at 60° contract to 98·33 gallons at 30°; and, reducing to proof strength—

$$\begin{aligned} 100 \times 1{\cdot}615 &= 161{\cdot}5 \text{ gallons of proof spirit,} \\ 98{\cdot}33 \times 1{\cdot}642 &= 161{\cdot}5 \quad \text{do.} \quad \text{do.} \end{aligned}$$

whence it is evident that, by the employment of correct tables of strengths, the estimate of the equivalent value of a given quantity of spirit in gallons of proof spirit would be identical at all degrees of temperature. The spirit tables published by Dr. Derham, to which Sir Henry Roscoe lately called the attention of the Chancellor of the Exchequer, are calculated on this principle.

Dr. Derham also supplies what has long been wanted, a scientific hydrometer having a succession of poises to continue the series the indications of which are also specific gravities. It is well known that, in order to effect this, the increment to the total bulk of the instrument with each successive poise should be the bulk of the graduated stem. Bates's saccharometer is a more or less successful mechanical adaptation of this requirement. But it had escaped previous inventors that, in order to perfectly satisfy the conditions of the problem, the specific gravities of the successive poises should bear an exactly defined relation to the specific gravities to be indicated by the instrument. The principle upon which the calculation of the hydrometer is based is that—

$$\frac{\text{weight}}{\text{bulk}} = \text{specific gravity.}$$

Let W = weight of hydrometer; B = bulk of hydrometer; G = initial specific gravity of the instrument: g = specific gravity of any poise; a = the number of degrees of gravity indicated in the length of the stem; and unity = bulk of graduated stem; then, since the bulks of the poises must be multiples of the bulk of the graduated stem, according to their position in the series,

n = bulk of nth poise.
ng = weight of ,,

By the definition of specific gravity,

$$\frac{W}{B} = G; \text{ and } \frac{W}{B - 1} = G + a,$$

whence

$$W = BG, \text{ and } \frac{BG}{B - 1} = G + a,$$

and

$$Ba = G + a.$$

Again, generally, with nth poise attached,

$$\frac{BG + ng}{B + n} = G + na,$$

whence

$$g = 2G + (n + 1)a.$$

And if the hydrometer were intended to indicate gravities from ·780 to 1·000, the value of the stem being ·020, and the initial specific gravity accordingly of each range ·800, ·820, ·840, &c., the successive specific gravities of the poises would be 1·60, 1·62, 1·64, &c.

THE CŒLOM AND THE VASCULAR SYSTEM OF MOLLUSCA AND ARTHROPODA.[1]

THE object of the author was to establish the fact that the system of blood-containing spaces pervading the body in Mollusca and in Arthropoda was not, as sometimes (and indeed usually) supposed, equivalent to the cœlom or perivisceral space of such animals as the Chætopoda and the Vertebrata, but was in reality a distended and irregularly swollen vascular system—the equivalent of the blood-vascular system of Chætopoda and Vertebrata. Hence he proposed to call the body-spaces of Mollusca and Arthropoda "hæmocœl," in contradistinction to "cœlom." It had been held by previous investigators that in Mollusca and Arthropoda the cœlom and the vascular system were united into one set of spaces—whether by a process of gradual fusion, or owing to the fact that the two systems had never been differentiated from a common original space representing them both in the ancestors of these two great phyla. the author stated that he had been led to the view which he now formulated by his discovery of distinct spaces in both Mollusca and Arthropoda, which appear to be the true cœlom, and are separate from the swollen vascular system.

In Mollusca the pericardial space is the chief representative of cœlom. It is usually taught that the pericardium of Mollusks contains blood, and is in free communication with veins; but the author had succeeded in showing by observations on the red-blooded *Solen legumen* (already published, *Zoolog. Anzeiger*, No. 170, 1884), and by more recent careful investigation of *Anodonta cygnea*, *Patella vulgata*, and *Helix aspersa*, that the pericardium has no communication with the vascular system, and does not contain blood. The perigonadial spaces (so-called generative glands) and the pericardial space (which has arborescent tubular outgrowths in some Lamellibranchs forming Keber's organ) are, then, the cœlom of the Mollusca. It is quite distinct from the hæmocœl. In Cephalopods, and in the archaic Gastropod Neomenia, the pericardial and perigonadial cœlomic remnants are continuous, and form one cavity. There is strong reason to believe that in ancestral Mollusks the hæmocœl was more completely tubular and truly vasiform than it is in living Mollusks. In the later Mollusks the walls of the vessels have swollen out in many regions (especially the veins), and have *obliterated* the cœlom, which has shrunk to the small dimensions of pericardium and perigonadium. There are, however, many Mollusks with complete capillaries, arteries, and veins, in certain regions of the body. These had been recently studied by the author by means of injections, and by silver impregnation, and drawings illustrative of them were exhibited to the Section.

With regard to the Arthropoda, Prof. Lankester formulated the same view, viz. that the ancestral blood-vessels have swollen and enlarged, especially the veins, so as to form large irregular spaces, which have blocked up and so obliterated the previously existing cœlom. Nevertheless the cœlom still persists in some parts of the Arthropod body quite separate from the swollen blood-vascular system. It persists as the tubular generative glands (perigonadium), and also as a system of small spaces (lymph-system) in the connective-tissue of Astacus and of Limulus, and as the internal terminal vesicle of the green glands and other nephridia present in various Arthropoda. Prof. Lankester stated that he had been led to this view with regard to the vascular system and cœlom of the Arthropoda by the results of his histological investigations on the vascular system and connective-tissues of Astacus and Limulus, and by the results obtained in his laboratory by Mr. Gulland in studying the development of the nephridial "coxal gland" of Limulus (already published, with note by Prof. Lankester, in the *Quart. Journ. Micr. Sci.*, 1885, vol. xxv. p. 515). He had also been led to this view by the attempt to explain theoretically the origin of the peculiar structure of the Arthropod's heart and blood-holding pericardium.

The Arthropod's heart and pericardium are absolutely peculiar to the group, and characteristic of all its members—even of Peripatus. The author had asked himself how the existence of a tubular heart with paired valvular apertures in each segment of the body—lying within a blood-holding sac—could be explained. He conceived that it might best be explained by that tendency of the veins to dilate and to form irregular large blood-sinuses, which on other grounds we have reason to consider as a structural tendency of Arthropods. Each pair of valvular apertures in the Arthropod's heart represents a pair of distinct tubular veins which in the ancestors of the Arthropoda brought blood to the heart from the gills. These veins have dilated, and their adjacent walls have been absorbed, so that we now have, instead of a series of veins, a great continuous blood-sinus on each side of the heart or dorsal vessel.

