THURSDAY, OCTOBER 19, 1893.

BRITISH BUTTERFLIES.

The Lepidoptera of the British Islands; a Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities. Vol. I. *Rhopalocera.* By Charles G. Barrett, one of the Editors of the *Entomologist's Monthly Magazine.* (London: L. Reeve and Co., 1893.)

NOTWITHSTANDING the number of popular books on British insects which are constantly issuing from the press, it is only occasionally that we have to notice the appearance of a work of higher pretensions than this, even as regards our British butterflies. And yet it is of great importance that we should place on record a full and complete account of our native insects as speedily as possible. Much information that might still have been preserved fifty years ago is now irrecoverably lost, for the drainage of the fens has robbed us of many of the British insects which were absolutely peculiarto our country. But some still remain; and notwithstanding the comparative poverty of the British insect-fauna as compared with that of the Continent, the British Islands possess a much larger number of peculiar forms than is generally imagined, and the French entomologists actually call Britain "le pays des variétés."

The volume before us is the commencement of a comprehensive work on the whole of the British Lepidoptera (about 2000 species in round numbers) and is edited by Mr. C. G. Barrett, who is well known to entomologists as one of our best practical workers. He has had unusual facilities for personal observation in many parts of the country, and has devoted much attention to our native Lepidoptera, and more especially to some of the more difficult groups of the smaller moths; but he has hitherto only contributed to periodical literature.

The work appears in monthly parts, with plain or coloured illustrations. It commenced last year, and the first volume, including the butterflies, and illustrated with forty plates representing all the species regarded as undoubtedly British, in addition to numerous figures of larvæ and varieties, is now complete in ten parts, and has been reprinted on smaller paper, and without plates. It appears to us to be a grave oversight that there is no reference to this in the smaller edition, except in the advertisements at the end of the volume. Prominent attention should certainly have been called to the larger edition, even at the risk of injuring the sale of the smaller one, either in the preface or by a conspicuous advertisement.

In his introduction Mr. Barrett gives a concise account of the general structure and metamorphoses of Lepidoptera, and remarks on classification and synonymy. With respect to classification, everyone will agree with him in the following observations:—

"Classification is, however, largely a matter of opinion. The absolute necessity—in books, lists, and collections—for a linear arrangement precludes the possibility of one which is really natural, since, although the relation of groups to each other is often evident, they ramify, extend, intersect and interlace to such a degree that it is only possible to take group after group in as natural a succession as seems to commend itself to the individual writer, with the knowledge on his part that the arrangement is partly the outcome of his own particular views, and that in all probability those of other authors are equally substantial."

But when he adds, "That which has hitherto been followed for our native species does not appear to be disturbed to a very large extent by an examination of the species found in other parts of the world," it is only so far true on account of the vast bulk of the Order having hitherto prevented any rearrangement of the families (the butterflies excepted) in a sufficiently natural series to be regarded in any other light than as tentative.

Mr. Barrett cuts the Gordian knot of synonymy, as is best in a work of limited scope, by quoting every name under which any species is widely known. No other course was open to him, unless he had worked out the synonymy of every species for himself, a work of great labour, difficulty, and at times uncertainty, or unless he had decided to follow some previous author throughout.

Dealing with British Lepidoptera only, Mr. Barrett appears to have almost confined himself to the use of English authors, from the time of Haworth, including an examination of the principal periodicals. A great deal of hitherto unpublished information is also included in the work, from the observations of the author and his correspondents. But little use appears to have been made of continental authors, except as regards the larvæ of some of the species described.

Turning to the body of the work, we find that under each species the dimensions, essential characters, variation, larvæ, pupæ, habits, &c., are discussed in sufficient detail for most practical purposes. A useful feature of the book is the addition of many of the species which have been reputed, on fairly good authority, to have been taken in Britain, but which are still regarded either as accidental immigrants, or as doubtfully British. Of course these notices are much briefer than those of the well-established British species, about which there is no question. But we do not see what has guided the author in his selection of reputed British species; he has included such an insect as *Thais rumina*, a conspicuous South European butterfly, once found flying in Brighton Market, but which could hardly by any possibility be indigenous in Britain, while he makes no mention of many species recorded by the old authors as having been at least casually taken in England. As he has included such species as *Thais rumina* and *Parnassius Delius*, we think he should have given at least a passing notice of every butterfly recorded as having been taken in Britain (except, perhaps, in cases where there was reason to believe that there had been an actual error of identification, or when a careless and ill-informed author like Turton has marked species as British at random); or else have omitted all the reputed British species, except those which there was some ground for believing might ultimately prove to be indigenous. Among the latter were many moths which were really omitted from, instead of inserted in, the British list "without authority," by the late Henry Doubleday, and which have since been proved to be indigenous, and reinstated. But we are glad to find that Mr. Barrett admits *Lycæna argiades* and *Danais Archippus* among our native butterflies. The latter, though an importation from America, has been so frequently taken in England of late years, that it is hoped it may become permanently naturalised. On the other hand, there are several apparently extinct species, formerly common in England, such as *Chrysophanus dispar*, last taken in 1865, as well as others which appear to be now on the verge of extinction as British species, without any obvious reason, such as *Aperia cratægi* and *Polyommatus acis*. In a few years we fear that entomologists may have seriously to consider the desirability of finally erasing several of our British butterflies from our list as absolutely and undoubtedly extinct. *Per contra*, we may look for occasional additions (though very rarely among the butterflies) among species which are possibly overlooked or confounded with others, like *Lycæna argiades* and *Hesperia lineola*, the two latest novelties. In the case of *Lycæna bœtica*, first taken in England in 1859, there is good reason to believe that the species is naturally extending its range in North-Western Europe. Possibly this may also be the case with the moth, *Syntomis phegea*, which is said to have been taken once or twice in England of recent years, and which, though gregarious and generally abundant wherever it is found, is excessively local north of the Alps, though there are several isolated colonies in Germany and the Netherlands.

We could have wished that Mr. Barrett had paid more attention both to the foreign literature relating to British butterflies, and to the older English literature before Haworth; but no man can accomplish everything, and within the limits to which he has confined himself his work must be regarded as by far the best and most complete which has yet appeared. W. F. Kirby.

COOKE ON LOCOMOTIVES.

British Locomotives. By C. J. Bowen Cooke. (London and New York: Whittaker and Co., 1893.)

LOCOMOTIVE engineers, like their brethren in the medical profession, very often differ widely in their practice; again, they often follow the practice of some older locomotive engineer dead and gone, may be. Who can say that the late Mr. William Stroudley has not left his mark on the locomotive design in this country, and that many British railways do not bear his handiwork in the design of their locomotive stock? To the layman the question why certain railways have engines with domes, and other railways have engines without domes, will always remain unanswered. The same may be said of bogies, injectors, pumps, &c.

In the large locomotive works, where engines are built by contract, these divergencies of practice are brought prominently forward, and one is in danger of coming to the conclusion that anything will do in the way of locomotive design. Nor is it only in the design that there is so much variation, for one finds quite as much in the systems of doing work often rigidly specified to be followed.

Another point also deserves attention. Since the use of steel has come into use as a material for the construction of boiler shells, it is amusing to observe the different ways this material is handled, or rather specified to be handled. Some engineers allow the plates to be sheared to size, and the rivet holes punched full size without hesitation; others again partly follow this practice, but require the sheared edges of plates to be planed to a depth of a quarter of an inch, and punched holes to be machined to a depth of an eighth of an inch on the diameter. Another school declines to have punched rivet holes at any price. The same variation in practice holds good with the question of annealing the plates, and particularly the flanged plates which go to form the boiler.

It is possible to take the principal parts of a locomotive and to demonstrate that what is considered good practice by one locomotive engineer is considered by some other to be decidedly wrong, and for this reason no good can be attained by following this view of the question further. Any book, therefore, treating on locomotive engineering will naturally tend to follow the practice of some particular locomotive engineer as regards design, and particularly the details, the principles of course being the same in all cases.

The volume before us "does not profess to be a scientific work; its purpose being more to give the reader, who may not feel disposed to dive into figures and calculations, some information about locomotives in a condensed and intelligible form." This is to be regretted, because there is no modern work on locomotive design available for reference. But on the other hand, the author has written a most readable book, useful alike to the apprentice and lay reader.

The author, being on the locomotive staff of the London and North-Western Railway, naturally follows the practice in vogue on that line, and a better example of good all-round locomotive engineering will be difficult to find.

The volume may be roughly divided into three parts; viz. the early history of the locomotive, details of construction of recent engines, and descriptions of modern locomotives in use on the principal railways in this country. In all three divisions the author has done ample justice to the subject; although, as we have before pointed out, the book would have been of far more value to an engineer had the author gone deeper into the question of design, and particularly the strengths of parts.

Chapter v. deals with the boiler, the most important and delicate part of a locomotive engine; for given a well-made boiler of ample capacity, then the engine will have every chance of being a success. The author on page 91 mentions Bessemer steel as a material for boiler shells n such a way as to give an impression that it is the common practice to use that material for this purpose, whereas Siemens-Martin open hearth steel is generally used, and Bessemer steel is the exception. Further on, the tensile strength of various materials used for making boiler shells is given. Surely the author should also specify an extension or contraction of area as well?

We read that "rivet holes may be drilled, but in general practice with locomotive boilers they are punched when the plates are cold." Has the author ever seen rivet holes punched in a hot plate? It certainly is the practice to punch the rivet holes at Crewe, but no large contractor dreams of punching at all, nor would most engineers allow it to be done; and as regards cost, it is certainly no more expensive to drill.

Fig. 55 represents the arrangement for staying the crown of the fire-box by direct stays to the casing plate. This is said to be "a good arrangement." There are, however, several objections to it, the more important being that no provision is made for the expansion of copper tube plate on raising steam, the first two rows of stays being usually carried by a sling attached to the boiler shell. The old-fashioned roof-bar is again coming into vogue, owing probably to the fact that the fire-box is not held so rigidly, and therefore the plates are not so liable to crack with the constant expansion and contraction.

The chapter on boiler fittings is good, but the asbestos packed fittings made by Messrs. Dewrance and Co. might have been included with advantage. On the subject of cylinders we find much useful information, the latest types being clearly illustrated. Under the heading of general details, the radial axle-box, Adams' bogie and blast-pipe are described, but the bissel truck is not included. This is to be regretted, because it is very commonly in use abroad, and is more efficient than the radial axle-box. The all-important question of brakes is discussed in Chapter xiii. Everybody will agree with the author that it is a pity there should be two brakes in the field, because where vehicles have to run over lines using different brakes, both systems of brake gear are usually fitted: and so thoroughly has this to be done, that in the case of fish trucks used with passenger trains the cost of the brake gear comes to more than half the total cost of the vehicle.

The many improvements recently made in the design of the fittings and gear of the automatic vacuum brake have rendered it most efficient and easily maintained; a sectional drawing of the combination ejector, as made by Messrs. Gresham and Craven, would have been welcome in this chapter. The Westinghouse brake is well described, and is illustrated with the familiar sectional drawings of that company.

Chapter xiv. is on modern locomotives, and is capitally illustrated. The locomotive types on the L. and N.W.R. are described, and a table is given, being a complete list of the different standard classes with the number of engines of each class. Another table gives the numbers and names of all the passenger engines; following this chapter we find the standard types of other companies' locomotives treated in much the same manner. On p. 252 there is evidently an error. The author mentions "Mr. Stirling's 4 ft. coupled inside cylinder engines with 5 ft. 6 in. driving wheels." What does this mean? Page 266 gives the information that the Chatham and Dover Railway has the automatic vacuum as their standard brake. Surely this line is claimed by the Westinghouse Company. Scotch locomotive practice is well represented by Messrs. Holmes and Drummond's fine engines running on the North British and Caledonian railways respectively. Page 286 contains an error in the statement that Mr. Drummond's engines of a particular type are fitted with the Bryce Douglas valve gear. One engine certainly was so fitted, but after a series of breakdowns the gear was done away with, and the ordinary link motion was adopted.

The compound locomotive is treated in Chapter xvi. Both the Webb and Worsdell types are copiously illustrated and described, but there is nothing absolutely new to be learned from a careful perusal of this chapter. No drawing is given of the Worsdell intercepting valve; but this is a mistake which can be rectified in a future edition.

The volume concludes with chapters on lubrication and packing, combustion and consumption of fuel, engine-drivers and their duties, &c. The question of metallic gland packing is just mentioned, and that is all. There are hundreds of engines now running fitted with the Jerome metallic packing, or that of the United States Company, and descriptions of these would not be out of place in this work.

Taken as a whole, this volume contains much readable and useful matter. The author has certainly succeeded in writing a most interesting book, which is sure to leave many clear notions, on the minds of its readers, concerning the practical side of a subject of vast importance. Most of the illustrations are very clear. The printing is good, and the volume is strongly bound.

N. J. LOCKYER.

WEATHER PROPHESYING.

Sécheresse 1893, *ses Causes.* Par l'Abbé A. Fortin, Curé de Châlette. (Paris: Vic et Amat, 1893.)

WHATEVER effect such a period of drought as that through which some parts of England and the Continent have recently past may have had on the harvest, it is pretty certain to be followed with a heavy crop of literature. Some writers content themselves with a simple record of facts, and a comparison with similar experiences in the past; some try to explain the causes, and others have remedies to suggest which may diminish the ill effects of similar periods in the future.

The work quoted above belongs rather to the two last categories, but unfortunately we cannot congratulate the author on his contribution to either the scientific or the economical side of the question. His explanation of the cause of the drought is easily expressed, though we cannot hope that the suggestions put forward will carry conviction to the readers of this journal. In the opinion of the author, the drought is due to three contributory causes. (1) To the sun-spots, which for the three months in question exhibited themselves, it is stated, on the southern side of the sun. (2) To the fact that during the three months, March, April, and May, "Vénus s'est trouvée en opposition constante et prolongée." (3) The third cause is due to the fact that from the beginning of the year the lunar apogee has coincided with the new moon, and the perigee with the full moon.

M. l'Abbé Fortin has apparently many readers and admirers. If we have understood the text correctly, he publishes an almanack in which the weather predictions are given a year in advance, and to judge from the advertisement, these predictions have met with a ready circulation. Further than this, it is mentioned with pardonable pride, that when the gifted author was in need of a micrometer for the prosecution of his studies of these sun-spots, a generous and a sympathising public subscribed 700 francs with a readiness and devotion that should attest the usefulness of his labours and his popularity. With these advantages on his side we feel the responsibility of venturing to disagree with him, or of questioning his figures and his results. Nor is any hope entertained of convincing him of the inadequacy of his arguments, and some apology is perhaps due for pointing out one or two facts which, if they do not convict the reverend Abbé of misrepresentation, exhibit at least a want of candour, which we should not have expected to meet in one of his sacred calling. We may pass over his first argument resting on sun-spots, because it is not impossible but that these do exercise an influence on our atmosphere not yet explained, though we are certain that the warmest adherent of such a theory will find little additional support from the arguments stated by the Abbé. It may not be possible to do justice by a translation to the words "opposition constante et prolongée," as applied to Venus. By "opposition" is evidently meant superior conjunction, but why constant and prolonged? The superior conjunction of Venus did not take place till the beginning of May, and we regret to say that the words "coincident cette année 1893 avec les mois de Mars et Avril" (p. 46) are unwarranted and misleading. The same remark applies to the words (p. 90), "Vénus ne se rapprochait de sa conjonction qu' en Juillet," and it may further be remarked that since Venus was approximately at the same distance from the earth in the beginning of July as at the beginning of March, June ought to have been included in this "constant and prolonged opposition." Again, with regard to the moon's apse, it is declared (p. 90), "il arrivait encore que l'apogée se faisait juste en pleine lune, et le perigée à la nouvelle lune." A comparison of the dates of new and full moon with those of perigee and apogee shows that the Abbé is not more accurate here than in his remarks on Venus. The average deviation for the three months under notice is two and a half days, and in one case the time of full moon was March 31, 19h, while the apogee did not occur till April 5, 7h., or a difference of time of four and a half days. But the curious and to some extent the most interesting feature of the whole is, that the admirers of the Curé will still continue to regard him as an authority, and, what is more to the purpose, eagerly purchase his almanacks, and would continue to do so even if his errors were more palpable—more numerous they could scarcely be.

The remedy which the gifted author would apply to prevent a recurrence of the ill effects which have made themselves felt this year consists in an extensive system of irrigation. Doubtless financial considerations would enter in a perplexing manner into such a scheme, and prevent it becoming a part of practical agriculture. But the knowledge of local circumstances which the Abbé probably possesses, and certainly we do not, permits him to speak with an authority we do not like to question.

W. E. P.

OUR BOOK SHELF.