Capillaries of the finest dimensions were shown by Prof. Lankester to exist in certain parts of Astacus and of Limulus. In studying these he had come across the remnants of cœlom. Between the capillaries and unconnected with them—in the connective-tissue of both Astacus and Limulus—is a system of spaces containing a coagulable fluid. (These spaces were described and figured in Limulus in 1884 by Prof. Lankester in the *Quart. Journ. Micr. Sci.*) It is into this system of spaces that the tubular nephridium which becomes the coxal gland of Limulus opens. Hence these spaces are remnants of the cœlom, elsewhere blocked up and obliterated by the swollen veins which form the hæmocœl. The tubular generative glands of Arthropods are to be explained as perigonadial cœlom communicating with the exterior through modified nephridia. Beddard's discovery of such a condition of the ovary and oviduct in the earthworm Eudrilus is confirmatory of this explanation.

The views which had been thus arrived at by Prof. Lankester and very briefly indicated in the note in the *Quart. Journ. Micr. Sci.*, 1885, p. 515, have received a startling and demonstrative confirmation in Sedgwick's brilliant results as to the development of cœlom and hæmocœl in Peripatus, published in the *Quart. Journ. Micr. Sci.*, February 1888, and announced early in 1887 to the Cambridge Philosophical Society.

[1] Abstract of a Paper read in Section D, at the Manchester meeting of the British Association, by Prof. Ray Lankester, F.R.S.

THE TEETH OF THE MYXINOID FISHES.

IN the course of my work upon the morphology of the Vertebrata, it has occurred to me to ascertain how far the generally accepted account of the structure of the teeth in Cyclostomata exhausts the facts at our disposal. The inquiry is one of extreme interest in relation to the disputed affinities of this group with the other fishes. It is well known that Balfour regarded the Myxinoids as the survivors of a very primitive group which had never possessed true jaws. Dohrn, on the other hand, while holding that these fishes retain very many primitive characters, has always asserted their degenerate nature as a canon of his doctrine of the ancestry of Vertebrates. He has endeavoured to produce evidence of this in several of his "Studien," but so far as I am aware, the secondary character of the sucking mouth of the group has never yet been fully proved.

In Balfour's "Comparative Embryology" (vol. ii. p. 264), we read, "I am acquainted with no evidence, embryological or otherwise, that they (the Myxinoid fishes) are degraded gnathostomatous forms."

As the nature of the mouth in this group was one of Balfour's arguments against Dohrn's gill-cleft origin of the mouth of all Vertebrates,[1] and as my own views of the nature of the hypophysis cerebri are also affected by Balfour's reasoning, I may perhaps be allowed to state why I attach great importance to the structure of the teeth in the Myxinoids. With the exception of these animals and Amphioxus, all Vertebrates are known to possess true teeth and true jaws; but it appears to me that if it can be shown that the Myxinoids present traces of true teeth, it must be assumed that they once had true biting jaws. For true teeth are necessary appendages of biting jaws, while they are never found except when true jaws are present. It is important to note that Huxley long ago insisted upon the presence, in the lamprey, of a true mandibular jaw-apparatus, homologous with that of the gnathostomata.

All previous investigators of the group, from Johannes Müller to Parker, have described only the horny nature of the teeth, and that simply because no one has till now made microscopical sections of them. It must here suffice to point out that the current view is correct only so far as the Petromyzontidæ are concerned. They alone possess only horny teeth. In *Petromyzon marinus*, these are curiously complicated, in that they are represented by three horny cusps or thimble-like bodies lying one upon the other, and each arising in a special groove at the base of the tooth. (Prof. Howes writes me that he has long known of this fact.)

Myxine and Bdellostoma, which retain many more primitive characters than the Petromyzontidæ, possess true teeth in the sense of those of other Vertebrates. These are hidden by the aforenamed horny cones, which are formed above them, and, in fact, each horny tooth in these two genera has a true odontoblastic pulp underlying it. The following is a brief description of the appearance of such a tooth in longitudinal section, as exemplified in Bdellostoma. Outside all is the bright yellow horny layer, formed from a "horn groove" at the base of the tooth. Within this is a stratified epithelium, which extends inwards as far as the true tooth; I am unable, however, to find any modified layer of epidermic cells which might represent the so-called enamel organ of other developing teeth. The true tooth is mainly composed of a very hard conical cellular mass, which is probably calcified (I have not yet tested it chemically). It possesses a true pulp-cavity with blood-vessels, &c., while it is made up of cellular elements, which are arranged in a somewhat radiate fashion. The cells are hard, possessed each of a large nucleus longitudinally striated, especially at the apex of the tooth and near the surface.

The apex of the cone is surmounted by a small cap of bright transparent structureless matter, which is either dentine or enamel; from its appearance, and from the fact that the pulp is very hard and obviously calcified, I am inclined to regard it as an enamel structure. While as yet it is not possible to follow the development of this cap, it appears to me to be a secretion of the pulp-cells; and, should it turn out to be enamel, we shall have striking confirmation of the enderonic origin of that layer, advanced by Huxley more than thirty years ago. I, for one, do not believe his view to be so improbable as is generally supposed.

The teeth of Myxine present essentially the same structure as those of Bdellostoma; they are, however, smaller, weaker, and more degenerate, for the cap of enamel (or dentine) is, in them, reduced almost to nothing—indeed, it can only be found after very careful search, and I think that from some of the teeth it is entirely absent.

With this discovery, true teeth come to be characteristic of all the lowest Vertebrates except the outcast Amphioxus, and thus the gulf separating the latter from the former becomes widened. Some zoologists explain the absence of spinal ganglia in Amphioxus by assuming that they are still within the spinal cord: might one hint that they can now also suppose that the teeth of Amphioxus are still within the gums?

In view of the facts here stated it becomes an interesting question for the palæontologist as to how far the "Conodonts" really are the remains of Myxinoid teeth. Zittel's view that they are really Annelidan teeth seems to me the more probable one (*Handbuch der Palæontologie*, Bd. iii. p. 38).

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[1] Amphioxus is here left entirely out of account. Personally, I do not intend to commit myself in seeking to compare any organs of Amphioxus with those of the higher Vertebrates. I would rather leave Amphioxus alone, but I may at least remark the possibility that the mouth in Amphioxus may turn out to be the homologue of the hypophysis—gut passage in Myxine and Bdellostoma. The fact that no hypophysis has yet been discovered in this animal is only in accordance with other negative comparisons between it and other fishes.

MODELS ILLUSTRATING THE MODIFICATION OF THE ARTERIAL ARCHES IN VERTEBRATES.