Geological and Solar Climates: their Causes and Variations. A Thesis. By Marsden Manson. (London: Dulau and Co., 1893.)

SEVERAL thinkers have from time to time set to work to enlighten their fellow-creatures on the subject of the cause of the Ice age, a period when ice covered quite generally both the temperate and the tropical areas. Each one has in his own way added something towards the solution of this problem, whether that something was large or small, but the theory that will produce conviction in all minds, or rather in the majority of minds, has yet to come. The causes which have been suggested are many and varied. Some say the age was due to a decrease in the original heating of the globe; changes in the elevation of the land, and therefore varied land and water distributions; changes in the position of the axis of the earth; while others account for the phenomenon by suggesting a period of greater moisture in the atmosphere; variations in the amount of heat radiated by our sun; variations in the absorbing power of the sun's atmosphere; variations in the temperature of space; coincidence of an Aphelion winter with a period of maximum eccentricity of the earth's orbit; a combination of the last mentioned with that of changes in the elevation of the land; and lastly, the explanation recently put forward by Sir Robert Ball.

In the present thesis the author, after reviewing briefly the suggested explanations, goes back to the idea of the decrease in the original heating of the globe, and on that builds up a very plausible theory. To state briefly this theory, one must mention that two sources of heat were at work—first that of the resident or internal heat of the earth, and second that of the sun. As the earth passed from the era in which its climates had been controlled by internal heat to one in which solar heat predominated, uniform climates "must have been passed through during which isotherms were independent of latitude." Before the era was reached at which the sun had complete control over the climates, the author says the continental areas must have been glaciated, independent also of latitude.

To state in so many words the direct *cause* of the Ice age, he says that it is due to the remarkable properties of various forms of water in relation to heat and cold. As vapour it played an enormous part in the loss and receipt of heat by radiation, as water it was the last to retain "the effective remnant of earth heat, on account of its high specific heat, and as ice it was able to store a great amount of cold."

The author then deals in detail with the way these three forms of water played their part in this stupendous phenomenon.

The end of the Ice age was brought about so soon as the solar heat could find its way to the earth's surface; the air being cleared of obscuring clouds and fogs by the chilling of the oceans and the glaciation of continental areas.

The first zone over which the solar energy would first establish its power would be the torrid zone; travelling polewards the glacial conditions would gradually be removed upon lines parallel with the present isotherms.

More on the subject need not be said here, but we would recommend any one who takes an interest in this problem to give this book a perusal, for although there may be many who would not agree with the writer in all points, yet he has made an honest and plausible attempt at suggesting a cause of one of the most difficult and yet most fascinating problems with which we have to deal.

A Manual of Electrical Science. By George J. Burch. (London: Methuen and Co., 1893.)

OF the many useful volumes in the University Extension Series published by Messrs. Methuen, this is one of the best. "I have written," says the author, "not for wealthy amateurs, nor for people who do not care to think, but for men and women who have to give up something else to spend a sovereign on their own education. Nearly all the apparatus described in this book can be made by anyone with a few tools and a little finger-skill." In conformity with this laudable desire, technical terms are rarely introduced without being explained, and by simple words and apt illustration the way to electrical knowledge is made as easy and pleasant as it possibly could be. Indeed, popularity of style appears to be the book's sole *raison d'être*, for, with one or two exceptions, the facts described are to be found in a number of elementary text-books. However, it can be said that there are very few, if any, books of the modest dimensions of the one before us in which so much information is imparted in a more popular manner. The descriptions of experiments and principles are easy reading without being diffuse; the hydrostatic and other analogues are numerous, yet they are never used where likely to lead to a misconception. The illustrations, however, are not worthy of the text. They should have been far more numerous and less sketchy in order to appeal to the public for whom the book has been specially designed.

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.*]

The Supposed Glaciation of Brazil.

IN the second volume of NATURE, p. 510, I reviewed the late Prof. Hartt's "Geology and Physical Geography of Brazil," and called attention to the author's views, as well as those of the late Prof. Agassiz, relating to the supposed glaciation of that country. From their very positive statements I concluded that the evidence as described by them did actually exist, and that until it was disproved it should not be ignored. In my "Darwinism," p. 370, I stated, on the authority of my friend, Mr. J. C. Branner, now Professor of Geology in the Stanford University, California, who succeeded Prof. Hartt in Brazil, and had a much more extensive knowledge of the country, that the supposed glacial drift and erratic blocks were all results of subaërial denudation. Recently, however, Sir Henry Howorth has quoted some passages from my review in illustration of the wild and incredible theories of some geologists, as samples, in fact, of the "Glacial Nightmare"; and, as no authoritative disproof has yet been given of the exceedingly strong and positive statements of Agassiz and Hartt, I beg leave to lay before the readers of NATURE some extracts from a paper on "The Supposed Glaciation of Brazil," by Prof. Branner, which will shortly be published, and of which he has kindly sent me a type-written copy in advance. As a partial justification of what has now proved my too hasty acceptance of the statements of these gentlemen, I will give one passage in which Prof. Agassiz refers to the supposed glacial phenomena near Ceara:—"I may say that in the whole valley of Hasli there are no accumulations of morainic materials more characteristic than those I have found here, not even about the Kirchel; neither are there any remains of the kind more striking about the valleys of Mount Desert in Maine, where the glacial phenomena are so remarkable; nor in the valleys of Loch Fine, Loch Awe, and Loch Long, in Scotland, where the traces of ancient glaciers are so distinct." Both Agassiz and Hartt were equally strong as to similar phenomena near Rio.

It is to be first noted that Hartt had only spent eighteen months in Brazil when he wrote his book, and his views on the glacial phenomena were thus based on a very hasty survey of that enormous territory. Prof. Branner went with him when he again visited Brazil in 1874, helped him in his geological work till his death in 1877, and himself remained five years longer making a geological survey of the country; and he states that, before his death, Hartt's views underwent a radical change. Prof. Branner says:—

"Under his direction I did more or less work in the mountains about Rio de Janeiro for the purpose of sifting the evidence of glaciation in that region, and I am glad to say, in justice to the memory and scientific spirit of my former chief and friend, that long before his death he had entirely abandoned the theory of the glaciation of Brazil, and that the subject had ceased to receive further attention, even as a working hypothesis."

A few extracts must now be given showing to what causes the phenomena which deceived these observers are really due. And first as to what were supposed to be erratic boulders often embedded in boulder clay.

"The boulders believed to be erratics are not erratics in the sense implied, though they are not always in place. The first and most common are boulders of decomposition, either rounded or subangular, left by the decay of granite or gneiss. Sometimes they are embedded in residuary, and therefore unstratified, clays, formed by the decomposition in place of the surrounding rock. And everyone has heard of the great depth to which rocks are decomposed in Brazil. The true origin of these boulders and their accompanying clays is often obscured by the 'creep' of the materials, or in hilly districts by land slides, great or small, that throw the whole mass into a confusion closely resembling that so common in the true glacier boulder clays. In this connection too much stress cannot be placed upon the matter of land slides; they are very common in the hilly portions of Brazil, and aside from profound striations and faceting produce phenomena that, on a small scale, resemble glacial till in a very striking degree." . . . .

"The second method by which these boulders have been formed is quite similar to the first, but instead of being cores of granite or gneiss, they have been derived by the same process of exfoliation and decomposition from the angular blocks into which the dikes of diorite, diabase, or other dark-coloured rocks break up. Their colour marks them as quite different from the surrounding granites, and the dikes themselves are almost invariably concealed. The residuary clays derived from the decomposition of these dikes are somewhat different in colour from those yielded by the granites, so that when 'creep' or land-slides add their confusion to the original relations of the rocks the resemblance to true glacial boulder clays is pretty strong. The chance of discovering the source of such boulders is further decreased by the depth to which the mass of the rock has decayed, and by the inpenetrable jungles that cover the whole country, and so effectually limit the range of one's observations. Dikes, such as these last mentioned, are not uncommon in the mountains about Rio de Janeiro. Indeed, what have generally been regarded as the very best evidences of Brazilian glaciation, some of the boulders near the English hotel at Tijca, fall under this head, though some are of gneiss. The fact is that the great mountain masses about Rio are of granite or gneiss, while some of the boulders come from the dikes of diabase or other dark-coloured rock high on their sides—dikes which were not visited by Agassiz or Hartt."

Prof. Branner then describes a third class of supposed erratic, derived from certain sandstone beds of the tertiary deposits, which, by exposure, change to the hardest kind of quartzite, and when the surrounding strata are removed by denudation, and a few blocks of this quartzite are left, they are so unlike the rocks by which they are surrounded that unless the observer has given a special study to the tertiary sediments, he is liable to be misled by them.

The wide-spread coating of drift-like materials tha covers considerable areas of the country, consisting of boulders, cobbles, and gravels, sometimes assorted and sometimes having clay and sand mixed with them, are then described, and are shown to be due to the denudation of the tertiary beds during the last emergence of the land, aided by subsequent subaërial denudation and surface wash. Prof. Branner thus concludes:—

"I may sum up my own views with the statement that I did not see, during eight years of travel and geological observations that extended from the Amazon valley and the coast through the highlands of Brazil and to the head waters of the Paraguay and the Tapagos, a single phenomenon in the way of boulders, gravels, clays, soils, surfaces, or topography, that required to be referred to glaciation."

The very clear statement above given of the real nature of the phenomena which deceived Prof. Agassiz and Mr. Hartt, is very instructive, and it shows us that a superficial resemblance to drift, boulder-clay, and erratic blocks, in a comparatively unknown country, must not be held to be proofs of glaciation.

We require either striated rock surfaces or boulders, or undoubted *roches moutonnées*, or erratics, which can be proved not to exist sufficiently near to have been brought by "creep" or landslides. In view of these liabilities to error, we may be almost sure that the supposed evidences of glaciation described by the late Mr. Belt in his "Naturalist in Nicaragua" (p. 260), are explicable in the same manner as the Brazilian evidences, since he nowhere found glacial striæ or any boulders that could be proved to be true erratics; and this is the more certain because he himself states (p. 265), "I have myself seen, near Pernambuco, and in the province of Maranham, in Brazil, a great drift deposit that I believe to be of glacial origin."

All students of the past and present history of the earth are indebted to Prof. Branner for having relieved them of a great difficulty—a true glacial nightmare—that of having to explain the recent occurrence of glaciation on a large scale far within the tropics and on surfaces not much elevated above the sea-level. ALFRED R. WALLACE.

Telegony.

DR. ROMANES' letter inviting a discussion concerning the remarkable phenomenon of telegony will be welcomed by many who have felt that too little notice has been paid by men of science up till now to one of the most obscure problems of heredity. At the conclusion of his remarks, Dr. Romanes rejects Prof. Weismann's hypothesis that sperm elements are capable of penetrating into the ovary, and fertilising immature ova *in situ*, on the ground of their obvious incapability of doing so. It seems, however, possible to doubt whether the spermatozoa are so incapable of penetrating such tissues as the stroma surrounding an ovarian follicle. Although, as far as I am aware, the actual penetrating of spermatozoa through ovarian tissues has in no case ever been shown to take place, yet we are bound to take it for granted that in some cases this actually occurs, from facts observed in many Invertebrata.

Prof. Whitman, in an exhaustive paper published in the *Journal of Morphology*, January 1891, has collected a considerable mass of evidence to show that in many widely-differing animal groups the spermatozoa make their way through the external body wall at many different points, usually a large number being bound together to form spermatophores. Perhaps the best examples of animals where this occurs are found among the Turbellarians and Leeches. In these forms the spermatozoa pass directly through the epidermis, basal membrane, and the layers of muscular and connective tissue till they reach the body cavity. Here the spermatophores break up, and in some instances the individual spermatozoa undoubtedly must penetrate the wall of the ovary in order to fertilise the ova *in situ*.

As in many mammals, the immature ova lie very near the surface of the ovary, it does not seem to be beyond possibility that even in the higher vertebrates some similar process may occur.

On the other hand, as Prof. Weismann points out, if such be the case we should expect to find animals pregnant several times in succession after once being crossed, of which no instance has ever been recorded.

Dr. Romanes' suggestion that the followers of Weismann may explain the facts of telegony by supposing the spermatozoa to disintegrate and that their "ids" and "determinants" somehow enter the unripe ova, must for the same reason be dismissed as impracticable, unless it be assumed that enough "ids" never reach one egg to supply the place of those "ids" which have been got rid of by the reducing division of the egg nucleus, and would be replaced in the ordinary course of things by the spermatozoon. Such an assumption would be obviously unscientific and unwarrantable.

It seems, therefore, unsafe, until more definite experimental work has been done with regard to this obscure and interesting problem, to attempt to give any very definite explanation of the facts as they now stand, if we adopt Prof. Weismann's, views as to the continuity of the germ plasm. The facts, as Dr. Romanes very rightly insists upon, show that telegony is on the whole, of very rare occurrence, and on this account it is premature to go so far with Mr. Spencer as to maintain that the few isolated instances of telegony are sufficient to knock down at a blow the far-reaching theories of heredity which Prof. Weismann has put forth. M. D. H.

September 29.

The Use of Scientific Terms.

PROF. LODGE has made a valuable statement regarding scientific terms in last week's NATURE as follows:—"The words used in the current language of biology are extremely classical and as unlike the language of daily life as can be contrived. This is done to keep free from the misunderstandings arising out of the attempt to give to popular words a scientific, *i.e.* an accurate meaning." Botanists have not always been as careful as Prof. Lodge would have us believe, and as an instance to the contrary I would cite the following: I was recently lecturing on forest utilisation, and used the word bark in its ordinary meaning of the outer envelope of a tree. One of the students in the class interrupted me to point out that I was speaking loosely, as *bark* is now a scientific term, meaning the transformed outer envelope of a plant, the German *Borke*, after the growth in it of corky or stony tissues.

I appealed to the sense of the class as to whether botanists have any right to adopt a common English word for something beyond its ordinary meaning, and the class took my view of the subject unanimously, carrying eventually even the objector with them.

The substance now scientifically termed *bark* might be styled *rhytidome*, as is done in France (*vide* "Flore Forestière," by A. Mathieu, edition 1887, p. 595); or can any reader of NATURE propose a better term? W. R. FISHER.

Coopers Hill, October 16.

Rustless Steel.

SOME months ago I noticed, in *The Field*, the statement that steel containing twenty per cent. of nickel was free from rust and, on that account, very suitable for the manufacture of small arms of high quality. From its use in the manufacture of ordnance and armour-plate I presume, moreover, that the nickel alloy does not compare unfavourably with ordinary steel in point of tenacity and hardness.

If this proves to be the case—and it is the object of this letter to elicit the information from some of the numerous readers of NATURE—nickel-steel would form an invaluable material for the construction of certain parts of astronomical and geodetic instruments, notably the pivots and axes, which, as made at present, slowly deteriorate from rust when of steel, or from wear when of bronze. With geodetic instruments, continually set up as they are in exposed situations, sometimes near the sea, it is seldom there is not, after a few years' use, evidence of rust enough on the pivots to have destroyed much of the extreme perfection of figure attained by makers like Repsold or Ertel. The wear of bronze pivots is even worse. I am informed that the earlier meridian observations at a leading observatory are not comparable in accuracy with those taken after the original bronze pivots had been replaced by steel ones.

Cape Town, September 27. H. G. FOURCADE.

RESEARCH LABORATORIES FOR WOMEN.[1]

THE session which we inaugurate to-day will in the future be regarded as of prime importance in the history both of Bedford College and of the higher education of London at large.

It will be remembered in the history of London, for in the course of it the Gresham Commissioners will issue their long-expected report. Whatever the nature of that report may be it will be important; most important if the Commissioners succeed in solving the difficult problem which has been proposed to them, and enlist in favour of their recommendations so strong a sentiment of public approval that a teaching university is at length established on the lines which they lay down. Important, though no doubt less important, if they add to the long list of failures to find the true solution, and thus only prove that another route to the desired end is barred.

As regards Bedford College itself, we meet this session under the shadow of a loss. Miss Martin, for many years the Lady Resident, who has done so much in helping to

[1] Inaugural address delivered at the Bedford College for Wome , by Prof. A. W. Rücker, F.R.S.]

guide our institution amid the difficulties which have surrounded it, has retired from her post. Many here have already had opportunities of expressing their regrets to her in person, but I feel sure that none interested in Bedford College would wish the first meeting of this session to pass without our conveying to Miss Martin the assurance of the affection with which she has inspired many generations of Bedford College students, or without our telling her once more of our hopes that she may enjoy for many years the rest she has so well earned.

In an inaugural address, however, it is natural to look rather to the future than to the past.