HAVING recently, with the help of my assistant, made some simple and inexpensive models illustrating the modifications of the arterial arches in Vertebrates, which I find very useful for purposes of demonstration, I send a short description of them to NATURE. Students, as a rule, find it difficult to understand figures of these structures, and a model, in three dimensions, gives a much more accurate idea of their general relations than any drawing can do.

My models are founded mainly on the figures given by Boas, in his paper "Ueber die Arterienbogen der Wirbelthiere" (*Morphol. Jahrbuch*, Band xiii. Heft 1).

The various vessels are represented by stout brass wires (about $\frac{1}{8}$-inch in diameter), bent to the proper form and soldered together; and each model is made, in the first place, to represent six arches. In the case of the fish, the ventral aorta and lower half of each arch (representing the afferent branchial trunk) is painted blue, to indicate that the blood contained therein is venous; the upper half of each arch (representing the efferent trunk), together with the epibranchials and dorsal aorta, are coloured red, to show that they contain arterial blood. The heart is modelled out of modellers' clay, and fixed on to the ventral aorta before being dried; it shows the typical parts of the fish-heart, and is painted blue.

At present I have only made two other models, representing these structures in air-breathing Vertebrates, the types taken being the frog and the mammal. In these, similar colouring is used, but those parts which disappear in the adult are painted *white*. The various parts of the heart are also coloured red or blue, according to the nature of the blood contained in them.

Thus, in the frog the left auricle is red, the right auricle and sinus venosus blue, and the ventricle purple, to show the mixed character of the blood. The first, second, and fifth arches, the portion of the epibranchial between the third and fourth arches, and the ductus Botalli of the sixth arch, are white; the third arch (carotid and lingual artery), red; the fourth (aortic) arch and dorsal aorta, purple; and the lower part of the sixth (pulmonary), blue. In the mammal, the left side of the heart, the left aortic arch, dorsal aorta, and carotids, are red; the right side of the heart, and the pulmonary artery, blue; and the remaining parts, which disappear in the adult, white.

The paint I have used is Aspinall's oxidized enamel.

As this method of illustrating blood-vessels is also particularly useful for lecture-purposes, I intend, later on, to model whole vascular systems in the same way.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A small revolution has been effected in the teaching of geometry by the adoption of a regulation allowing any proofs of the propositions in Euclid to be given in the "Little-Go" or previous examination. No proof, however, of any proposition occurring in Euclid will be admitted in which use is made of any proposition which in Euclid's order occurs subsequently.

The estimates for the new plant-house (£2760) and research laboratory (£250) at the Botanical Gardens are accepted, Messrs. Boyd, of Paisley, being engaged for the former, Mr. Sindall for the latter. Sir Joseph Hooker, Mr. Thiselton Dyer, and several skilled horticulturists have inspected the plans, and they meet with general approval. The proposed fern-house, stove, and orchid-house, have a combined area of 2660 square feet, as compared with 2290 square feet, the area of the corresponding present houses.

The apparent boycotting of the Cambridge mechanical workshops by the Museums and Lecture-Rooms Syndicate, and other Cambridge authorities has led to a considerable diminution of work, and consequently to a serious reduction of profit in the workshops, which have also suffered to some extent by the unfortunate rejection of the Engineering Tripos scheme. In a recent discussion Prof. Cayley expressed the opinion that it ought to be as much a matter of course to send University mechanical work to the University workshops as to send University printing work to the Pitt Press. He considered the work done by the workshops compared very favourably with similar work done by contractors. Mr. Lyon, superintendent of the workshops, claimed that, while much of the work done outside for the museums had to be frequently repaired, none of the mechanical workshops' work had required this. They had done the work for the Morphological Laboratory for £1000 less than was estimated. A good deal of testimony was given to the excellence of their work, against which it was stated that the Syndicate thought they could get their work done cheaper and better by a professional builder.

A scheme has been prepared for the future fitting up of the old Botanic Gardens site with University buildings in extension of the museums and lecture-rooms. The most salient points are that the site between the new Chemical Laboratory and the Museum of Human Anatomy is declared sufficient for the new Museum of Geology, and that the next buildings to be taken in hand should be those for Human Anatomy and Physiology. It is also proposed to accommodate the Department of Pathology in the old Chemical Laboratory.

Mr. Wilberforce will deliver a course of lectures on Dynamo-Electric Machines at the Cavendish Laboratory during the Easter term.

Among the Fellows elected at King's College last week were Mr. A. P. Laurie, who obtained a first class in the Natural Sciences Tripos, Part II., June 1884, and Mr. H. W. Richmond, Third Wrangler 1885, and placed in Division I. in the third part of the same Tripos, 1886.

Mr. R. Pendlebury, Fellow of St. John's, has been appointed a University Lecturer in Mathematics for five years.

Open Scholarship examinations in which natural science Scholarships may be awarded will be held at Downing College on May 29, and at Peterhouse in October. The Clothworkers' Exhibition in physical science will be competed for in connection with the Oxford and Cambridge schools examination in July.

SCIENTIFIC SERIALS.

IN the *Journal of Botany* for February, Mr. G. S. Boulger calls attention to the exceedingly loose way in which the term "endosperm" is applied by botanical writers to structures in Angiosperms, in Gymnosperms, and in Vascular Cryptogams which have no real homology with one another.—A very interesting new fern from New Guinea (*Polypodium Annabellæ*) is described and figured by Mr. H. O. Forbes, belonging to the small group in which the fertile portion of the frond is only an extension of the lower barren portion.—In this, and in the number for March, Mr. J. G. Baker continues his synopsis of *Tillandsieæ*, and the editor commences an exceedingly useful alphabetical biographical index of British and Irish botanists no longer living.