It has been thought well that the organisation of the College should be brought into closer approximation to that which obtains in most similar institutions, whether intended for the education of men or of women. We have now a Lady Principal. It would be impossible in the presence of Miss Penrose to express fully how much we hope from her in the future; it may be sufficient to say that we welcome her as the daughter of a distinguished scholar, and as one who has shown herself capable of climbing the very highest rounds of the ladder of learning. Miss Penrose was selected as Principal by the Council from among a group of candidates, of whom several would have adorned the post, and we believe that the large share in determining the future of Bedford College, which she must now take, has been placed in safe hands.

On the occasion of this new departure it may be well to consider how widely the position of those who are now engaged in working for Bedford College differs from that of its founders.

When the College was first instituted the very principle which it was intended to embody was disputed on all hands. It was denied that the doors of the Temple of Learning should be thrown open to women equally with men; that there is no crypt, however dark, no chapel, however sacred, which may not be entered by both alike.

That principle has now been vindicated. Women are working side by side with men in the same universities, competing with them in the same examinations, and proving by their successes that they can bear a worthy part in the intellectual strife of the schools.

But if in this respect the Council have not to face the prejudices which their predecessors overcame, they have to encounter new difficulties caused in part by the very success of the principle for which their predecessors contended.

Bedford College was the first institution designed for the introduction of women to the higher learning, but unfortunately, or, as the cause is greater than the College, I should perhaps say fortunately, it had no patent rights in the theory which it first illustrated. Rivals, friendly rivals, have sprung up, and in some respects they possess advantages we cannot claim.

Some share the charm of the surroundings and the prestige of the names of the older universities. Another, near London, has wealth to which we have not yet attained. As women's colleges have become more numerous, the beauty of their buildings has increased, the standard of their equipment has improved. To beauty of outward adornment we cannot in York Place pretend, but I would not have dwelt on this point to discourage you. Our laboratories, though small, are well fitted; the art studio, the class and lecture rooms are sufficient for all the claims that are at present made upon them, and we may truly assert that Bedford College, though without the advertisement of external decoration, is adequately equipped for its great task.

Another change which has taken place since Bedford College was founded is in the ideals of those who are engaged in promoting the higher education.

When the College was first inaugurated the great examination craze was at, or was approaching, its height. Since then we have learnt that that method of testing ability is not all-sufficient, and signs are not wanting of a growing disbelief in its efficacy, especially when applied to very advanced students.

The Education Department is laying greater stress on inspection and less on examination. In the University of London the note-books of the work done by scientific students in the laboratory are submitted to the examiners, thus recognising work done outside the examination room.

At Cambridge the Smith's prizes are given for successful theses instead of after an examination test.

To have completed an original research now carries a man further towards his fellowship than all the triumphs of the Schools.

In the University of London the degree of Doctor of Science is given without further examination, if the candidate can prove that he has added to knowledge on the subject he professes.

I am told that there is at present a movement on foot at Oxford for giving to those who have carried out a successful research, what is still to some Englishmen almost inconceivable, an examinationless degree.

It is perhaps chiefly in the mathematical and physical sciences that this movement is most noticeable, and it is largely based upon the growing conviction of both teachers and students, that it is, if not useless, at all events unsatisfactory to master all the intricacies of a mathematical or experimental machinery for investigating nature, if the knowledge gained with much pain and labour is not turned to account.

Every man who has solved a mathematical problem has done work which is, as far as he is concerned, original, and it is absurd to train men so as to endow them with a special facility for such work, and yet to do nothing to show them in what direction their exceptional attainments may be of real service.

A student who has mastered a science but complains that he can add nothing to knowledge, is like an athlete who has learned to run well on a cinder track, but fails on the high road.

More and more stress, then, is now being laid on the power both of teacher and students to use their knowledge. It is no exaggeration to say that original papers are produced in the principal London colleges by the score. If we turn to the provinces we find that the Commissioners of the 1851 Exhibition give scholarships to those among the provincial students whom their colleges recommend as capable of undertaking advanced scientific work. And here it may be noticed that examination has again been dispensed with. In the old days the candidates would have been selected after a centralised examination held in London, whereas now the Commissioners are content—and, in my opinion, very properly content—with the recommendation of responsible authorities.

In view then of this great change in the aims and objects of the higher education, I want to impress upon you that fact that if Bedford College, if women's colleges in general are to hold the high position which the success of their students in the examination room has won for them, they must become places, not merely for acquiring knowledge, but for adding to it. I do not think that it can be honestly said that up to the present time the success of women as investigators has, in spite of some notable exceptions, been as great as their rapid and extraordinary achievements as students would have led us to expect. Nevertheless, if the fundamental idea of our founders is to govern us in the future as it has guided us in the past, the students of Bedford College must distinguish themselves in the research laboratory as they have often distinguished themselves in the struggle for a degree. In undertaking this task, many of them possess one qualification for success which most men lack: they have, at all events, time at their disposal.

Do not let me be misunderstood. I am far from desiring that the students of Bedford College should leave its walls impressed only with the importance of adding to knowledge, and inclined to neglect other and, at least as urgent duties. In my opinion, no man or woman can afford to cultivate any one part of their nature to the exclusion of the others. Sad stories have sometimes been told of homes in which work has been done which will never be forgotten, but done at the cost of all the brightness and happiness which are usually associated with the name of home. This want of the sense of proportion, of the relative importance of different claims, casts a shadow on the brightest intellectual fame. I am not asking for such sacrifices. I believe that in general they are absolutely unnecessary. But where the over-mastering curiosity of the born investigator exists, it will find a career, which may indeed involve self-sacrifice, but which need make no harsh demand on others.

There are, to my knowledge, at the present moment a large class of men who are living more hardly than they otherwise might live, who are cheerfully surrendering days which might be given to pleasure or to money-making, and are spending laborious nights, simply because they are impelled by the desire to add something to the pile of knowledge which our race is through the centuries accumulating. It cannot but be that if the same spirit animated the women and girls of this generation, many would be found among them who, without neglecting any duty, would work with the same energy for the same object.

It is possible that some of my hearers may accuse me of holding up an impossible ideal. My answer is that the founders of Bedford College held up to their generation an ideal which was then regarded as impossible but which has nevertheless been realised. Women, if they please, can now be educated to the same high level as men. I in turn venture to hold up to you an ideal at which Bedford College should aim in the future. It is that it should be known as a place of learning as well as a place of education, as a place where not only is the number of those who know added to, but where knowledge itself is increased.

THE INNER STRUCTURE OF SNOW CRYSTALS.

THE ice and snow crystals photographed and described by me[1] may be referred to the following types.

I. Crystals developed in the direction of the vertical axis. (*a*) Hexagonal prisms. (*b*) Bottle-shaped prisms. (*c*) Needles.

II. Tabular crystals. (*a*) Hexagonal tables. (*b*) Stellated tables. (*c*) Dendritic tables.

III. Crystals equally developed along the vertical and lateral axes.

Among these groups, types I. (*c*) and III. are in no way different from the ordinary hexagonal crystals, and accordingly of less general interest. The former, I. (*c*), is common in drifting snow; to the latter belong the sharp edged hexagonal prisms *without cavities*, which compose the under layers of the snow covering. They are never found among the snowflakes, and are accordingly originated by a molecular change in the snow covering. Type II. (*c*) comprises the relatively large dendritic crystals with complicated ramifications which are visible even to the naked eye as handsome regular stars. They have been figured and described by several observers, from Claus Magnus and Keppler to Scoresby and Glaisher, and I shall therefore not dwell upon them in the present paper. Of the remaining extremely interesting types (I. *a*, *b*; II. *a*, *b*), which, owing to their microscopic dimensions, have hitherto received no attention from men of science, I give a brief description.

I. (*a*) *Hexagonal Prisms.*

Fig. 1 shows the commonest type. It is bounded by the basal planes and the hexagonal prism, and of interest on account of the *hour-glass shaped cavities* invariably present within the crystal. These are, as shown by the figure, widest near the two basal planes, where they are bounded by a negative hexagonal prism; nearer the centre they contract again to expand in the form of two bulbs, elongated to points and confluent. The shape of the cavities is almost always the same. Crystals of this type are very small (about 0·5 mm. long), and the inner structure only distinguishable under the microscope. They are common in drifting snow.

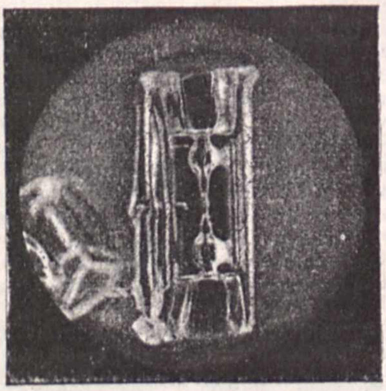

FIG. 1.

I. (*b*) *Bottle-shaped Prisms.*

The bottle-shaped crystals of elongated prismatic form have the appearance shown in Fig. 2. Like the crystals of the preceding type, they are bounded by an hexagonal prism and the basal plane; but one end is pointed, and the crystals accordingly hemimorphic. The bottle-shaped crystals also contain cavities, less regular, however, than those in the crystals of the preceding type. The following circumstance attaches a special interest to these crystals. On February 8 there was a rather sparse fall of agglomerations of bottle-shaped crystals such as are shown in Fig. 2. *The cavities in these crystals proved under the microscope to*

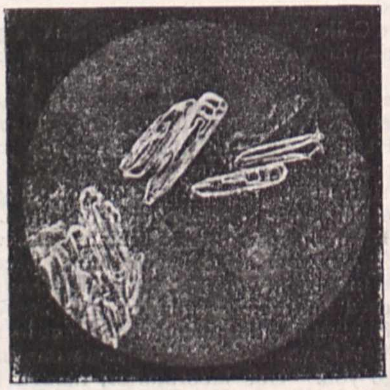

FIG 2.

[1] "Geol. Foren. i Stockh." Forh. Bd. 15, p. 146.

contain water in which one could sometimes (as in Fig. 2) *discern a small air-bubble.* On the day when this snowfall occurred the temperature was $-8°$ C. Still there was a continual dripping of water from the house roofs, in spite of the fact that the sky was overcast, and the sun thus could not contribute to melt the snow. The dripping continued even at midnight in a temperature of $-12°$ C. Shortly after the fall of snow a transformation could be observed in the crystals; on the surface of the snow they had passed from prismatic bottles to hexagonal tables *without any cavities.* The above described fall of small ice-bottles containing water, a phenomenon, as far as I know, new to meteorologists, combined with the transformation of the crystals after their descent, affords a simple explanation of the fact that, in spite of the severe cold, the new-fallen snow was so saturated with water as to cause an incessant dripping from the roof.

II. (*a*) *Hexagonal Tables.*

To the naked eye these crystals look like small, lustrous scales. Their dimensions vary between 0·8 and 1·4 mm. Under the microscope they prove to contain regular cavities, remarkable as being bounded not by planes, but, contrary to the accepted principles of crystallography, by *regularly distributed curved surfaces.* The limits of these cavities are shown under the microscope as fine black markings, to which, on account of their resemblance to forms within the organic world, I have applied the name of *organoid* lines, cavities, and formations. The following

FIG. 3.

example will illustrate the structure of such crystals, including such organoid cavities. The snow-crystal (Fig. 3) shows in the centre a handsome star. The crystal is composed of two (or more?) superimposed tables, with the same orientation. The different hexagons indicate the outer limits of these tables. Two tables are united by a stratum, which has the outlines shown by the stellate figure. Within this figure the crystal is therefore homogeneous; without the same, its two different layers are separated by a flattened cavity, bounded by sinuate surfaces, and probably containing air. The same star includes some extremely regular cavities of smaller size. On this table we can observe a hemihedral development, the six triangular fields into which the hexagon is divided by lines drawn between the centre, and the angles being only alternately equal to each other. Such a hemihedry is the rule in this type. It is most developed in some almost triangular tables that occur among the equilateral hexagons. The above described structure, two tables united by a stellate layer of ice, is the general rule in the tabular ice crystals.

The organoid figures show a great multiplicity of forms, but the fundamental type is the same in all of them. It is evident that their outlines are fixed by certain crystallographic laws yet unknown to us. We might possibly find in these organoid formations, which so strongly remind us of shapes in the world of life, a clue to the mathematical laws of the structural outlines of organisms. Or perhaps these remarkable organoid figures are caused by microscopical aërozoic organisms, around which the crystals have developed. I hope next winter to be able to collect observations for the answering of this question

II. (*b*) *Stellate Tables.*

Figs. 4-6 show some of the countless modifications exhibited by crystals of this type. The central table often shows beautiful organoid figures sometimes hemihedrally developed and regularly orientated cavities. Similar

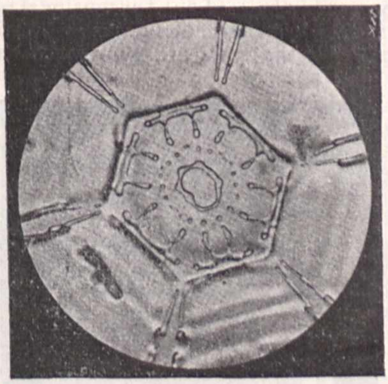

FIG. 4.

cavities, usually of very minute size, are with great regularity distributed in the arms of the star.

The ramification of the plates has some connection or other with the orientated cavities. Through each arm of the six-sided star runs what may be called the *main nerve*, which originates either in the central plate or just outside it. This nerve is present in all the tables and dendritic stars with elongated arms. The main nerve is bounded by two fine, parallel *gas canals.*

The first beginning of these canals consists of two or

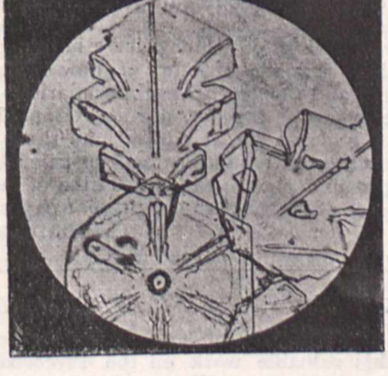

FIG. 5.

four small cavities with parallel orientation. In the continuation of these small cavities lie larger ones, often prolongated to extended canals (see Fig. 4). Owing to evaporation on the surface of the crystal, these canals gradually become open, first at one end, and then along a part or the whole of their extent, only the ridge that divides them remaining as a *nerve* (Fig. 5). That these canals are really cavities in the ice I have ascertained by observing and photographing snow crystals in a coloured liquid.

I found that the liquid gradually penetrated into and filled the canals which were open. Fig. 4 shows the central parts of crystals with canals partly filled with the coloured liquid. Near the centre small air-bubbles are still visible. Fig. 6 is the central part of a star powerfully magnified. The interesting structure may be judged by the photograph.

Phenomena attending the Compression of Snow Crystals.—A stellate plate was slowly compressed by screwing down the objective upon the cover-glass. After this pressure it was still entire. In the interior of the crystal *new curvilinear figures or pressure lines had appeared*, following a regular course analogous to that of the organoid figures. This analogy suggests that the latter may possibly be explained as tensional phenomena.

Exceptional Symmetrical Conditions.—The fine cavities in the centre of the stars are sometimes regularly ar-

FIG. 6.

ranged after only *two* symmetrical planes at right angles to each other and of different value (see Fig. 4), in accordance with the symmetrical conditions that we find in crystals belonging to the orthorhombic system.

Hoar-frost.—In addition to the photographing of snow crystals, I have also examined and reproduced by photography crystals of hoar-frost deposited on window-panes. Even these crystals formed often hexagonal tables, but were entirely without the remarkable cavities observed in snowflakes.

The investigations of which I have here given a brief account show that the structure of snow crystals is very complicated, and display several peculiarities which, so far as we know at present, are unexampled in other crystals. I hope to be able to resume these investigations next winter on a more extensive scale, in order to obtain, if possible, a complete elucidation of the interesting phenomena alluded to in the present paper.

G. NORDENSKIÖLD.

BÜTSCHLI'S ARTIFICIAL AMŒBÆ.[1]

PROF. BÜTSCHLI, of Heidelberg, so well known by his valuable work on the Protozoa, and his contributions to Bronn's "Klassen und Ordnungen," has, in the monograph under review, approached a subject of deep interest and great difficulty, namely, the cause of protoplasmic movement. His researches in this direction are already known to readers of the *Quarterly Journal of Microscopical Science*, for in 1890 Prof. Lankester inserted a letter from Prof. Bütschli, in which the latter gave a short account of his experiments. In the present monograph his researches are given in a completed form and in great detail. The gist of the whole subject may be put as follows:—Prof. Bütschli makes an artificial oil and water emulsion in a way suggested by Nuincke, and finds that under certain conditions drops of this emulsion exhibit streaming movements and changes of shape: according to Prof. Bütschli, protoplasm is itself a natural emulsion, and the streaming and amœboid movements of protoplasm are, like those of the artificial emulsion, due to surface tension.

Working at emulsions, Nuincke had previously found that if substances soluble in water be finely powdered and rubbed up with oil, and the oil subsequently surrounded with water, the latter diffuses into the oil, which it converts into a foam or emulsion of little water droplets closely packed together in the oily matrix. The emulsion may obviously be compared with the sea-foam, in which we find air globules closely packed in a water matrix, the oil in the emulsion and the water in the sea-foam having an alveolar or honeycomb build or form. The Nuincke emulsion is obviously, too, the reverse of the emulsions made by Johannes Gad with weak K_2CO_3 and oil, in which the oil droplets lie closely packed in a water matrix; it is also the reverse of the numerous emulsions made every day by the druggist who uses oil in mucilage, malt-extract, &c. When Bütschli first tried the Nuincke method he used common salt, sugar, and nitre, taking these as examples of substances readily soluble in water. He succeeded, however, better by using Na_2CO_3, or K_2CO_3, and proceeded as follows. The salt, preferably K_2CO_3, was obtained pure and dry, and was finely powdered in an agate mortar. He then breathed upon it until it was slightly moist, and rubbed it up with olive oil until a thick white paste was formed. A tiny drop of the paste was then placed on the centre of a cover-glass, and inverted over a drop of water, and in order that the drop might not be pressed out of shape by the weight of the cover, the latter was supported by little pellets of wax or paraffin. The preparations so obtained were placed on one side in a damp chamber for twenty-four hours, and then washed out with water by inserting a piece of blotting-paper into the chink between the slide and cover, and supplying fresh water at the opposite side of the cover by means of a pipette. The water was then replaced by equal parts of glycerine and water, after which the drops of emulsion became clear and transparent, exhibiting changes in shape and streaming movements very much like those of an amœba. It appears that the consistency of the olive oil is a very important factor in determining the successful issue of one of these experiments. Ordinary oil is of no use, it must be kept for some time in an open vessel, though the time may be shortened by keeping it in a hot-air chamber at 50°C. and testing the oil from day to day. It must be thick and viscous, but not too much so.

When examined by the aid of a microscope the emulsion appears as a network of oil enclosing the water droplets, for the structure is, of course, seen in optical section. Curious streaming movements may be observed within the emulsion, and these may continue for hours; movements of the drop as a whole occur, and always in the direction of the stream. If the emulsion drop be carefully watched it will be seen to change its shape, and to throw out processes—which, by the way, are always club-shaped—and to withdraw others. Up the centre of these processes a streaming movement takes place, and the streams at the tops of the processes spread out and flow back in a layer next the surface. These movements are influenced by warmth and electricity, and we have, therefore, in these Bütschli's drops something which might deceive one into supposing that actual amœbæ were in the field of observation.

The movements of the oil emulsion are due, no doubt, to changes in the surface tension of the fluids in contact with each other, Bütschli's case being an illustration of

[1] "Untersuchungen über mikroskopische Schäume und das Protoplasma." Von O. Bütschli. (Leipzig: Wilhelm Engelmann, 1892.)

the effects of surface tension, effects which are more simply shown in the contracting films, and tears of wine of the laboratory and dinner-party. It is well known that surface tension is capable of producing important and curious changes in the form of fluids, and will induce well-defined movements of a streaming character; surface tension, and the movements resulting from it, are modified and influenced by heat and electricity, and many biologists have suggested that surface tension may play an important part in producing amœboid movement. Prof. Bütschli takes many steps in advance of this; for having formed his artificial emulsion, he sees in all living protoplasm nothing but a similarly constructed emulsion, and concludes that because it is so similar its movements must be of the same nature. We feel in reading his work that not only does he in his enthusiasm twist the appearances of protoplasm to suit his own especial view of what its structure must be, but he is guilty of want of logical treatment of his premises when he has got them. Frommann, Hertzmann, Klein, and, indeed, most histologists regard protoplasm as consisting of a network of less fluid material, the interstices of which network are filled with a more fluid material, and this structure has been demonstrated in almost every animal cell. This view of the nature of protoplasm is open, however, we think, to criticism, for histologists are in the habit of preserving and hardening their tissues in fluids such as alcohol, picric acid, corrosive sublimate, which act as precipitants to protoplasm, and they blindly conclude that what they see in these preparations are present in the living cells. On this account many have questioned whether these networks are ever present in the living cells, and Berthold and Bütschli view living protoplasm as an emulsion of two fluids, one forming an alveolar honeycomb, the other filling its cavities. This honeycombed structure—emulsion —Bütschli finds everywhere, from the protoplasm of the protozoa to that of the higher vertebrates; where there was once a network now there is an emulsion. The interfibular substance of muscle mistaken by a few observers for a network is, for Bütschli, a honeycomb with frequent transverse partitions, and the fibrillated axis cylinder of a nerve has cross strands indicating that this is a honeycomb too. In the apparently structureless protoplasm of the outer part of an amœboid cell, such as is figured by Schäfer in the last edition of "Quain's Anatomy," this structure is present to Bütschli, and as he cannot see it there, even with the eye of faith, it is believed to be too delicate and the meshes too finely drawn out to be seen.

As to the chemical nature of protoplasm, about which most biologists who have had anything of a chemical training feel themselves rather in the dark, Prof. Bütschli has fairly definite views, and these it must be admitted fit in admirably with the emulsion theory. The honeycomb he regards with Reinke as a nucleo-albumen, containing some molecules of a fatty acid, and not miscible with water; the more fluid portion of protoplasm, filling the interstices of the honeycomb, he regards as a watery fluid containing albumen and an alkali free or combined with it.

Holding the above views concerning the structure of protoplasm, which indeed, according to Bütschli, resembles both in minute anatomical structure and chemical and physical properties the microscopic froth which he can manufacture, he looks upon the cause of the movements of the froth as the cause of the movements of the amœba, and also in all probability of striped muscle itself. Let Prof. Bütschli speak for himself:—

"Die Bewegung einfacher Amöben, wie A. guttula, limax, A. blattæ, Pelomyxa, ist den früher beschriebenen strömenden Oelseifenschaumtropfen so ungemein ähnlich, ja in allen wichtigen Punkten, so ganz ihr Ebenbild, dass ich von der Uebereinstimmung der wirksamen Kräfte in beiden Fällen vollkommen überzeugt bin" (page 198, see also pages 200 and 208.)

Now, for some time past it has been held that surface tension plays a part both in the streaming movements of protoplasm and in the production of amœboid movement, but no one has pushed this idea to the extent that Bütschli has done. Let us see if the facts of the case justify him in so doing. It is true that the picture of the moving foam and of the moving protoplasmic mass present many points of similarity to the eye of the observer, but what of that? The waxwork figure may deceive us all into imagining that it is a man, but once we know what it is the most ignorant of us would hardly venture to argue from its mechanism to our own. So when we look at Bütschli's foam particles, and when we are told that they do not consist of protoplasm, and merely of rancid olive oil and a weak carbonate of potash, then we may exclaim at their interest and novelty, but we shall not seriously compare them with living protoplasm. Science is passing through two phases—the first spiritualistic, the second mechanical. Psychology is still very much in the first stage, and physiology in the second. There are still those among us to whom the circulation is a thing of tubes and force-pumps, and nothing more, and absorption a process that can be imitated by a parchment dialyzer. Fortunately, we are getting rapidly through these two stages, and are beginning to recognise that the force-pump and parchment paper have led us often into wrong conclusions. Studies in evolution have taught us that protoplasm, made up no doubt of elements of the inorganic world, is nevertheless a complex of these elements of unique character, and with properties distinct from everything that is not protoplasm. The oil emulsion may, to the eye of the observer, conduct itself in a way exactly similar to an amœba—which, by the way, it does not, its processes being club-shaped, and never pointed—but this does not indicate that amœboid movements are similar in their nature. With equal right would the to-day representative of Madame Tussaud urge, on the strength of their waxwork show, that human arms move by springs and clockwork. Not only do these foam particles tell us nothing about protoplasm, but for the investigation of questions of surface tension they are evidently ill fitted. They are toys for the physicist, not for the physiologist. We know that surface tension can well account both for changes in shape and flowing movements of fluids; it is only by experimenting on protoplasm itself that it will be possible to determine what part this agency plays in protoplasmic activity.

In Professor Bütschli's work the reader will find much valuable information as to the views held from time to time as to the structure of protoplasm; and the production of this monograph is a strong indication of the singlemindedness both of German scientific men and of German publishers. It is a large quarto volume of two hundred and thirty pages, well printed, and illustrated with six beautiful plates, and upon a subject which of necessity appeals to a very limited number of readers.

JOHN BERRY HAYCRAFT.

FINGER-PRINTS IN THE INDIAN ARMY.

IT may interest some of your readers to see the terms of the order by which the method of finger-prints for purposes of identification has now been introduced into the Indian Army. A copy of it, sent by Lieut.-Colonel Surgeon Hendley, of Jeypore, has just reached me.

Army Headquarters, Medical Division, Simla, August 25, 1893.

In continuation of this Office Circular, No. 5, dated January 16, 1891, it is requested that as a means of identification of recruits for the Native Army, examining medical officers will cause an impression in printer's ink of the ends of the first three fingers of the right hand of each recruit passed by them as fit for the service, to be made on the Nominal Roll opposite the name of the recruit; and in the case of the Army Hospital Corps, in the Verification Roll.

A specimen of the required impression is shown below.

By order.

(Signed) C. H. PEARSON, Surgeon-Major,
Secretary to the P.M.O., H.M.'s Forces in India.

[Here follows the specimen impression.]

I trust that the medical officers who will have to take these prints, understand the importance of using so little ink that the impression shall be *clear*, though its tint may be only brown and not black; also that when comparing two prints they will use a low power lens and four pointers, two for each print. I have lately been using a watchmaker's glass of two-inch focus, secured to the end of a long and counterpoised arm, which turns, not too easily, round the screw by which it is attached to its support. The lens can be brought into focus with great ease, and it remains steady when left alone. I use at least two pointers for each print. They are T-shaped; their long arms are six or seven inches long, they are roughly made of wood as thick as the thumb, so that they are purposely not over light. Each pointer stands on three supports, viz. on the point of a bent pin, whose headless body has been thrust into the end of the long arm of the T, and on the ends of two nails, or better on staples, one of which is driven under either end of the cross-arm. It is most easy to adjust the point of the bent pin upon any desired character in the finger-print. Both hands of the observer are thus left free to manipulate other pointers, when desired. The stationary pointers are a great help in steadying the eye while pursuing a step by step comparison between two finger-prints.

FRANCIS GALTON.

NOTES.

THE collected works of Jean Servais Stas, which it is proposed to publish as a mark of honour to his memory, form three quarto volumes of about 500 or 600 pages each. The first volume contains the memoirs and papers relating particularly to the determination of atomic weights; the second comprises notes, reports, and lectures; and the third, posthumous works, which especially refer to spectroscopic researches. The edition is under the direction of MM. Spring and Defaire, and it will probably be completed in about a year. The three volumes will be published simultaneously at the uniform price of thirty francs. Subscribers of twenty francs or more to the Stas memorial fund will each receive a copy of the work, and contributors of less than twenty francs may increase their contributions to that sum, and so become a recipient. The names of subscribers will be published in an appendix to the third volume. After the completion of publication, the balance of the fund will be used for the erection of a monument. Stas' scientific work is more than sufficient to perpetuate his name among men of science, and the monument which it is proposed to erect will make it "known to all people."

AT the second day's meeting of the Photographic Congress, the opening of which was noted in our last issue, Mr. Andrew Pringle read a paper on "The Present Position of Micro-Photography," and W. Weissenberger contributed one on "A Process of Photo-Mechanical Printing in Natural Colours." The president, Capt. Abney, read a paper dealing with "Exposure and Chemical Action," in which he showed that the sum of excessively small exposures is not equivalent to the same exposure given at one time, and further, that very feeble intensity of light fails to produce the calculated amount of chemical action. Capt. R. H. Hills followed with a description of the instruments employed and the results obtained during the recent solar eclipse. At the final meeting of the congress, on October 12, Dr. A. Miethe read a paper on "The Practical Testing of Photographic Objectives," and Dr. P. Rudolph one on "The Measure and Numeration of the Stops of Photographic Lenses."

A STATUE of Duhamel-Dumonceau was unveiled at Pithiviers, on October 1. The French Minister of Agriculture, who performed the ceremony, claimed that Dumonceau was the first to institute agricultural experiments in the field.

DR. H. MÖLLER has been appointed Professor of Botany in the University of Greifswald.

AT the meeting of the International Geodetic Association, recently held at Geneva, a Commission, composed of M. Tisserand, with Profs. Foerster and Schiaparelli, was appointed to draw up a programme of observations to be made permanently at a number of different places in order to elucidate the question of latitudinal variations. The association will hold its annual meeting in Austria next year.

THE *Lancet* says that the Apothecaries' Society are about to apply to the courts for powers to sell their Botanical Gardens at Chelsea, the money value of which has been fixed at about £30,000. The removal of this historic garden would be a source of keen regret to the many who have profited by the instruction conveyed by its means.

WE are informed that the fund raised for paying the costs of Dr. Wallis Budge in the recent action of Rassam *v.* Budge has been fully subscribed. The list of the contributors, which is too long to print in its entirety, includes the following names:—Miss H. M. Adair, the Duke of Argyll, K.G., K.T., Lord Armstrong, C.B., the Marquis of Bath, Walter Besant, Dr. C. Bezold, Rev. H. Blunt, E. A. Bond, C.B., the Earl Cadogan, K.G., the Earl of Carlisle, Somers Clarke, N. G. Clayton, Miss Clendinning, Alfred Cock, Messrs. Thos. Cook and Son, Sir John Evans, K.C.B., F.R.S., Sir W. H. Flower, K.C.B., F.R.S., C. Drury Fortnum, A. W. Franks, C.B., F.R.S., Right Hon. W. E. Gladstone, M.P., Rev. Canon Greenwell F.R.S., Major-General Sir F. Grenfell, G.C.M.G., K.C.B., H. Rider Haggard, Lawrence Harrison, Thomas Harrison, James Hilton, Thomas Hodgkin, Sir H. H. Howorth, K.C.I.E., M.P., F.R.S., Right Hon. Thomas Huxley, F.R.S., Sir Frederick Leighton, Bart., P.R.A., William Lethbridge, Rev. W. J. Loftie, Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., Lady Meux, F. D. Mocatta, Walter Morrison, Sir Frank Mowatt, K.C.B., Sir Charles Nicholson, Bart., D.C.L., the Duke of Northumberland, K.G., F. G. Hilton Price, Hon. W. F. D. Smith, M.P., E. Maunde Thompson, C.B., Cecil Torr, Sir Reginald Welby, G.C.B., John White.

NEW and extensive electrical works were inaugurated at Blackpool at the end of last week. In the course of a speech made during the celebrations, Lord Kelvin expressed the opinion that municipal corporations were right to take into their hands everything calculated to further the general good of the borough. It seemed to him that the Government ought to take up the whole business of telegraphs and telephones, and it would not be an improper thing if the whole railway system of the country were placed under the same management.

AN International Congress on Aerial Navigation formed one of the series of congresses which have recently been held at Chicago. The papers read on that occasion are being published in the form of a supplement to the *American Engineer*, together with other information relating to aeronautical engineering. The new publication is given a distinctive title, *Aeronautics*, but whether it will be continued after the whole of the proceedings of the aeronautical conference have been issued will depend upon the success of the enterprise.

THE first International Botanical Congress ever convened on American soil was held at Madison, Wis., immediately after the adjournment of the American Association for the Advancement of Science, August 23 and 24. The foreign representation, however, was so small that the title of the meeting was changed to the "Madison Botanical Congress." The meeting was an outgrowth of that at Genoa last year. Prof. E. L. Greene, of California, was elected president. All the subjects discussed at the meeting referred to terminology, the following being the topics:—(1) Plant diseases; (2) anatomy and morphology; (3) physiology; (4) horticultural forms; (5) bibliography. It is expected that the next meeting will be held in Europe in 1894, but the precise time and place was not announced.