American Journal of Science, March.—Asa Gray, by J. D. Dana. The attention of the readers of NATURE has already been directed to this memoir, written by the friend and associate probably most competent to appreciate the life-work of the eminent American botanist.—Calibration of an electrometer, by D. W. Shea. In the various forms of the quadrant electrometer, and in the different methods of setting up the same instrument, the curves of calibration obtained are well known to correspond in a very irregular manner with the curves given by Maxwell's mathematical theory. In this paper are given some observations with an electrometer of the Mascart form, which show variations apparently due to change in the sensibility with variation in the temperature. The accompanying tables exhibit the changes in the form of the curves for various charges of the needle through the range of temperature attainable, at the time, in the room where the electrometer was set up.—On the so-called Northford (Maine) meteorite, by F. C. Robinson. One of the numerous specimens of this "meteorite" contained in various cabinets in Maine, and perhaps elsewhere, has recently been analyzed by Mr. Charles Fish in Mr. Robinson's laboratory. That it is not of meteoric origin seems settled by this analysis, which corresponds closely with some recorded analyses of copper-slag.—History of the changes in the Mount Loa craters; Part I, Kilauea (continued and concluded), by James D. Dana. The subjects discussed in this paper are: the size of the Kilauea conduit; the ordinary work performed by this crater; the kinds and sources of the vapours concerned; the effect of the expansive force of vapours in their escape from the liquid lavas (projectile action), and within the lavas (vesiculation and its mechanical effect); lastly, work of vapours generated outside of the conduit—fractures, displacements, and other results.—The Taconic system of Emmons, and the use of the name Taconic in geological nomenclature, by Charles D. Walcott. In this first paper on the North American Taconic system, the author deals (1) with the Taconic area in general and the geological work within it; (2) with the geology of the Taconic area as known at the present time. The Taconic area, as here studied, is stated to comprise the Taconic range running north and south nearly along the border-line between the States of New York, Vermont, Massachusetts, and Connecticut, with the country immediately adjacent to the range on the east and west. The strata included within the whole area are grouped under six terranes, identified as Middle Cambrian (1 and 5), Upper Cambrian (2), Calciferous, Chazy, and Trenton limestones (3), and Hudson shales, sandstones, &c. (4 and 6).—On the crystalline form of polianite, by E. S. Dana and S. L. Penfield. The true crystalline form of the anhydrous manganese dioxide, MnO_2, from Platten, Bohemia, to which Breithaupt has given the name of polianite, has been the subject of much discussion. Köchlin's recent contribution to its elucidation has induced the authors to continue their own studies, which establish beyond all doubt the independent position of polianite as a tetragonal crystal isomorphous with cassiterite and the allied species of the RO_2 group.

NEARLY the whole of the number of the *Nuovo Giornale Botanico Italiano* for January is occupied by a monograph by Sig. A. N. Berlese of the genus of Fungi *Pleospora*, of which 104 undoubted species are described, several of them new to science, besides a considerable number of doubtful species. The eight plates, in which the essential characters of nearly all the species are illustrated, as well as monographs of the allied genera *Clathrospora* and *Pyrenophora*, are postponed to the next number.—Prof. A. Beccari also describes three new species of palm from New Guinea.

Rendiconti del Reale Istituto Lombardo, February 9.—On colour-hearing, by Tito Vignoli. A somewhat detailed account is given of this obscure psychological phenomenon, cases being described in which not only sound produced the sensation of colour and colour of sound, but also cases in which sensations of smell and taste were stimulated by sound and colour. Rejecting the explanations hitherto advanced, the author refers the phenomenon to the primæval condition of the brain itself before the various senses became differentiated and localized in this organ. These senses must be regarded as so many forms of the primitive and essential condition of the nerve-tissue in which they became gradually specialized. But although the protoplasmic substance of the brain was thus made the seat of distinct sensations by virtue of incident forces and slow selection, still it has never

ceased to possess the aptitude as a whole for receiving all kinds of impressions from without, and in fact it is this general aptitude that has rendered possible the evolution of the special senses in special centres. Thus the common origin of all the senses would seem to offer the readiest explanation of their occasional confusion even in the human brain itself, the highest development of all. Colour-hearing might in this way be regarded somewhat as a case of reversion or atavism.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 23.—"On Remnants or Vestiges of Amphibian and Reptilian Structures found in the Skulls of Birds." By W. K. Parker, F.R.S.

(1) *Jacobson's Organ.*—This remarkable structure, which must be looked upon as an accessory olfactory organ, is present in certain of the higher Vertebrata, or *Amniota*. It consists of a paired cavity, which early becomes separated off from the proper nasal chamber, and which opens into the mouth by the anterior incisive foramen. It is innervated by branches from the olfactory and trigeminal.

Jacobson's organs are largest in Snakes, Lizards, and Monotremes, and next in order come the Marsupials, Edentates, Insectivores, and the Mammalia generally. Their presence in Man is doubtful, and what has been described as a rudiment of them has probably quite another explanation.[1] They are not known to exist in Chelonians, Crocodiles, and Birds.

In the Snake and Lizard, these structures lie each in a little dish, formed by the vomer of that side, covered in by another vomerine bone—the septomaxillary. They are also protected at the opening of the capsule by a pedate tract of cartilage, derived from the alinasal fold, which, in the Snake, frequently becomes detached from its root. In low Mammalia there are several vomers, and in most of the lower Mammals a pair of small anterior vomers lie on the inside of Jacobson's organ, but the capsule itself is formed by a peculiar fold of cartilage—the recurrent cartilage,—which closes in upon itself, and unites its edges round the organ. As a rule, these "recurrent cartilages" retain their union with the alinasal folds, as in the Lizard; in the Rabbit (Howes) they are distinct, as in the Serpent.

Now in Birds these cartilages not unfrequently appear, but no Jacobson's organ has been found with them. The Birds whose vomerine region comes nearest to that of a low Mammal are the Turnicidæ, or Hemipods, and the great group of the Passerine birds (Coracomorphæ, or Ægithognathæ of Huxley). It is not uncommon for the "ox-faced" vomer of these birds to be formed of two pairs of bony centres, and these become not only fused together, but actually grafted upon the floor of the cartilaginous nasal capsule, in the same manner as is common in the lower kinds of Mammalia.

Remnants of the cartilaginous capsule of Jacobson's organs are found not only in the Hemipods and in the lower Neotropical Passerines (*Homorus, Synallaxis, Anæretes*), but also in some of the highest of the singing-birds—namely, the Wren (*Anorthura troglodytes*)—and also in some of the Woodpeckers (Picidæ), outside the Passerine Order.

In a paper on the "Skull in the Ostrich Tribe" (Phil. Trans., 1886, pl. 10, Fig. 14, *a.i.t.*), the present author figured and described, but did not then fully understand, a peculiar cartilage perched right and left upon the large vomer of the *Rhea*. He, however, has for a long time been satisfied that this is one of the vomerine or Jacobson's cartilages, and this view is strongly corroborated by the recent description of the palate of *Apteryx*, given by T. Jeffery Parker (Proc. Roy. Soc., February 23, 1888). Now if the figure of the transversely-vertical section through these cartilages and the crura of the vomer in the *Apteryx*, be compared with various figures in the present author's "Memoirs on the Mammalian Skull" (Parts I., II., and III., "Phil. Trans."), it will be seen that it so nearly corresponds with sections of the skull of the Pig, the Edentates, and the Insectivores, especially those taken just behind Jacobson's organ, that without explanation it would be impossible to tell which figure belonged to the Bird, and which to the Mammal.

(2) *Parasphenoid.*—This bone forms a large superficial basicranial beam in Ganoidei, Teleostei, Dipnoi, and Amphibia. It corresponds to the subcutaneous part of a dermal scute formed inside the skin of the mouth, developed for support to badly ossified endocranium.

The parasphenoid of the Frog is dagger-shaped, and reaches from near the foramen magnum behind, to the nasal capsule in front, the "guard" of the dagger supporting the auditory capsules. Now in Serpents only the *blade* is present; in Lizards only a very fine thread of bone representing the blade; in some, *e.g. Trachydosaurus rugosus* (Cyclodontidæ), even this is wanting. It is not present in those very amphibian forms, the Chelonians; and only a small remnant of the "guard" right and left can be found in Crocodiles, consisting of two "basitemporal" plates, soon covered over by the huge pterygoid.

In all Birds basitemporals are large, as large as in Frogs and Toads; this is equally true of the *Dinornis* and of the smallest Humming-bird. There is a tendency for them to break up into lesser bony parts; thus for a day or two in the chick there are two "basitemporal" and one "rostral" centre; but in several species of the Ranidæ, *e.g.* the Bull-frog, the point of the dagger-shaped bone is separately ossified, and remains distinct.

In the Paradoxical Frog (*Pseudis paradoxa*) there is no "handle" to the dagger; the same form of parasphenoid is common among the water-birds, *e.g. Alca, Uria.* This is an ossification which is the earliest to appear in skulls that take on any kind of ossification; it is also the first bone to appear in an embryo bird, as in the larval Frog.

(3) *Prenasal Rostrum.*—Scarcely any Urodeles, and only a few of the Anura, show any special elongation of the "intertrabecula" or prenasal rostral cartilage; this must have been very long in the Ichthyosauria, as in the Selachii, and as in the embryos of all Birds.

(4) *Palato-pterygoid arch or arcade.*—In the Frog, after metamorphosis, during which the hinge of the jaw becomes shifted far backwards, three regions may be distinguished in the fore-part of this arch; thus the suspensorial part or pedicle is the ethmo-palatine, the anterior free spike the pre-palatine, and the hinder part which runs into the pterygoid is the post-palatine.

The anterior part of the pterygo-palatine arcade is distinct from the pterygoid in Urodeles, and the pterygoid in them is an outgrowth of the quadrate which grows forwards towards the palatine, but does not coalesce with it, except in *Ranodon sibiricus*.[1] The "post-palatine" tract of cartilage is developed as a distinct nucleus in the Axolotl (*Siredon*).[2]

The only Reptiles in which the author has discovered any distinct trace of the *endoskeletal* palatine is in the Green Turtle, in which it is very small (see *Challenger* Reports, vol. i. part 5, plate 12, Figs. 9, 9*a*, 9*b*: *e.p.a.*).

This endoskeletal cartilaginous palatine, with its peduncle and fore and hind ray or *crus*, appears in several kinds of birds, in addition to their normal *parosteal* palatine—a mere membrane bone, as in Reptiles and Mammals. This vestige or remnant remains in the adult; it is of no apparent use, and occurs in the Families in the oddest way; sometimes, however, it is present in all the members of some particular Family-group, as for instance in the Musophagidæ or plantain-eaters (*Musophaga, Schizorhis*, and *Corythaix*).[3] It is also found in the Oil Bird (*Steatornis caripensis*) and in the Green Tody (*Todus viridis*), and it is also well developed in *Scythrops* (see Linn. Soc. Trans., ser. 2 (Zool.), vol. i. plate 23, Figs. 3 and 4, *o.u.*).

In that nearly extinct Neotropical type, *Steatornis*, this curious partly ossified remnant has the three crura, all well marked, and their morphological meaning is evident; albeit the whole piece is so small and feeble that it can serve no purpose in the solid palate of that remarkable bird.

To show how unexpectedly this remnant exists, a list of the Birds in which it has been found in a segmented state as a distinct bony element of the face is added below; it often shows itself as a mere process of the ecto-ethmoid, but these cases are not included in the list.

[1] See Gegenbaur, "Ueber das Rudiment einer septalen Nasendrüse beim Menschen," *Morphol. Jahrbuch*, Bd. xi., 1885. At the time when the present paper was read, the author was not aware of Gegenbaur's conclusions with regard to the supposed rudiment of Jacobson's organ in Man.

[1] See Wiedersheim, "Kopfskelet der Urodelen," Leipzig, 1877, Plate 5, Figs. 69, 70.

[2] See W. K. Parker, "On the Skull of the Urodeles" (Phil. Trans., 1877, Plate 24, Figs. 1–3).

[3] See Reinhardt, "Om en hidtil ukjendt Knogle i Hovedskallen hos Turakoerne (*Musophagides*, Sundev)," Copenhagen, 1871, Plate 7.

Motacilla yarrelli, *Budytes rayi* } Motacillidæ.
Todus viridis. Todidæ.
Steatornis caripensis. Steatornidæ.
Schizorhis, *Musophaga*, *Corythaix* } Musophagidæ.
Dicholophus. Dicholophidæ.
Procellaria, *Prion*, *Thalassidroma*, *Diomedea*, &c. } Procellaridæ.
Larus, var. spec. Laridæ.
Tachypetes. Tachypetidæ.

Another more partial remnant is seen in the Coracomorphæ or Passerine birds generally, which together make up nearly half the number of known birds.

A distinct nucleus representing the post-palatine region of the Frog's skull reappears in the Crow and the Sparrow, and in all the Passerines, as far as they have been worked out. It lies outside the hinder part of the normal parosteal palatine bone, becomes a solid ear-shaped tract of hyaline cartilage, acquires its own osseous (endosteal) centre, and this, when ossified, coalesces with the normal palatine bone.

These facts, and many others that could be mentioned, make it evident that, in seeking for a clue to the uprise of the Feathered Fowl, we may leave out of immediate consideration all the existing types of Reptilia: ancient Amphibians, or Reptiles just rising out of Amphibian lowliness, are the forms that alone will help us in this search. We do get some light upon the Reptilian relationship of Birds, but it is at best a scattered light; the head of a Bird is like that of the *Ichthyosaurus* in its great facial elongation, the neck- and limb-regions of a Bird are those of a *Plesiosaurus*, whilst the hips and legs are like those of the Ornithoscelida.

But these are not all, or nearly all, the vestigial structures that may be seen in the Bird's skull, to say nothing of the skeleton generally;[1] they are sufficient, however, to justify the assumption that Birds arose, by secular transformation, either from the lowest and most ancient of the true Reptiles, or equally with Reptiles from archaic Amphibia, low in structure, but full of potential excellence, and ready, *pro re nata*, to become Reptile, Bird, or even Mammal, as the case might be.