THAT Traugott Friedrich Kützing, the author of the *Phycologia generalis*, should have been still with us until within the last few weeks will probably be a surprise to many. As an author, Kützing had indeed completely disappeared from the scientific world; he had published nothing for more than twenty years, and nearly all his most important works appeared before the close of the first half of the present century. He may indeed be regarded as the founder of a scientific study of the Algæ, especially of sea-weeds. Much of his work has, of course, been superseded by more recent investigations; but his *Phycologia generalis*, published in 1843, his *Tabulæ Phycologicæ*, issued in twenty volumes from 1845 to 1870, with 2000 illustrations, and his *Species Algarum*, 1849, are still classical works, which must needs be in the hands of every student of the lower forms of vegetable life, if it is only for the excellence and life-likeness of their illustrations. In 1841 he published the *Umwandlung niedrer Algenformen in höhere*, and in 1844 the *Die kieselschaligen Bacillarien oder Diatomen*, the introduction to our knowledge of the structure of the diatom-shell, in which there is now so extensive a literature. Kützing died on September 9, at Nordhausen, in the 87th year of his age. His extensive collection of dried Algæ has long been in the possession of the University of Leyden.

MR. G. W. YOUNG has issued "A Key-table showing the characteristics of the principal Natural Orders of the British Flora," compiled for the use of students. A very brief synopsis is given of the leading characters of each natural order, and a familiar plant is mentioned as a "type." A few small corrections might be made in a subsequent edition. Thus, *Dielytra spectabilis* is the gardener's, not the scientific, name of the plant indicated; in the Caryophyllaceæ the "free central placentation" is by no means universal.

FEW geographers of the present day enjoy so wide a reputation as Baron F. von Richthofen, Professor of Geography in Berlin University, and it is pleasant to observe the fitting way in which his former students did honour to the sixtieth anniversary of his birth on May 5, 1893. Many of them wrote papers, either on geographical or geological subjects, for special publication in the form of a handsome book, "Festschrift," bearing Baron von Richthofen's portrait as frontispiece. Among the contributors we note the names of A. Philippson, F. Frech, H. Yule Oldham, C. E. M. Rohrbach, and E. Hahn.

DR. A. PHILIPPSON'S contribution to the "Festschrift" is an interesting investigation of the "Types of Sea-coasts" (Ueber die Typen der Küstenformen). Dr. Philippson insists upon the study of the simplest types of form and the individual relationship of these types to the groups of natural agents which produce them. He shows how all sea-coasts may be reduced to two great and fundamental types. (1) Isohypsal coasts, where the existing form of the coast-line still coincides with the primary relief of the earth's surface at that part, so that we may trace its origin from tektonic, volcanic, or other earth movements. (2) Thalassogenic coasts, where the primary isohypsal condition of the coast-line has been in greater or less degree obliterated by the action of "littoral forces." Dr. Philippson gives particular prominence to the flat-beach variety of thalassogenic coasts, and describes in detail the purely potamogenic type due to the action of inflowing rivers, the purely thalassogenic type due to the action of breakers, and to the building-up and breaking-down of "strand-walls." Lastly, the mixed potamogenic and thalassogenic type combining the characteristics of both. Numerous examples are drawn from familiar European coast-lines, and several diagrams are given.

A paper on "The Mechanical Genesis of the Form of the Fowl's Egg," was read before the American Philosophical Society on April 21. In it Dr. J. A. Ryder gives evidence that the configuration of the outline of the hen's egg is determined by mechanical means while the egg membranes and shell are in the process of formation within the oviduct. "The pressure preventing the passage of the elliptical mass down through an elastic tube must be developed largely in the form of friction, and the resistance of the walls of the oviduct to dilation. To overcome this a greater pressure must be exerted on the elliptical egg-mass at a point above its minor axis than below the latter. This will tend to squeeze part of its substance, since it is at last enclosed in an elastic capsule before shell-formation takes place, into the lower or larger end of the mass. In this way the ovoidal form of the egg seems to have first arisen." It therefore appears that the development of the figure of the eggs of birds is a purely dynamical problem, or one in which energy is applied in a definite manner to the plastic surface of a mass in statical equilibrium within the oviduct. This principle has many extensive applications, and may lead to the elucidation of several obscure points connected not only with the eggs of birds, but also those of reptiles and insects.

IN a letter to *Science* for September 15, Mr. O. T. Mason relates the discovery at the World's Columbian Exposition of two examples of the Mexican atlatl, or throwing-stick, lying in the Colorado Alcove. His description is as follows:—The shaft is a segment of a sapling of hard wood. At the distal end is a shallow gutter and a hook to receive the end of a spear-shaft. At the proximal end or grip in the more perfect specimen, about four inches from the extremity, is a loop on either side of the stick, one for the thumb, the other for the forefinger. The remaining three fingers would be free to manipulate the spear-shaft. These loops were made by splitting a bit of raw hide, sliding it down the proper distance on the stick, forming loops less than an inch in diameter by bringing the projecting ends of the raw hide, and seizing it fast to the shaft. Below the finger-loops or stirrups were a long chalcedony knife or arrow-blade, the tooth of a lion, and a concretion of hematite seized by a plentiful wrapping of yucca cord. Mr. Mason believes that the Bourke example from Lake Patzcuaro belongs also to the same outfit. This is the first instance, as he says, of "finding the ancient atlatl figured in the codices, and described by Mrs. Nuttall." A connection between the cliff dwellers and the Mexican peoples is thus indicated.

DR. G. SCHOTT contributes to a recent number of *Globus* an account of the Atlas of the Indian Ocean, published by the *Deutsche Seewarte*, with particular reference to the behaviour of the storms of the tropical part of that ocean. The article plainly shows that whereas some twenty years ago the Germans were dependent on the labours of English seamen for their sailing directions, they now rely almost entirely on their own publications, except as regards nautical charts. Dr. Schott gives an intelligible account of the older or circular theory of storms, and of the later, or spiral theory, to which attention was drawn by Dr. Meldrum, in 1860. If the former theory be correct, a ship which in a given position might safely run across the path of an advancing storm, would according to the later theory run into the most dangerous part of it. Between these theories seamen must therefore have great difficulty in shaping a correct course at the most critical time, and every careful investigation into the movements and laws of storms should be welcomed, in the interest of science, whether undertaken by this country or by foreign nations.

IN connection with the science meetings at the Chicago Exhibition, Dr. M. A. Veeder read a paper on periodic and non-periodic fluctuations in the latitude of storm tracks, in which he referred to the occasional rearrangements in the distribution of the atmosphere, consisting, in the main, in the displacement of the belts of high pressure on each side of the equator, with the consequent deflection northward or southward of the usual courses taken by storms. Notable instances of this kind have occurred at different times, such as in 1877–8 and in 1888–9, and the present year also affords another example, the winter in northern latitudes being distinguished by a severity in strong contrast to their mildness during the years above mentioned. These rearrangements of weather conditions on a large scale make it difficult, the author considers, to resist the conclusion that the atmosphere as a whole is under the control of forces which have a common origin, and depending upon some form of solar variability. Although it is not yet beyond dispute whether the sun is hottest or coldest when most free from spots, the evidence appears conclusive that the weather conditions in question bear some sort of relation to the spottedness of the sun. The author thinks that there is ground for the belief that there may be special forms of solar activity not yet fully understood, which exercise powerful terrestrial effects independently of the amount of solar heat falling upon the earth as a whole, and which may be of the nature of electro-magnetic induction, and depend upon conditions different from those which appear in the case of simple radiation from a source of combustion. If the variation in weather types follow the solar electro-magnetic record, he thinks that it would not be unwise to approach the problems from this side of the question, although it would involve a reconsideration of the facts of meteorological science from a standpoint different from that of an assumed variability of solar heat. The author considers that it may be necessary o discard provisionally the accepted theory of the origin of storms, in order to determine the part which electro-magnetic induction of solar origin plays, independently of heating effects. In any case, the study of periodic and non-periodic fluctuations in latitude of the cyclonic and anti-cyclonic belts surrounding the earth is most important in many ways.

A CONVENIENT modification of the hydrometer method of determining the densities of gases has been devised by M. Meslans, whose apparatus is described and illustrated in the *Comptes rendus*, No. 11. It consists of two hollow spheres hung to the arms of a balance. Each sphere, which is made of glass, aluminium, or gilt copper, hangs in a separate compartment, the suspending thread being introduced through a hole in the lid. The compartments are enclosed in a box and surrounded by water in order to keep them at equal temperatures. They are at first filled with air to determine the position of equilibrium. The gas whose density is to be determined is then introduced through a long tube immersed in the water, and enters one of the compartments, having previously been dried. The gas is passed through in a slow and continuous stream, and if its density differs from that of air, the equilibrium of the balance is disturbed. The weight necessary to re-establish equilibrium is noted, and the density calculated according to a simple formula. Thus the density is found by a single weighing, and by keeping the current of gas continuous any variation in its density is easily observed. A fairly high accuracy is attainable, depending upon the sensitiveness of the balance and upon the perfection of gauge of the spheres. One important application of the apparatus is that for determining the density and composition of the products of combustion in furnaces. The scale of the balance is graduated so as to show at a glance the percentage of carbonic acid, and hence the degree of efficiency of the furnace in question. This percentage, which is 21 theoretically, never exceeds 18 in practice, except in gas generators. In a great number of works it varies between 6 and 8. M. Meslans' apparatus is being applied to the study of the various methods of heating. Another application is that by which the presence and percentage of marsh-gas is indicated. With spheres of 1 litre capacity and a balance sensitive down to half a milligramme it was found possible to detect 0·1 per cent. of methane in the air of a mine.

THE *Electrical Review*, in the course of an article on "Electrical Engineering at the World's Fair," describes the curious rotary effects of a two-phase alternating-current field-magnet. A ring-armature is wound with four coils, connected in pairs across the circle; one pair is connected to one of the two-phase currents, the other pair to the second current. The ring-armature is then laid horizontally on a table, and a board placed over it. Almost any metallic article placed on the board immediately begins to run round above the ring. Copper balls, coins, &c., or any other easily movable conducting article will at once get into motion.

THE October number of *Mind* contains an article on theories of light-sensation, by Mr. C. L. Franklin.

MR. GEORGE HOGBEN has sent us two papers extracted from the Transactions of the New Zealand Institute, 1892, and referring to earthquakes experienced at the Antipodes in June, July, and December, 1891.

THE lecture on "The Interdependence of Abstract Science and Engineering," delivered by Dr. W. Anderson, F.R.S., at the Institution of Civil Engineers, in May last, has been extracted from the Proceedings of the institution, and is now published separately.

A COURSE of lectures upon Planetary Astronomy, with especial reference to "The Planet Venus" will be delivered in the theatre of Gresham College, on the evenings of October 24, 25, 26 and 27, by the Rev. E. Ledger.

A HANDY book on "The Art of Projection and Complete Magic Lantern Manual," by an expert, has been published by Mr. E. A. Beckett, Kingsland-road, N.E. Lantern operators will find in it many useful hints upon matters of manipulation.

MESSRS. WHITTAKER AND CO. have published the "Principles of Fitting," for apprentices in engineering and students in technical schools, by a Foreman Pattern Maker. The book is profusely illustrated, and should be of great assistance to the workers for whom it is intended.

STUDENTS preparing for the examination in the "Principles of Mining" held by the Department of Science and Art, or for colliery managers' examinations, are recommended to use an elementary text-book of "Coal Mining," by Mr. Robert Peel, just published by Messrs. Blackie and Son. The book is very well written and quite trustworthy.

A DAINTY brochure, by Martha F. Sesselberg, entitled "In Amazon Land," and containing adaptations from Brazilian writers, with original selections, has been published by Messrs. G. P. Putnam's Sons. The part of the book of interest to us refers to Amazonian legends, beliefs, traditions, and superstitions.

A SECOND edition of "An Introduction to Human Physiology," by Dr. A. D. Waller, F.R.S., has been published by Messrs. Longmans, Green and Co. Several alterations and transpositions of text have been made, and the results of many recent investigations have been included, thus giving additional value to an already highly appreciated work.

WE have received the Transactions of the Sanitary Institute, vol. xiii. The volume consists chiefly of reprints or abstracts of the papers read at the conferences which were organised in connection with the congress held at Portsmouth in 1892. It also includes an address to sanitary officers, delivered by Sir Douglas Galton at Worcester.

A CLASSIFIED list of plants in the Royal Botanic Gardens, Trinidad, has been issued as a *Bulletin of Miscellaneous Information*, No. 17, by Mr. J. H. Hart, the Superintendent. The list contains the names of plants under cultivation and indigenous in the Gardens, and is of scientific as well as economic interest.

DR. KICUCHI, of Tokyo, has just published, in Japanese, a text-book on Trigonometry, thus carrying on the good work he has begun in his manuals on Geometry, Logic, &c., and in his translations of "Clfford's Common-sense of the Exact Sciences," of "Russell's Technical Education," &c. The degree of Rigakuhakushi (= D.Sc.) is a degree conferred by the Minister of Education with the advice of the Council of the University.

LIEUT. J. P. FINLEY has prepared a report on "Certain Climatic Features of the Two Dakotas" for the U.S. Department of Agriculture. The report is illustrated with 163 tables, charts and diagrams, and it presents a vast amount of information concerning the meteorological phenomena which are believed to have a marked influence upon the agricultural interests of the States investigated. From the report it appears that the Dakotas should at once resort to an extensive system of irrigation in order to increase the precipitation and check the high evaporation. Forests ought also to be preserved, and extensive plantings of trees should be made. In the words of the report, "The meteorological and physical features of the Dakotas are such that, under the influence of settlement and the consequent development of agriculture, changes are effected which tend to the rapid dissipation of the moderate rainfall, through absorption and evaporation. Irrigation and reforestation are the only remedies."

THE disinfecting properties of peroxide of hydrogen have long been known, but considerable additions have been recently made to our more exact information concerning its bactericidal action. Richardson (*Chem. Soc. Journal*, Sept. 1893) has shown that the antiseptic action of sunlight on urine is due to the production of peroxide of hydrogen, for samples exposed to sunshine remained clear, and on examination were found to contain peroxide, whilst similar samples kept in the dark became turbid and contained no peroxide. Traugott, in "Einige Ergänzungen zur Praxis der Desinfection" (*Zeitschrift für Hygiene*, vol. xiv. 1893, p. 427), points out as the result of his investigations that this material may be substituted in all cases for corrosive sublimate and carbolic acid where the period of contact is not less than a quarter to half an hour; but that it is not suitable where rapid disinfection is required, as in the case of the disinfection of the hands, &c. Being innocuous and also harmless as regards clothing and the like, it is a safer disinfectant for general application than the former; its cost is, however, considerably greater. Some years ago, Heidenhain stated that he had constantly used peroxide of hydrogen as a gargle in cases of diphtheria, and Traugott mentions in his memoir that ten seconds' contact of a 2 per cent. solution of H_2O_2 with a young and vigorous growth of the diphtheria bacillus on blood serum, entirely destroyed this organism. If however two days' old cultures were similarly treated, contact for thirty minutes, even when repeated three times, was not sufficient for its annihilation. Thus the therapeutic value of this material consists in its immediate application at the very outset of the disease, whilst it may be recommended as an important prophylactic during epidemics of diphtheria.

AS regards the hygienic importance of peroxide of hydrogen, and its practical application, the experiments of Van Tromp and, later, Altehoefer on its action upon bacteria, pathogenic and otherwise, in water are of much interest. Van Tromp mentions that an addition of peroxide of hydrogen in the proportion of 1 : 10,000 parts of the water, when shaken up and allowed to stand for twenty-four hours, is usually sufficient to sterilise a water. Altehoefer, however, found that to ensure sterility it was advisable to use larger quantities, viz. 1 : 1000 parts of the water. Experiments made with waters purposely infected with cholera and typhoid bacilli, respectively, showed that in both cases these organisms were destroyed after twenty-four hours by this proportion of peroxide of hydrogen. Altehoefer, moreover, specially mentions that he found this addition in no way interfered with the dietetic value of the water, and recommends its application for household purposes as a protective measure during any epidemics of typhoid fever and cholera. Traugott also testifies to the innocuous character of this material even when swallowed in large doses, and states that 100 grm. or half a wineglassful of a 5 per cent. solution was administered by one of the doctors in a hospital in Breslau without any ill-effects whatever, whilst undoubted benefit was derived from its use. Care must, however, be taken that the particular material employed is as pure as possible, as traces of the poisonous barium chloride in larger or smaller quantities may be present; moreover, it is important that the sample should be freshly prepared, as its strength and consequently bactericidal action is reduced when it has been preserved for some time.

WE are indebted to *The Gas World* for the following particulars concerning a remarkable process, which is now being successfully worked, for very considerably increasing the illuminating power of coal gas, involving what at first sight would appear the highly dangerous operation of introducing into the gas a quantity of pure oxygen. In the year 1890 Mr. Edward Tatham, of New South Wales, made the bold proposal to add considerable quantities of pure oxygen to warm, heavy oil gas, with the object of producing a stable gas of very high illuminating power. Later in the same year Dr. L. T. Thorne communicated to the Gas Institute the results of preliminary experiments with this gas, which he had carried out on behalf of Brin's Oxygen Company. These experimental results led to the conclusion that rich oxy-oil gas *per se* was far and away more effective as an illuminant than the coal gas now employed for this purpose, but that its more immediate prospect of use lay in the direction of enhancing the lower illuminating power of ordinary coal gas. Preparations have since been made for practically testing the applicability of oxy-oil gas to the enrichment of coal gas, and the Hydro-Oxy Gas Patents Proprietary, Limited, have erected at 11, Salisbury-square, E.C., a complete experimental plant for the purpose. Moreover, the corporation of Huddersfield are erecting a plant for the purpose of enriching the coal gas supplied to the borough. The Huddersfield installation is not yet completed, but a portion of it is ready, and is now in actual operation. When complete it will consist of an oxygen plant and four bays of oil-gas retorts, capable collectively of producing 200,000 cubic feet of oxy-oil gas per day, together with the necessary condensers and holders. The oxygen plant has been already erected by Brin's Oxygen Company, and is their newest type of producer. It is built in two sections, which may be worked together or independently, and will make no less than 30,000 cubic feet of oxygen per day. This, the largest oxygen-producer ever constructed, is now in active operation. Of the oil gas plant one bay, consisting of fifteen cast iron retorts, is also working, and is capable of producing 50,000 cubic feet of oil gas per day. The lowest and hottest of the retorts are intended for "cracking" the residues from the upper retorts, but they may of course be fed with clean oil if required. The oxygen is introduced into the oil gas soon after the latter leaves the retorts and while still warm; the mixed gases then pass together through the condensers. The admission of the oxygen is automatically adjusted by means of a combination of meters, so that the proportion is constantly maintained at fifteen per cent. The oxy-oil gas is stored in special holders, and it is arranged to admit it into the coal gas just before the entry of the latter into the station meter, the quantity being regulated by a meter coupled to the station meter. The results so far attained are highly satisfactory. The admission of about six per cent. of oxy-oil gas is already found to increase the illuminating power of the corporation gas by the equivalent of five and a half candles, and this is probably much below the enrichment which will eventually be attained when the plant is complete, and when normal coal can again be employed at the cessation of the strike. The results attained by the Salisbury Square plant are considerably superior to this, and it is expected that the Huddersfield installation will eventually attain the same standard. Further, a marked increase in the stability of the gas is observed, for poor coal gas actually loses more illuminating power by storage than the same gas admixed with oxy-oil gas does. As regards cost, it is calculated from the experimental data furnished by the working portion of the Huddersfield installation, that the increased cost of production of the gas so enriched will not, at the highest estimate, exceed a third of a penny per thousand cubic feet.

NOTES from the Marine Biological Station, Plymouth.—Last week, like its immediate predecessors, was characterised by stormy weather, which confined the dredging operations to inshore areas. The chief capture was a large haul of the Opisthobranch *Oscanius* (*Pleurobranchus*) *membranaceus*. The approach of winter is already indicated in the bottom fauna: colonies of the Compound Ascidian *Fragarium elegans* have been frequently taken in their state of "hibernation," and the colonies of the Polyzoan *Bugula turbinata*, which in the summer orms extensive forests on the stones in certain areas, have now almost completely died down. The Nemertine *Amphiporus dissimulans* has begun to breed, and the greater number of *Micrura fasciolata* are full-grown and sexually mature.

THE additions to the Zoological Society's Gardens during the past week include two Sykes's Monkeys (*Cercopithecus lbigularis*, ♀ ♀) from West Africa, presented by Mr. W. H. Barber; a Thick-furred Capuchin (*Cebus vellerosus*) from South America, presented by Mr. R. Kettle; three Tigers (*Felis tigris*, ♂ ♀ ♀) from India, presented by H.R.H. Princess Beatrice; a Senegal Parrot (*Pœocephalus senegalus*) from West Africa, presented by Mrs. Rylands; a Ruddy-headed Goose *ernicla rubidiceps*, ♂) from the Falkland Islands, presented y Mr. Henry Phillips; a Tuatera Lizard (*Sphenodon punctus*) from New Zealand, presented by Mr. C. Stonham, F.Z.S.; a Diamond Snake (*Morelia spilotes*) from New South Wales, presented by Mr. Arthur W. Darker; a White-fronted Lemur (*Lemur albifrons*) from Madagascar, two Common Squirrels (*Sciurus vulgaris*, *albino*) British, deposited; two Blue-winged Teal (*Querquedula cyanoptera*) from South America, a Japanese Teal (*Querquedula formosa*) from North-east Asia, a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, a Turnstone (*Strepsilas interpres*), a Curlew (*Numenius arquata*) European, purchased; a Molucca Deer (*Cervus moluccensis*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE SCINTILLATION OF STARS.—Though the question as to the cause of the scintillation of stars has not received the attention of many workers, yet it has had and still retains its adherents. In a recent number of the *Revue Scientifique*, M. Dufour gives the results of observations commenced in the year 1853. The observations were made with the naked eye, and were continued in all seasons and in all conditions of the weather, since the chief object of the investigation was to find out whether there was any relation between the scintillations of stars and the disturbances which occur in our atmosphere. The first results which were obtained led to the forming of the following laws. (1) That red stars scintillate less than white stars. (2) The intensity of the scintillation is nearly proportional to the product obtained by multiplying the astronomical refraction for the height at which the star appears, by the thickness of the stratum of air traversed by the luminous ray that one is considering, and (3) that the causes of some of the essential differences between the scintillations of different stars may perhaps be due to the stars themselves. Experiments for studying the question as to whether there was any difference between the scintillation on mountains and upon the plain, showed that on the mountains the scintillation was most feeble. An important meteorological conclusion, which, as M. Dufour says, is contrary to general opinion, and which he deduces from his numerous observations, is that a feeble scintillation generally announces the approach of bad weather. He gives many instances in support of his view, among which occur the observations at Col du Géant on July 12, 1788, when the brightest stars in Lyra, Cygnus, and the Eagle at the same altitude showed practically no signs of scintillating, while the next day there broke out over France the most violent storm that the annals of meteorology had ever registered. M. Dufour compares his work with that of M. Montigny, who commenced work after him, and who was led to the same three laws above mentioned. He suggests that as his observations were made in Switzerland, it would be interesting to find out if a feebleness of scintillation observed at sea also indicates bad weather.

A UNIVERSAL TELESCOPE STAND.—The construction of a good and simple universal mounting for small telescopes has been the aim of many instrument makers, and it is pleasing to note an advance in this direction made by the firm of K. Fritsch, formerly Prokesch, in Vienna. In their new so-called "*Universal statio*" they have overcome many of the main difficulties. The chief point about this special kind of mounting is that the observer can either use the telescope as a theodolite—that is, with circles reading altitude and azimuth—or, by a slight adjustment, he may have the equatorial mounting where the circles read right ascension and declination. This end is gained by hinging what would be the polar axis on to a pivot at the side of the stand, thus allowing the axis to be moved from the horizontal to the vertical or any intermediate position. A strong metallic arc fixed on the top of the stand supplies a means of clamping this axis, and giving it a slight adjustment. With the axis vertical, we have then practially a theodolite mounting; with the axis out of the vertical, a parallactic mounting. It is needless to say that this mounting is only for small telescopes, and indeed its application to large ones is not needed. A detailed account of the mounting, with figures, will be found in No. 208 of *Prometheus*.

POPULAR ASTRONOMY.—Some time ago we inserted a note in this column to the effect that the editors of *Astronomy and Astro-Physics*, if they received sufficient support, would publish a monthly journal—*Popular Astronomy*—written especially for the rapidly increasing number of amateurs. We are glad to say that we have recently received the first (September) number, and, as far as one can judge, the journal has a successful future before it. The present number contains the first chapters of some series of articles on various subjects. To give some idea of the subject-matter and their writers, we may mention that "The Spectroscope, and some of its applications," is dealt with by Keeler; "Concerted Observation of the Aurora," by Veeder; "Shooting Stars: How to observe them, and what they teach us," by Denning; "Nebulæ and Comet-seeking," by Lewis Swift; "The Moon," by W. W. Payne, &c.; while future numbers will contain a series of articles by Barnard, on "Celestial Photography"; one by Elgar, on "The Moon"; another by Hale, on "The Sun," and many others. The treatment of the subjects is all that could be desired for those not acquainted with technicalities, and the illustrations, which include two excellent ones of the moon, are of the same style as those familiar to readers of *Astronomy and Astro-Physics.* The various tables, notes, &c., which complete this journal of forty-eight pages, form a useful and important addition.

THE AUGUST METEORS.—The prevalence of fine weather during the month of August afforded many observers excellent opportunities of observing the Perseids, and it is not surprising to hear that so many observations were made. *Astronomische Nachrichten* (No. 3192) gives some of the results, showing that at Warendorf, August 8–11, 410 paths were recorded, at Eversunital 72, Brilon 184, Arnsberg 114, Altona Hamburg more than 400, and so on. Prof. Denza, in the current number of *L'Astronomie* (No. 10, October), gives a list of some of the observations made in Italy. He refers to the shower as among "les plus éclantantes remarquées jusqu' à présent," and suggests that for the next few years it should receive special attention. The radiant point he locates as $\alpha = 44°$, $\delta = +55°$, the number of meteors attaining their maximum on the night of the 10th to 11th. Mr. Denning has also a few words to say (the *Observatory* for October) with regard to this shower, commencing first with the inaccuracy shown in observing the Lyrids of April, and pointing out "the same extraordinary differences" manifested in these Perseid observations. The accurate places, as he believes, were obtained by Mr. Booth on August 9, 43° and + 57°, and by Mr. Evershed on August 10, 44° + 57°. On August 16 he himself deduced the radiant as 52° and + 57°, a value agreeing approximately with Kleiher's theoretical position for that date, namely 54° + 59°.

ASTRONOMY OF THE FELLAHIN OF PALESTINE.—An interesting paper by Mr. P. J. Baldensperger, on the beliefs of the Fellahin of Palestine, is found in the] October report of the Palestine Exploration Fund. It appears that the Fellahin know the Pleiades by the name of Thureiyah. Besides this, many of the conspicuous stars and constellations have received names. The following are examples, though the list can be considerably extended:—

Banat Na'asch	The Great Bear.
Nijmetain el-Joz	Castor and Pollux.
Thureiyah	Pleiades.
Hareef el Thureiyah	Auriga.
Sawak el Thureiyah	Aldebaran.
Il Jiddi	Vega.
Nijmet el Danab	Denebola.
Ilsamak	Fomalhaut.
Ilmizâne	Orion's Belt.
Nashallat il mizâne	Betelgeuse and Rigel.
Sawak il mizâne	Sirius.
S'hèle	Canopus.
Tareek i-tubânet	The Milky Way.

The planet Jupiter is known as Nijmet el Gharara, Venus as Morning Star, and Mars as Nijmet el Sha'ate. A number of curious stories and beliefs are connected by the Fellahin with the stars, and a few with planets.

GEOGRAPHICAL NOTES.

M. A. HAUTREUX has been engaged this summer (*Bulletin* of the Bordeaux Society of Commercial Geography, 1893, No. 14) in investigating the difficult question of the currents of the Bay of Biscay, by means of specially contrived floats consisting of two bottles attached by a cord a metre in length. The lower bottle being weighted with water keeps the upper one, containing air, from being driven by the wind, and the whole drifts along with the superficial layer of water. The results obtained seem to point to the absence of any current northward along the coast of the bay. From all points of the line at which floats were discharged west of France they showed a tendency to drift rapidly south-eastward towards the south-eastern angle of the bay. The observations will be continued, and the result will be of value in furnishing additional information to sailors of the landward drift that has so often proved fatal to vessels on the north coast of Spain.

THE Queensland Branch of the Royal Geographical Society of Australasia has adopted a resolution approving of Sir Thomas McIlwraith's proposal to adopt an hour-zone system of time reckoning for Australia and New Zealand, with the 150th meridian (ten hours from Greenwich) as a unit, and urging the other branches of the society to take the matter up. The meridian of 150° E. runs through Cape Howe in the south-east of Australia and through the south-east of New Guinea, and its time would hold for the capitals of the three eastern colonies and Tasmania. The next hour interval westward (135° E.) would include the whole of South Australia, and the third (120° E.) would hold good for Western Australia. Eastward the time of the 165th meridian would apply to the south island of New Zealand, and that of the 180th meridian (twelve hours from Greenwich) to the north island and to Fiji.

Globus announces that an exploring and surveying expedition, to which five Germans are attached, has been organised in Brazil to study the less known parts of the Amazon basin and collect information as to ethnography and natural history. The expedition was intended to leave Santos in August, and cross the plateau of Matto-Grosso towards the upper waters of the Amazon, where surveys and scientific collections will be made.

THE last number of the *Mouvement Geographique* gives a sketch-map of Lake Leopold II., which lies south of the Congo. It has been resurveyed, in April 1892, by Mr. Mohun, the United States Consul to the Congo State, who was accompanied by M. De Meuse. The lake extends from 1°5′ S. to 2°45′ S., and its outflow drains into the Congo from the southern end. The lake receives no important streams, but is fed by drainage from extensive marshes which stretch away from its north-western end. The water is shallow, but rises 1·5 metres in the rainy season, inundating a large area of country. The deeply-indented bays serve as harbours for the canoes of the warlike slave-hunting races who inhabit the surrounding country, their villages being hidden deep in the forests at some distance from the shores of the lake.

THE new session of the Royal Geographical Society will be opened by an address on "Geographical Desiderata" by the new President, Mr. Clements R. Markham, F.R.S., on November 13. At the second meeting a paper on the Antarctic regions is expected from Dr. John Murray, of the *Challenger*, which will be followed by a discussion. Other papers which are being arranged for will be announced later. Mr. Mackinder will give the second course of his educational lectures on the relations of geography to history after Christmas, and a course of educational lectures on the principles of commercial geography is now being given, under the auspices of the Society, by Dr. H. R. Mill, in the London Institution.

THE HARVEIAN ORATION.[1]

IT is now 237 years since the illustrious Fellow of this College whose name we are met to commemorate, provided, when two years before his death he conveyed his estate at Burmarsh to the College, that:—

"There shall be once every year a general feast for all the Fellows; and on the day when such feast shall be kept, some one person of the said College shall be from time to time appointed by the President and two Eldest Censors and two Eldest Elects for the time being of the said College (so that the person so to be appointed be not in that behalf appointed two years together), who shall make an Oration publicly, in the said College, wherein shall be a commemoration of all the benefactors of the said College by name, and what in particular they have done for the benefit of the said College, with an exhortation to others to imitate those benefactors, and to contribute their en-

[1] Delivered by Dr. P. H. Pye-Smith, F.R.S., at the Royal College o Physicians, on Wednesday, October 18th.

deavours for the advancement of the Society, according to the example of those benefactors; and with an exhortation to the Fellows and members of the said College to search and study out the Secrets of Nature by way of experiment; and also for the honour of the profession to continue in mutual love and affection among themselves, without which neither the dignity of the College can be preserved, nor yet particular men receive that benefit by their admission into the College which they might expect; ever remembering that '*concordia res parvæ crescunt, discordia magnæ dilabuntur.*'"

I. Concerning the originality of that immortal discovery, which places Harvey in the limited class represented by Aristotle and Archimedes, Copernicus, Newton, and Darwin, it is sufficient to bear in mind the following considerations:—

1st. If Harvey's doctrine of the circulation was not new, why was it opposed by men in the position of Riolanus and Hoffmann, and welcomed as a discovery by Bartolinus and Schlegel and Descartes? Surely his contemporaries were better judges of the novelty of his views than we are!

2nd. Admitting that Servetus and Columbus taught the doctrine of the lesser circulation, we need but a moment's thought to convince us that no complete knowledge of this part of the subject was possible until the existence of a systemic circulation was established; for the one is physically impossible without the other.

3rd. The title of Harvey's great work is not, as it is sometimes quoted, "The Circulation of the Blood," but "*De Motu Cordis et Sanguinis.*" He first showed that the flesh, or parenchyma, of the heart is true muscle, that the heart is not a passive chamber receiving the blood, but a contractile organ expelling it. Until the motive power of the heart was understood there *could* be no true theory of the circulation.

The fact is, that when we know the true solution of a problem, it is easy to see or think we see it in any discussion which preceded the discovery; for there is only a limited number of answers to most questions, and therefore true as well as false solutions are almost sure to have been proposed.

In the writings of Columbus, Servetus, and Cæsalpinus, phrases occur which sometimes seem as if the writers were going to state the truth that Harvey first asserted.