Physical Society, March 10.—Prof. Reinold, President, in the chair.—Mr. G. L. Addenbrooke exhibited and described a compact form of reflecting galvanometer, lamp, and scale, which he has designed as a portable commercial instrument, and also a modified Post Office Wheatstone's bridge.—Mr. E. C. Rimington read a paper on the measurement of the power supplied to the primary coil of a transformer. The first part of the paper contains a proof of a formula given by Prof. Ayrton at a recent meeting of the Society of Telegraph-Engineers for measuring the power given to a transformer by using a Siemens's watt-meter, and the disadvantages of the method are enumerated. A method is then described in which a high-resistance dynamometer is used. One coil of the dynamometer is placed as a shunt to the primary coil, and the other as a shunt to a known inductionless resistance, R, placed in series with the primary. The time constants of the dynamometer coils are made equal by adding an inductionless resistance to the one having the greatest time constant. Thus arranged the difference of phase between the currents in the dynanometer coils is the same as that between the P.D. and current in the primary of the transformer. The mean power, p_m, is shown to be

$$p_m = \frac{K}{R}\delta\,(1 + \tan^2\phi_1),$$

where $\frac{K}{R}$ is the constant of the dynamometer for watts, δ the reading of the torsion head, and ϕ_1 the lag angle of the currents in the coils of the dynamometer which can be determined from their time constant and periodic time. The best method of arranging the dynamometer in order that R may be as small as possible is discussed. Prof. Ayrton pointed out that the formula first referred to by the author was given to show *why a watt-meter should not be used*, and that the method suggested by Mr. Rimington was a modification of the well-known electrometer method, but with an additional serious objection, that the periodic time must be known. He also described a direct-reading method of using an electrometer, on ordinary transformer circuits, suggested to him by Mr. Sayers. Mr. Blakesley thought the above formula, given by Mr. Rimington, would only be true where there is no iron in the circuit. He described a method of determining the power by observations on two low-resistance dynamometers, one of which is placed in the primary circuit. Of the other dynamometer, one coil is placed in the primary and the other in the secondary circuit. The power is given by

$$p_m = Aa_1r_1 + r_2\frac{m}{n}, Ca_3$$

where r_1, r_2, m, n are the resistances and numbers of convolutions of the primary and secondary coils, A and C the constants of the dynamometers, and a_1, a_3 their reading. A geometrical construction from which the formula is deduced was given. Mr. Sumpner said all the formulæ at present obtained were founded on the assumptions that the induction coefficients of a transformer under working conditions are constant, but, in a paper to be brought before the Society shortly, he hoped to show these assumptions to be erroneous. In replying, Mr. Rimington said, if the periodic time was not known beforehand, it could easily be determined from the note given out by a telephone placed near the transformer.—On the magnetic circuit in dynamo machines, by Prof. W. E. Ayrton and Prof. J. Perry. An abstract was read by Prof. Perry. The authors have worked out a number of formulæ for dynamo machines, involving the thickness, t, of the armature winding, and α the highest permanent current density per square centimetre of cross section of that winding. One of them is

$$W = \frac{2v\mathrm{N}t\alpha}{10^8},$$

where W = highest permanent output in watts, v = circumferential velocity, and N = total induction through the armature. As the winding is thin, $t\alpha^2 = q^2$, a constant. For the best modern machines, which do not get too hot, q has a value of about 288. It is shown that the best permanent output is a maximum when the magnetic resistance of the space occupied by the armature winding is equal to all the other magnetic resistance in the circuit, and the best machines are found to satisfy this condition. From this important result the characteristic of such a dynamo can be drawn with considerable accuracy. For small inductions the air resistance only need be considered, and a line drawn on squared paper connecting N and S'A', satisfying

$$\mathrm{N} = \frac{4\pi\mathrm{S'A'}}{10} \div \frac{2(d + t}{a_2},$$

gives the first part of the characteristic, where S'A' = ampere-turns, d = clearance, and a_2 = the area of the pole pieces exposed to the armature (increased by a fringe of 0·8 $(d + t)$ all round). From the maximum value of N (viz. $a_1\beta_1$) where a_1 = area of diametral section of iron in armature, and β_1 = maximum induction (17,000 to 18,000), find the value of S'A' from the formula

$$\mathrm{N} = \frac{4\pi\mathrm{S'A'}}{10} \div \frac{4t}{a_2},$$

and plot the values of N and S'A' as the co-ordinates of a point. A curve drawn through this point to touch the line first drawn, at a point corresponding with $\mathrm{N} = \frac{1}{2}a_1\beta_1$ will not differ materially from the characteristic of the constructed machine.—A note on the employment of an electro-dynamometer for determining the difference of phase of two harmonic currents of electricity, by Mr. T. H. Blakesley, was taken as read. This is a claim of priority for a method published by the author in the *Electrician* of October 2, 1885, which has recently been described and claimed as the invention of Prof. Ferraris, in a paper communicated to the Royal Academy of Science of Turin. In a book on "Alternating Currents," published at the end of 1885, Mr. Blakesley shows how the method can be used for determining induction coefficients and capacities.

Chemical Society, March 1.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read:—The origin of colour and the constitution of colouring matters, by Prof. H. E. Armstrong, F.R.S. The majority of compounds, especially those of carbon, are colourless; and in the case of elements

[1] As regards the skeleton of the manus and pes, the indications of at least five carpals (two of these in some types undergoing further subdivision), three small additional rudiments of digital rays in the manus, five tarsals, and a rudiment of the fifth metatarsal, are all important facts bearing upon this subject.