But it would be as reasonable to infer, from such passages, that the circulation of the blood was then known, as from the lines that Shakespeare puts into the mouth of Brutus:

> "As dear to me as are the ruddy drops
> That visit my sad heart."

As Paley well said, *he* only *discovers* who *proves.* To hit upon a true conjecture here and there amid a crowd of untrue, and leave it again without appreciation of its importance, is the sign, not of intelligence, but of frivolity. We are told that of the seven wise men of Greece, one (I believe it was Thales) taught that the sun did not go round the earth, but the earth round the sun, and hence it has been said that Thales anticipated Copernicus—a flagrant example of the fallacy in question. A crowd of idle philosophers talking all day long about all things in heaven and earth, must sometimes have hit on a true opinion, if only by accident, but Thales, or whoever broached the heliocentric dogma, had no reason for his belief, and showed himself not more but less reasonable than his companions. The crude theories and gross absurdities of phrenology are not in the least justified, or even excused, by our present knowledge of cerebral localisation; nor do the baseless speculations of Lamarck and Erasmus Darwin entitle them to be regarded as the forerunners of Erasmus Darwin's illustrious grandson. Cuvier was perfectly right in his controversy with Geoffroy St. Hilaire; the weight of evidence was undoubtedly on his side. Up to 1859 impartial and competent men were bound to disbelieve in evolution; after that date, or at least so soon as the facts and arguments of Darwin and Wallace had been published, they were equally bound to believe in it. He discovers who proves, and by this test Harvey is the sole and absolute discoverer of the movements of the heart and of the blood.

Concerning the *methods* used by Harvey they were various, and his discovery, like most great advances in knowledge, was not achieved by one of the happy accidents which figure in story books, or by the single crucial, and never-in-after-ages-except-under-license-and-special-certificate-to-be-repeated, experiment which some members of a certain Royal Commission supposed to be the only kind of experiment needed in scientific inquiries.

A perusal of Harvey's own statements makes it plain, it seems to me, that having gained his knowledge of the anatomy of the heart and of the current hypotheses of its function from his Italian masters, he reasoned thus:—First, that the cardiac valves must be intended for such physiological service as their construction would indicate. He believed that every part of this human microcosm has a meaning; that it is by no chance result of blind forces that an organ is adapted to its end. This great postulate is necessary for scientific progress. If the difficulties of physiology, whether normal or morbid, seem so intricate and insuperable that we are tempted to doubt whether the riddle after all has an answer, we must again and again fall back on the faith of Harvey and of Newton, of Boyle and of Linnæus. The great doctrine of natural selection has thrown wonderful light upon the methods by which the results that we see have been reached, but has not impaired the excellence of those results nor their evidence of beneficent design.

Belief then that the body and all its parts is a machine constructed for certain uses, that everything in Nature has a reason and an end—this was Harvey's postulate when he argued out the functions of the heart and vessels from their anatomical construction.

Harvey's second method was that of actual experiment. On this point he leaves us in no doubt. His second chapter is headed, "*Ex vivorum dissectione qualis sit cordis motus,*" and in the introductory chapter which precedes this, he says:—

"Tandem majori indies et disquisitione et diligentia usus, multa frequenter et varia animalia viva introspiciendo, multis observationibus collatis et rem attigisse et ex hoc labyrintho me extricatum evasisse, simulque motum et usum cordis et arteriarum quæ desiderabam comperta habuere me existimabam."

Many of his vivisections were not strictly speaking experiments, but observations—inspection of the living heart and arteries—others were experiments in the modern and restricted use of the word. These were Harvey's methods, as they must be the methods of all natural science. First, observation; next, reflection; then experiment. "Don't think; try," was Hunter's advice to Jenner; an advice that is often needed by an acute inquiring genius like his; still more often by sheer idleness, that will never bring its fancies to the test of fact.[1]

Experiments without hypotheses are often fruitless, but hypotheses which are never brought to the test of experiment are positively mischievous.

How far have the Fellows of this College obeyed Harvey's precept and followed his example in "searching out the secrets of nature by way of experiment." We must, I fear, confess that after the brilliant period of the seventeenth century (in some respects the greatest of our history and certainly the most fruitful in great men) experimental science made slow and uncertain progress, so that between Harvey and Newton, Hook and Grew, Mayow and Boyle on the one hand, and Cavendish, Black and Priestley, Hunter and Hewson on the other, there was a long period of stagnation or even retrogression. Hypotheses and dogmas, misapplied mathematics, imperfect chemistry, and an affected literary style (made more conventional by the practice of writing in a foreign language better fitted for rhetoric than science) contributed to make the eighteenth century comparatively barren, in so far as science generally, and physiology and medicine in particular, are concerned.

The "way of experiment," in the strict sense of the word, has been hitherto most successfully applied to normal physiology. The successors of Harvey were not Sydenham, Radcliffe, Arbuthnot, Garth, Meade, Freind and Heberden, but Lower, Mayow, Hales, Vierordt, Ludwig and Chauveau. *Pathology* as an experimental science is still in its infancy, but the infancy is that of Hercules, and bids fair to strangle such dire pests as anthrax, cholera, tetanus and hydrophobia.

Before quitting this part of my subject, I would fain correct a popular misconception that Harvey was a neglected genius—that his contemporaries, his professional brethren, and in particular this ancient College, refused to listen to his new notions, ridiculed his discoveries, and spoiled his practice. Whether as his fame grew his practice diminished, we cannot tell. If so, his patients were the losers. What Harvey and every honest man cares for, is not popular applause, but the confidence and esteem of his comrades; and this he deserved and received. It was as lecturer at this College that he propounded

[1] Ea autem vera esse vel falsa. Sensus nos facere debet certiores, non Ratio; αὐτοψια non mentis agitatio. Second Epistle to Riolanus, p. 133. (College edition).

his discoveries; it was here that he found his disciples and his friends. Here he was urged to take the presidential chair; and here his statue was erected, five years before his death, with the inscription, "*Viro monumentis suis immortali.*" It would have been a poor compliment to his elaborate demonstrations, and unworthy of a liberal profession, if so startling a revolution as Harvey proposed had been accepted without inquiry. It was considered, it was discussed, and, without haste but without timidity, it was at last accepted—the very way in which Darwin's theory was received and criticised, and finally adopted by Lyell and by Hooker. Let then no scientific impostor or medical charlatan quote Harvey to console him under merited censure.

II. Of Harvey's writings, the second, and by far the longer treatise, is that upon Generation. This formed the subject of a valuable criticism in the Harveian Lecture by the late Sir Arthur Farre. It is full of interest and contains many observations that remain true for all times, many acute criticisms, and a few broad and true generalisations, such as the famous dictum — "*Omnia animalia ex ovo progigni.*" Perhaps, however, what most strikes the reader of this treatise is the *learning* of the writer. He is familiar with his Aristotle, and quotes from Fabricius and other writers with much greater freedom than in the succinct and almost sententious treatise, "*De Motu Cordis et Sanguinis.*" Some would have us believe that here, as in other cases, erudition was a clog upon genius. This question has been often discussed, and it has even been maintained that he is most likely to search out "the secrets of Nature by way of experiment" who comes fresh to the task with his faculties unexhausted by prolonged reading, and his judgment uninfluenced by the discoveries of others. This, however, is surely a delusion. Harvey could not have discovered the circulation of the blood had he not been taught all that was previously known of anatomy. True, no progress can be made by mere assimilation of previous knowledge. There must be intelligent curiosity, an observant eye, and intellectual insight.

"Doctrina sed vim promovet insitam,"

and few things are more deplorable than to see talent and industry occupied in fruitless researches, partially rediscovering what is already fully known, or stubbornly toiling along a road which has long ago been known to lead nowhither, We must then instruct our students to the utmost of our power. Whether they will add to knowledge we cannot tell, but at least they shall not hinder its growth by their ignorance. The strong intellect will absorb and digest all that we put before it, and will be the better fitted for independent research. The less powerful will at least be kept from false discoveries, and will form (what genius itself requires) a competent and appreciative audience. Even the dullest scholars will be respectable from their learning, and if they cannot make discoveries themselves, can at least enjoy the delight of intelligently admiring the discoveries of others.

III. There is, however, a third phase of Harvey's intellectual work of which, unfortunately, the records have for the most part perished, and which has not, perhaps, been duly appreciated. What I believe Harvey contributed, or would, but for adverse fate, have contributed to medicine as distinct from physiology, was a systematic study of morbid anatomy. In the following passage he speaks of the great benefit that would ensue from the regular observation of the structural changes produced by disease:—

"Sicut enim sanorum et boni habitûs corporum dissectio plurimum ad philosophiam et rectam physiologiam facit, ita corporum morbosorum et cachecticorum inspectio potissimum ad pathologiam philosophicam."

Now this was a new notion. It was not uncommon for the body to be opened after death, especially in the case of great personages, either for the purpose of embalming or for discovering (as it was supposed) the fact of poison or other foul play; and occasionally a physician would obtain permission for a like inspection when something unusual in the symptoms had excited a laudable curiosity to ascertain their cause. But the records of such inspections in the seventeenth century by Bartolinus, or Tulpius, or Bonetus, or, in our own country, by Mayerne, or Bate, or Morton, are fragmentary, their object being limited to the individual case. There was no attempt to search out the secrets of nature in disease by a systematic observation of the state of the organs after death, nor was there for more than a century after Harvey's death. Morgagni in Italy; the French anatomists of the early part of this century, Corvisart and Laennec, Broussais and Cruveilhier; in Germany Meckel and Rokitansky, and in England Baillie, Abercrombie, Carswell and Bright—these were the founders of scientific pathology on a sure anatomical basis almost within living memory.

Not only had Harvey the prescience to recommend the study of morbid anatomy for itself, but he had himself carried it out by recording a large number of dissections, or, as we should now call them, inspections, of diseased bodies. Unfortunately most of these post-mortem reports, with his observations on the generation of insects, and other manuscripts were destroyed, or irrevocably dispersed, when his house in London was searched while he was with the King at Oxford. If the records of these inspections had been published, may we not asssume that Harvey's great authority would have set the fashion, and that the systematic study of morbid anatomy would have begun a century and a half earlier than it did? And think what this would have meant. With the exception of a few shrewd observations, a few admirable descriptions, and here and there a brilliant discovery, such as the origin and prevention of lead colic and of scurvy and the introduction of vaccination, it may be said that medicine made no important progress between the time of Harvey and that of Laennec. The very notion of diagnosis in our modern sense of the word depends upon morbid anatomy. The older physicians seldom attempted to determine the seat of an ailment. Disease was looked upon not as a condition depending upon disordered physiological functions, but as something external, attacking a previously healthy person, disturbing, and, if not expelled by art, finally destroying him; while any structural changes which were found after death were regarded rather as the effects than the causes of the symptoms during life.

Now, the ambition of every intelligent student—and in medicine we are life-long students—is to fix upon the most objective, certain, and important of the symptoms of a patient, to follow out this clue, to determine the organ affected and the nature of the affection, so that in his mind's eye the tissues become transparent and he sees the narrow orifice for the blood-stream and the labouring muscle behind it; or the constricted loop of intestine with violent peristalsis above and paralysis below, the blood-current stopped and congestion passing hour by hour into gangrene; or, the spinal cord with grey induration of a definite region, and the motors, sensory and trophic changes which physiologically ensue.

Sometimes this minute search to fix upon the locality and exact nature of a lesion has been ridiculed; and we are asked what benefit to the patient such knowledge when attained can bring. We answer, that in medicine, as in every other practical art, progress depends upon knowledge, and knowledge must be pursued for its own sake, without continually looking about for its practical application.

Harvey's great discovery (which we physicians rightly celebrate this day) was a strictly *physiological* discovery, and had little influence upon the healing art until the invention of auscultation. So also Dubois Reymond's investigation of the electrical properties of muscle and nerve was purely scientific, but we use the results thus obtained every day in the diagnosis of disease, in its successful treatment, and in the scarcely less important demonstration of the falsehoods by which the name of electricity is misused for purposes of gain.

It is true that Bernard's discoveries of the diabetic puncture and of the digestive function of the pancreas have not yet received their practical application. He was right when he said, "*Nous venons les mains vides, mais la bouche pleine d'esperances légitimes*"—but he should have spoken for himself alone.

The experiments on blood-pressure begun by Hales, and carried to a successful issue in our own time by Ludwig, have already led to knowledge which we use every day by the bedside, and which only needs the discovery of a better method of measuring blood-pressure during life, to become one of our foremost and most practical aids in treatment.

Again, we can most of us remember using very imperfect physiological knowledge to fix, more or less successfully, the locality of an organic lesion in the brain. I also remember such attempts being described as a mere scientific game, which could only be won after the player was beaten, since when the accuracy of diagnosis was established, its object was already lost; but who would say this now, when purely physiological research and purely diagnostic success have led to one of the most brilliant achievements of practical medicine, the operative treatment of organic diseases of the brain?

It has often been questioned whether the study of morbid anatomy has not withdrawn attention from morbid physiology; and, again, whether the time employed upon pathological researches would not have been better spent in directly therapeutical inquiry. To both these questions I take leave to answer, No. Anatomy must precede physiology, whether in the normal or the diseased state. The humoral physiology of the ancients did infinite mischief (mischief not yet exhausted), because it lacked the sound basis of anatomy; and experimental pathology, necessary and important as it is, and valuable as even its first endeavours have proved, was impossible without previous knowledge of the anatomy and histology of disease. As to therapeutics, I hold that for the successful cure of a patient it is far better that his physician should have a thorough and extensive knowledge of morbid anatomy, than that he should be acquainted with all the baths and waters, the hotels and lodging-houses throughout the world, or familiar with the barbarous names and pretended virtues of all the advertised nostrums that deface the fair English fields from London to Oxford. The public suppose that it is *their* business to know what is the matter, and the doctor's to find the remedy; if so, our art would be confined to learning the name of the patient's disorder by letter, post-card, or telegram, and looking up in an index of remedies the twenty or thirty drugs which are "good" for that particular complaint. *We* know that the real difficulty is to ascertain the nature and origin of our patient's disorder; when that is done, the treatment in most cases is obvious, and in many effectual; when it is not done, our treatment is vacillating, and either futile or mischievous. We have already ample means at our disposal for influencing almost every organ of the body. A new tool is occasionally offered us which deserves proving, but what we want far more is knowledge how to use the tools that we have. Treatment without diagnosis, besides its inefficiency, brings us for the time unpleasantly near to the charlatan who, whatever title he may assume, is always therapeutical and never pathological. Rational, bold, and effectual treatment, whether preventive or curative, must always depend upon accurate diagnosis and sound pathology, and the power of diagnosis depends upon that systematic inspection of the bodies of diseased persons which was recommended and practised by Harvey.

"Ad hanc inspectionem, cum Heraclito apud Aristotelem, in casam furnariam (sic dicam) introire si vultis, accedite: nam neque hic Dii desunt immortales. Maximusque omnipotens Pater in minimis et conspectior vilioribus quandoque est."

Suffer me, then, Mr. President and Fellows of this College, to obey the instructions of the founder of this lecture, by exhorting my hearers, and especially those Fellows who are junior to myself, to emulate, according to the varied talents entrusted to each, the example of Harvey in these three particulars:—

(1) In investigation by experiment, whether by pathology or physiology.

We have now difficulties unknown to Harvey in carrying out this duty, for duty it certainly is, incumbent upon all who have the opportunity and the necessary training. The countless experiments on living animals which were carried out during the 17th century in all civilised countries—in Italy, Holland, Denmark, France, Germany, and England—bore a rich fruit of physiological knowledge. If the anatomy of the human body was thoroughly ascertained by the great men of the 16th century, by Vesalius, Sylvius, and their successors, it is no less true that to the 17th century is due the discovery of the elements of physiology. The action of the heart and the circulation of the blood, the absorption of chyle by the lacteals and thoracic duct, the mechanism of respiration and some knowledge of its chemical effects, the function of secretion by glands, the minute structure of the eye and ear, and of the reproductive apparatus, and a knowledge—imperfect, but true as far as it went—of the functions of the brain and nerves, these were the achievements of the 17th century due to Harvey, Glisson, Willis, and Mayow, among our own countrymen, and to Pecquet, Malpighi, Leuwenhoeck, De Graaf, Swammerdam, Aselli, Redi, and Bartolinus. In all this brilliant advance of knowledge, experiment upon the lower animals was the method used, and the method is as indispensable now.