whose compounds are invariably coloured, the greatest diversity of colouring is often noticeable among the several compounds of one and the same element—as in those of chromium or manganese, for example: it is therefore clear that colour is in a high degree conditioned by special forms of intramolecular structure, and consequently that any attempt to determine the "origin of colour" must be based on a knowledge of the structure of coloured matters. For this reason it has become possible only within recent years to discuss the relation between colour and constitution, and, so far, the discussion has been limited to two papers by Graebe and Liebermann (*Ber. deut. chem. Gesellsch.*, 1868, 106) and by Witt (*ibid.*, 1876, 522) respectively. To illustrate the idea on which the argument in the paper is based, the author compares the unsaturated hydrocarbons with the paraffins. In the paraffins, which are singularly inert compounds, and all but colourless even in the infra-red and ultra-violet regions of the spectrum, the carbon atoms are united only by single affinities, and the remaining affinities are engaged by *monad* atoms; the unsaturated hydrocarbons, however, are not only more reactive than the paraffins, but the beginnings of colour are manifest in them in regions above and below the visible spectrum, whilst they are conventionally represented by formulæ in which the carbon atoms appear as united by two or three affinities of each, typified by straight lines or dots. Within recent years, however, the idea has found favour that "affinity has direction," and the author would apply this hypothesis to polyad atoms generally; and in formulating compounds in which such atoms are united by more than single affinites, would represent the polyad atoms as united by curved lines in order to suggest that the affinities are under strain in consequence of their being free to act only in certain directions. In the paper, the author cites a number of cases among inorganic compounds which he thinks afford evidence that the production of colour is dependent on special modes of atomic arrangement, and particularly on such modes of arrangement as involve the existence of a condition of strain in the resulting system, due probably to peculiarities in the affinity relationships of the constituent elements of the system which prevent complete mutual neutralization of the affinities. The occurrence of colour therefore is more frequently than not concomitant with a high degree of reactivity, the coloured compound being usually one of "high potential" or slight stability. Among carbon compounds there is no instance of a hydrocarbon being coloured, giving the term its conventional meaning; and omitting nitro-compounds, there are very few exceptions to the rule that derivatives of hydrocarbons containing only monad radicles are colourless; the exceptions, moreover, are of a very noteworthy character, being either *central* derivatives of anthracene, *i.e.* compounds formed by displacement of the hydrogen atoms of the central nucleus of anthracene—which although not coloured is significantly fluorescent; or the monad radicle contains at its origin a radicle such as CO. Attention is then drawn to the quinones and their derivatives, Fittig's ketone formula being throughout adopted for these compounds. The constitution of the better-known dye-stuffs is then discussed, and the author is led to conclusions which in some cases are different from those hitherto accepted; for example, the azo-dyes are formulated $O\overset{}{\frown}C_6H_4\overset{}{\frown}N.NHR'$ and $HN\overset{}{\frown}C_6H_4\overset{}{\frown}N.NHR'$; and rosaniline with its congeners, certain of the phthaleïns, and methylene-blue are also formulated on the quinone type. In the discussion on the paper, in which Profs. Debus, Rücker, and Dewar, Dr. Morley and others took part, Prof. G. C. Foster said that it appeared to him that the real question raised by Dr. Armstrong was whether a definite relation could be traced between chemical composition or chemical structure and the existence and position of absorption-bands in the spectrum of the transmitted radiation. The presence or absence of coloration, as it could be judged of directly by the eye, gave no conclusive answer to the question, for a substance might be as colourless as water, and still exert strong absorption in the ultra-red, or it might have strongly-marked absorption in the ultra-violet. But, more than this, a body might exert selective absorption within the visible spectrum, but if it happened to absorb two complementary colours it would be judged of by the eye as though it were destitute of selective absorption altogether. The subject, therefore, seemed to him to involve a systematic study of absorption-spectra.—Researches on chromorganic salts, Part II., by Mr. E. A. Werner.—Note on benzyldithiourethane, by Dr. A. E. Dixon.

Zoological Society, March 6.—Prof. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of February 1888, and called special attention to some examples of a Finch from New Caledonia (*Erythrura psittacea*), and to five specimens of a Pheasant (*Phasianus principalis*) from Afghan Turkistan. The pheasants had been brought home and presented by Major Peacock, R.E., of the Afghan Frontier Commission, at the request of Sir Peter Lumsden, G.C.B., C.S.I.—The Secretary exhibited (on behalf of Lieut.-Colonel H. M. Drummond Hay) a specimen of the Desert Wheatear (*Saxicola deserti*), lately killed in Scotland.—A paper by Prof. G. B. Howes and Mr. W. Ridewood, on the carpus and tarsus of the Anura, was read. The authors recorded observations made upon thirty-seven genera and sixty species, in all stages of development, representatives of all but three or four less important families. The authors were at variance with previous writers in points which had necessitated a reconsideration of the morphological value of the leading elements of both carpus and tarsus. They had failed to discover, at any stage, a trace of a third proximal element in either fore or hind foot, while they showed that Born was in error in regarding the *naviculare* as the prehallux tarsal. In the hind foot they recorded the discovery of a fourth tarsal, and in the fore foot that of a fifth carpal, which latter in *Xenophrys* was bony. Consequent upon this they regarded the element hitherto held to be the fifth carpal as a postaxial *centrale*; whence it followed that the Anura are, as a group, unique in the possession throughout of a double *centrale carpi*. The authors discussed the various changes undergone by the pollux and prehallux, and the several views concerning the morphological value of the latter. A second part was added, in which the peculiarities of the several families of the Anura were given in order, and the bearings of the structures in question upon classification briefly discussed. The Discoglossidæ were shown to combine most completely the least modified conditions of both fore and hind feet.—Mr. R. Bowdler Sharpe read descriptions of new species of birds, of which specimens had lately been received from the Island of Guadalcanar, Solomon Group, collected by Mr. C. M. Woodford. These were named *Astur holomelas*, *Astur woodfordi*, *Astur shebæ*, *Baza guadalcanarensis*, *Ninox granti*, *Graucalus hololius*, *Edoliisoma erythropygium*, and *Pomarea erythrosticta*.—Mr. W. R. Ogilvie Grant contributed a complete list of the birds obtained by Mr. Woodford on the Islands of Guadalcanar and Rubiana. These were altogether sixty-six in number, the new ones being *Nasiterna aolæ*, *Myzolema sharpii*, *Phlegœnas solomonensis*, *Ardeiralla woodfordi*, and *Nycticorax mandibularis*.

Entomological Society, March 7.—Dr. D. Sharp, President, in the chair.—Mr. J. H. Leech exhibited, and made remarks on, a number of butterflies forming part of the collection made for him last summer by Mr. Pratt, at Kiukiang, Central China. The specimens exhibited included *Papilio Macilentus*, hitherto only recorded from Japan, varieties of *P. Sarpedon*, and a supposed new species of *Papilio*; a series of *Sericinus telamon*; *Charaxes narcæus*, and var. *mandarinus*; *Palæonympha opalina*; new species of *Lethe*, *Apatura*, and *Neptis*; and a series of *Argynnis paphia*, with the var. *valezina* of the female. Mr. Leech stated that all the females of *A. paphia* taken at Kiukiang belonged to the var. *valezina*, the typical form of the female being unknown there. Mr. Poulton expressed his interest in Mr. Leech's statement that *valezina* was the only form of the female of *Argynnis paphia* known at Kiukiang, and said he considered this fact would probably throw a new light on the question of the dimorphism of the species. Mr. Jenner-Weir said he had in the course of some years obtained a series of forms intermediate between the typical female and the variety *valezina*. Mr. H. Goss, Dr. Sharp, and Mr. McLachlan, F.R.S., continued the discussion.—Mr. Champion exhibited, for Mr. J. J. Walker, R.N., about 950 species of Coleoptera, recently collected by the latter near Gibraltar. Mr. McLachlan called attention to the large number of water-beetles included in Mr. Walker's collection.—Mr. Verrall exhibited living specimens of *Aspidomorpha sanctæ-crucis*, from the caves of Elephanta.—Mr. Slater exhibited specimens of a species of weevil which had been doing much damage to maize sent to the Colonial Exhibition.—Mr. W. White read a paper entitled "Experiments upon the colour-relation between the pupæ of *Pieris rapæ*, and their immediate surroundings," which comprised a detailed account of a series of observations carried on at the author's instigation by Mr. G. C. Griffiths. The various experiments were intended to act as a test of the conclusions arrived at by Mr.

Poulton in his paper on the subject in the Transactions of the Royal Society; and to effect this object different and additional influences had been brought to bear on these pupæ, so that an analogy might be drawn between the two sets of results. Mr. Poulton, Lord Walsingham, F.R.S., Mr. Jacoby, Dr. Sharp, and Mr. White took part in the discussion which ensued.

PARIS.

Academy of Sciences, March 12.—M. Janssen in the chair.—Remarks accompanying the presentation of the second edition of his "Traité de Physique Mathématique," by M. H. Resal. To this edition have been added sections on mathematical optics and thermodynamics, enlarging the work from one to two volumes.—On the combination of measures of the same magnitude, by M. J. Bertrand. An attempt is here made to estimate the consequences of rejecting measures assumed to be less accurate as departing furthest from the mean in the doctrine of probabilities.—New theory of M. Lœwy's equatorial *coudé* and equatorials in general, by MM. M. Lœwy and P. Puiseux. An improved method is described for more accurately determining the constants both of bent and straight equatorials, with the most rapid processes for mounting and rectifying these instruments.—On phosphorus and phosphoric acid in vegetation, by MM. Berthelot and G. André. As a general result of their experiments, made especially on *Amaranthus caudatus*, the authors find that, after the normal flowering, the employment of phosphorous, and even to some extent of nitrous, manures seems almost, if not altogether, useless, whereas potassic manures may still be advantageously continued as long as vegetation lasts.—Classification of the Gasteropods, based on the various dispositions of the nervous system, by M. H. de Lacaze-Duthiers. This is a purely synthetic treatise, summing up the long and numerous analytical studies on the nervous system of various mollusks, such as Gadinia, Aplysia, Tethys, and many others described in the *Comptes rendus* and elsewhere. The object is to ascertain what data may be supplied by these different types of nervous systems for a physiological classification of the secondary groups of Gasteropods. Two sub-classes with five orders are proposed for the whole class.—On a general theorem of convergence, by M. J. L. Jensen. The studies undertaken by the author with a view to a generalization of the theory of convergence of a series with positive terms have led to an unexpected simplification of the present theory. It is shown that the criteria of Cauchy, of Duhamel and Raabe, of Bertrand, and others, may henceforth be treated summarily as simple corollaries of one general theorem.—On the measurement of magnetic fields by diamagnetic bodies, by M. P. Joubin. The author's renewed attempts to utilize the magnetization of diamagnetic bodies for measuring the intensity of a magnetic field seem to demonstrate the existence of several states of magnetic equilibrium in diamagnetic bodies. This unexpected result is in accordance with theory according to Duhem's calculations, as well as with the general considerations recently set forth by M. Brillouin.—On the magnetization of diamagnetic bodies, by M. P. Duhem. The grounds are explained which render highly probable the existence of several states of magnetic equilibrium for diamagnetic bodies placed in a given position and subjected to the action of given magnets.—A new eolipyle, by M. Paquelin. The apparatus here described has the advantage of working in any position without the risk of explosion, and consumes not more than 90 grammes of fuel in the hour.—Determination in wave-lengths of the two red rays of potassium, by M. H. Deslandres. This determination, made at the request of M. Lecoq de Boisbaudran, yields for the stronger ray 766·30, for the weaker 769·63, giving a mean 767·965, compared with 588·89 of the D_2 sodium ray, which served for the calculation of the constant.—On the decreasing solubility of the sulphates, by M. A. Etard. The sulphates of iron, cadmium, magnesium, lithium, rubidium, and potassium, as well as anhydrous selenious acid, all present the same phenomenon of decreasing solubility. But that of iron, like the previously described sulphate of copper, changes direction twice, first increasing and remaining constant, then decreasing; the complete series of transformations being accomplished between $-2°$ and $+156°$ C.—Action of roasting on several oxides and salts of manganese, by M. Alex. Gorgeu. The anhydrous protoxides heated briskly leave a red oxide; slowly roasted, so as to avoid incandescence, and then kept at a dull red until the weight of the residuum ceases to change, they yield a sesquioxide; lastly, when heated from 200° to 430° C., the oxidation of the MnO obtained at a high temperature is very slow, and appears not to go beyond the manganite $MnO_2 4MnO$, even after forty or fifty hours. Several other details are given of these interesting experiments.—On the collection of star-fish brought to Europe by the French Scientific Mission to Cape Horn, by M. Edmond Perrier. This collection comprises no less than 553 specimens, referred to 38 distinct species, of which 23 are new. This gives to the southern waters of the American continent a total of 57 species of these organisms.—M. J. Kunstler describes a new Foraminifer from the Arcachon basin.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Geological Evidences of Evolution: A. Heilprin (Philadelphia).—Age of Creation: W. J. Cassidy (Briggs, Toronto).—The Geological History of Plants: Sir J. W. Dawson (K. Paul).—A Treatise on Mine Surveying: B. H. Brough (Griffin).—Old and New Astronomy, Part 1: R. A. Proctor (Longmans).—Rainfall in the East Indian Archipelago, 1886: Dr. Van der Stok (Batavia).—Observations made at the Magnetical and Meteorological Observatory at Batavia, vol. ix. 1886: Dr. Van der Stok (Batavia).—Report on the Crops of the Year 1887 (Washington).—London Geological Field Class Reports, 1887 (Philip).—Morphologisches Jahrbuch, Eine Zeitschrift für Anatomie und Entwickelungsgeschichte, xiii. Band, 3 Heft (Leipzig).—Journal of the Chemical Society, March (Gurney and Jackson)—Journal of the Society of Telegraph-Engineers and Electricians, vol. xvii. No. 70 (Spon).—Notes from the Leyden Museum, October 1887 (Leyden).—Archives Italiennes de Biologie, Tome ix. Fasc. 2 (Turin).—Encyklopædia der Naturwissenschaften, Erste Abthg. 54 Lief., Zoologie, &c.; Zweite Abthg. 46 and 47 Lief., Chemie (Breslau).—Bulletin de l'Académie Royale des Sciences de Belgique, 1888, No. 1 (Bruxelles).

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