Anyone conversant with a single branch of natural science is aware that experiment, as well as observation, is necessary. Who would expect discoveries in physics, or in chemistry, without laboratories and experiments? Do not botanists investigate the functions of plants by dissection, by microscopic and chemical investigation, and by *experiment?* Have we not this very year celebrated the important results of fifty years' *experimental* researches into the life and growth of plants by Lawes and Gilbert? And is it not obvious that the same necessary well-tried and indispensable method of inquiry must be continued in the case of animals? Happily the same experimental science has discovered the means of abolishing the tribute of suffering which the brute creation paid in the hands of Harvey and Hales, of Haller, Magendie, and Sir Charles Bell. By means of chloroform and other anæsthetics, and by means of the antiseptic methods which we owe to Sir Joseph Lister, the subjects of experiment are spared the pain and shock of an operation, and the pain which used to follow an operation. In fact, almost the only experiments upon the lower animals which involve distress are those which are most immediately and directly useful to ourselves and to them; inoculations, namely, with a view to reproduce diseases, and the direct therapeutical testing of drugs. Cruelty is utterly repugnant to our calling; and it seems absurd that men, who will with just confidence entrust themselves and the lives of those nearest to them to our protection and care, should yet so far distrust us as to shackle attempts to improve our knowledge and our power by cumbersome and ridiculous restrictions. Let us hope that on the one hand increasing humanity and gentler manners will extend compassion for the lowest of God's creatures from the educated classes of England and America until it permeates all ranks and all nations; and that on the other full liberty will be given to the prosecution of researches, laborious and thankless in themselves, but of the utmost value for the relief and prevention of disease in man and brute alike. May I also express a hope that those who administer our laws will take heart of grace, and in this, as in other matters, try whether Englishmen do not prefer the conscientious maintenance of a statesman's own judgment before a time-serving submission to ignorant clamour.

(2) In the second place, I would exhort my brethren, and especially the members of this College, to cultivate learning. Harvey went to study in Italy, then the nursery of science as well as of art, and he was familiar with the writings of Plato and Aristotle and Virgil, as well as with those of his immediate predecessors, Fabricius and Columbus. So in that golden time which comes to most of us, between taking the academical degree and becoming immersed in the daily duties of hospital life, I strongly advise a visit to one of the German universities, or to Paris, to acquire the key to the two languages in which the best modern books are written; and to widen the mind by seeing the aspect of science and affairs from a continental standpoint. It is lamentable that there is so little professional intercourse between the students of one of our London schools and the teachers of another. The laudable energy which has made each of them complete, and well-equipped colleges has had this drawback, that at the present day the attention of a diligent student is more confined to the teaching and practice of his own school than it was sixty or seventy years ago.[1] The narrowness and prejudice bred by this isolation may be corrected by a visit to the famous sister universities of Edinburgh or Dublin; for their complete removal no prescription is so efficient as a prolonged stay in continental laboratories and hospitals. But even such a broad and liberal education, even familiarity with the daily advances of medical science recorded in periodicals and archives and year-books, or transmitted by telegraph to the wondering readers of the daily newspapers, is not all that is needful to make a learned physician. We know well the difference between reading of an experiment, or even seeing it performed, and doing it with our own hands. We know the difference between studying a pathological atlas, or even a cabinet of histological slides, and seeing and handling morbid tissues and making sections for oneself. So also is there all the difference between learning the present conclusions as they stand recorded in the

[1] Let us hope that the University of London when reconstituted by the labours of the Royal Commission, which is now preparing its report to the Crown, may provide by the regulations of its medical faculty for more community of teaching and learning among students of medicine in this city.

last edition of a text-book or compendium and tracing the steps by which our present knowledge has been reached.

With regard, for instance, to the physiology of the circulation, it is not only curious but instructive to follow its gradual growth from Galen and Vesalius, Columbus, Cæsalpinus, and Servetus, to Harvey and Lower and Malpighi, to Hales and Vierordt, to Ludwig, and Chauveau, and Gaskell, and Roy. The only true scientific method is the historical one. If we only know the results of a science without the steps by which they have been reached, we have indeed its practical use, but lose half its educational value. We are almost in the position of an engineer who knows the conclusions of trigonometry by rote, but is ignorant of the demonstration. I would therefore urge upon junior Fellows, while still enjoying the prospect rather than the fruition of professional success, to spare some of the time which is unoccupied by work in wards and laboratories for the perusal of such antiquated works as have been published as much as twenty years ago, and particularly for gaining acquaintance at first hand with classics like Virchow's "Cellular Pathology," and the lectures of Watson, Trousseau, and Stokes; or, if their time and inclination does not allow of more extended researches, at least to read such succinct masterpieces as Laennec's "Mediate Auscultation," Heberden's "Commentaries," Sydenham's "Treatise on Gout," and Harvey "On the Movement of the Heart and of the Blood."

(3) I would, moreover, exhort Fellows of the College to see that, while all the new methods of experimental pathology and pharmacology are carried out by duly trained physiologists, we do not neglect the fundamental method taught and practised by Harvey of inspecting the bodies of those who have died of disease. It was this union of morbid anatomy with clinical observation which made the discoveries of Laennec and of Bright really fruitful. Without these autopsies, clinical medicine is but an empirical art, diagnosis a sham, and treatment little better than quackery. Exclusive attention to therapeutics is apt to bring a man dangerously near to homœopathy and other pretended systems of treatment, but sound pathology, and diagnosis controlled by *post-mortem* inspection, give positive knowledge and that union of modest self-confidence and prudent enterprise which become the physician.

Lastly, I have to fulfil the duty of exhorting the Fellows of this ancient College "to continue in mutual love and affection" among ourselves; and this is the easiest task of all. For, if we must admit that experimental science in England, and particularly scientific pathology, is not surpassing our byegone achievements as it ought to surpass them, considering the increased number of competent labourers and the vastly improved methods of research; and if we admit that the crowd of modern literature, and the distractions which we fondly imagine to be peculiar to our generation, leave small opportunity for the cultivation of ancient learning; and if the prejudices of our patients, both gentle and simple, still make post-mortem inspections less common and systematic than they should be—whatever, I say, may be our shortcomings in these or in other respects—your Harveian orator may most honestly congratulate the College and the profession upon the concord and mutual esteem which has happily marked our history from the days of Linacre to those of Harvey, from the days of Arbuthnot and Garth to those of Meade and Freind, from the days of Fothergill and Heberden to those of Matthew Baillie, of Babington, and of Sir Thomas Watson. Long may this continue, for thereon depend not only the dignity and peace of our profession, but in great measure our power of doing good. However ignorantly our patients will sometimes decry what they call professional etiquette, the wiser among them know (and in the long run the wise lead the foolish) that this term really means the observance of the rules which distinguish a profession from a trade, which make our calling honourable as well as honest, which check the arts of advertisement and direct our ambition to obtaining the suffrages, not of the public which *cannot*, but of our profession which *can*, judge truly—rules of conduct which are, in fact, nothing but the carrying into daily practice of the golden rule to do to others as we would they should do to us. For maintaining and strengthening this spirit of concord and good feeling, we depend upon each one of our Fellows, but especially on the example and authority of our Head—an example and authority which, as the College well knows, are worthily maintained by the untiring devotion to its best interests of our honoured President.

THE EFFECT OF WATER VAPOUR ON ELECTRICAL DISCHARGES.

A VERY interesting paper by Prof. J. J. Thomson, on the effects of electrification and chemical action on a steam jet, and of water vapour on the discharge of electricity through gases, appears in the October number of the *Philosophical Magazine*. In it the author first considers the effect of an electrical field on the surface tension of a water drop, and he shows that if the electrical field is uniform, the diminution in the surface tension is very small and independent of the size of the drop; so that a uniform field will not be able to counterbalance the effect of surface tension, since the latter varies inversely as the radius of the drop, and therefore when the drop is excessively small must be greater than the constant effect due to the electric field. When, however, the electric field instead of being uniform is due to a number of charged atoms distributed throughout the volume occupied by the steam, the effect of the electric field in diminishing the surface tension varies inversely as the square of the radius of the drop. Thus for very small drops the electrification will overpower the cause (surface tension) which, under ordinary circumstances, puts an end to the existence of small drops. The above seems capable of explaining the effects of electrification on a steam jet first observed by Helmholtz, for the electricity which escapes into the gas is carried by charged atoms of the gas, and since in the region immediately around these atoms there will be a very intense electric field there will be a tendency for the steam to condense into drops in these regions. Helmholtz also discovered that chemical action in the neighbourhood of the jet affected it in much the same way as a discharge of electricity. If the forces which hold the atoms together in a molecule are electrical in their origin, so that in a diatomic molecule one atom has a positive and the other an equal negative charge, the above explanation will also apply to this case. For when the molecule of the gas is in the ordinary state, the equal and opposite charges of the atoms will, in the region outside the molecule, neutralise each other's effect, so that the electrical field round a molecule will be much less intense than that round a single charged atom, and thus, though the field round the latter may be sufficient to cause condensation, that round the molecule may not. When, however, the molecules which enter into chemical combination come together and form a new compound, requiring a rearrangement of the atoms, then while the chemical change is going on, there will be an interval during which the atoms are comparatively free, and there will be an electric field almost as strong as if the atom were dissociated.

The author also considers the effect of moisture in promoting chemical action, for if the forces which hold the atoms in the molecule together are electrical in their origin it is evident that these forces will be very much diminished when the molecule is near the surface of, or surrounded by, a conductor or a substance like water having a high specific inductive capacity. Thus if A and B represent two atoms in a molecule placed near a conducting sphere, then the effect of the electricity induced on the sphere by A will be represented by an opposite charge placed at the image of A in the sphere. If A is very near the sphere, this opposite charge will be very nearly equal to that at A. Thus the effect of the sphere will be to practically neutralise the electrical effects of A, and as one of these effects is to hold the atom B in combination, the affinity between the atoms A and B will be almost entirely annulled by the presence of the sphere. Molecules condensed on the surface of a drop of water or surrounded by water will thus be practically dissociated, or at any rate the forces between their component atoms will be much reduced. Since water vapour produces so great an effect on chemical combination, it is interesting to investigate whether its presence has any considerable influence on the passage of electricity through gases, since there is strong evidence that this phenomenon is closely connected with chemical changes taking place in the gas through which the discharge takes place. Observations were made on dry and damp hydrogen, and show that there is a marked difference both in the appearance of the spark and in the proportion between the potential difference necessary to produce the first spark through the gas, and that which is sufficient to cause one to follow it immediately afterwards. In the damp gas this difference was comparatively small, averaging about ten per cent. In the dry gas, however, this effect attains quite abnormal proportions, the potential difference required to produce the first spark being often more than twice that required to maintain it when once started. These experiments show that the behaviour of a gas with reference to the passage of an electric spark is analogous to that of a vapour condensing to a liquid, the freezing of a liquid, or the deposition of crystals from a saturated solution. For in the case of a gas which contains a foreign substance (water vapour) the potential difference which the gas can support without a spark passing is approximately steady, but when the gas is carefully dried it can support an abnormally large potential difference, though when once the discharge has started the potential difference at once falls to its normal value. The passage of the spark producing a supply of modified gas which persists for some time after the discharge has stopped.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The opening of the new department of Human Anatomy was the occasion of some ceremony on Saturday afternoon. The Vice-Chancellor presided at a large gathering of scientific and medical men, including some distinguished visitors from the leading medical schools and universities. After speeches from Sir William Turner, Mr. Arthur Thomson, Sir Henry Acland, and Prof. MacAlister, the Vice-Chancellor declared the buildings open, and the proceedings closed with a vote of thanks to the Vice-Chancellor, moved by Prof. Burdon Sanderson.

The lectures and practical courses in the Natural Science Department are as follows for the current term:—In Physics, Prof. Clifton lectures on Electricity, and gives practical instruction with the assistance of Mr. J. Walker and Mr. S. A. F. White. Mr. R. E. Baynes, lectures at Christ Church on Heat and Light, and Sir John Conroy and Mr. F. J. Smith lecture at Balliol and at Trinity College, respectively, on Elementary Physics and on Mechanics and Physics.

In Chemistry, Prof. Odling lectures on Organic Chemistry, and Mr. W. W. Fisher, on Inorganic Chemistry. Other lectures and practical instruction are given by Mr. J. Watts, Mr. V. H. Veley, Mr. J. E. Marsh, and Mr. J. A. Gardner. Mr. Vernon Harcourt and Mr. P. Elford lecture at Christ Church and St. John's respectively. Prof. A. H. Green lectures on Geology in the Museum on Mondays, Wednesdays, and Fridays.

Prof. Ray Lankester lectures three days a week on the Comparative Anatomy of the Vertebrata, and Dr. W. B. Benham and Mr. G. C. Bourne give other lectures in the Linacre Professor's Department. Mr. J. Barclay Thompson lectures on the Osteology of Fish and Amphibia; and the Hope Professor of Zoology, on Means of Defence in the Struggle for Existence.

In Physiology, lectures and practical instruction in the subjects for the Final Honour Examination are given by Prof. Burdon Sanderson, Mr. J. S. Haldane, and Mr. M. S. Pembrey.

Prof. S. H. Vines gives advanced and elementary courses on Botany at the Botanical Gardens.

In Anthropology, lectures are announced by Dr. E. B. Tylor, by Mr. H. Balfour, and by Mr. Arthur Thomson.

It is announced that the examination for a Biological Fellowship at Merton College will commence on November 14.

Examinations for Natural Science Scholarships and Exhibitions at Balliol, Christ Church, and Trinity, are announced to begin on November 21.

CAMBRIDGE.—The Vice-Chancellor gives notice that Mr. H. Yule Oldham, University Lecturer in Geography, will deliver an inaugural lecture on the progress of geographical discovery, in the large lecture theatre of the chemical laboratory, on Tuesday, October 24, at noon.

During the Michaelmas and Lent terms, Mr. Oldham will give courses of lectures on the principles of physical geography, in the same theatre, on Thursdays, at noon, beginning on October 26.

The Council of the Royal Geographical Society offer to award during the present academical year an exhibition of £100 to be spent in geographical investigation (physical or historical) of some district approved by the Council, to a member of the University of not more than eight years' standing, who shall have during his residence attended the courses of the lectures in geography. Further particulars will be announced.

The office of Director of the Fitzwilliam Museum is vacant by the resignation of Dr. Middleton. A new Director will be appointed on Friday, November 17. The stipend is £300 a year. Candidates are to send their names to the Vice-Chancellor by Friday, November 10.

The Walsingham Medal, founded by the High Steward of the University, will be offered during the present academical year for the best monograph or essay giving evidence of original research in any subject connected with biology or geology. Essays are to be sent to Prof. Newton by October 1, 1894.

There are this year 132 freshmen who have indicated their intention of studying medicine in the University.

Entrance Scholarships in Natural Science have been awarded at Christ's College to A.V. Cunnington (£60), Clifton College, and J. Hart-Smith (£30), Berkhampstead School; and at Emmanuel College to W. F. A. Ermen (£50), Clifton College, and R. G. K. Lempfert (£50), Manchester Grammar School. At Downing College an Examination for Minor Scholarships (£50) in Natural Science will be held on April 17, 1894. At St. John's the Examination for Natural Science Scholarships (£80 and under) and Exhibitions (£50 and under) will begin on December 5, 1893.

THE United States Bureau of Education has published a remarkable "Circular of Information," by Dr. Arthur Macdonald, entitled "Abnormal Man." The volume includes essays on education and crime and related subjects, with digests of literature and an extensive bibliography. With regard to the effect of education on crime a statistical investigation shows that in France and Italy there has been an increase of both education and crime. Germany shows an increase of habitual criminality and a general increase of both university education and crime. As far as statistics are accessible, Austria shows an increase in education and a decrease in crime. Also, while there has been a decrease in the number of convictions for crime from 1881 to 1887 in Norway and Sweden, there has been an increase in education. But in Norway alone for the year 1888–89 there was an increase in the number of crimes. In England, Scotland, and Ireland all statistics are in accord in showing an increase in education and a decrease in crime from 1885–1890. Japan and Saxony also exhibit an increase in education and a decrease in the number of convictions. It thus appears that while some countries show an increase in both education and crime, yet not a few, and some of the most developed nations, show an increase of education and a decrease of crime. The statistics, therefore, fail to show the exact relation between education and crime.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xv. No. 3. (Baltimore, 1893).—On groups whose orders are products of three prime factors, by F. N. Cole and J. W. Glover (pp. 191–220). In this paper the authors fully determine the groups for three prime factors, equal or unequal. Those of order pq and p^2 are known from Netto.—The nature and effect of singularities of plane algebraic curves, by Miss Scott (pp. 221–243) is a continuation of the paper in vol. xiv. In the earlier memoir the method employed was stated to be directly applicable, in general, to the determination only of the joint components of the singularity; in this the restriction is removed, and it is shown that the process enables one, in every case, to enumerate the double lines (double tangents and inflexional tangents) involved in the singularity.—The elliptic irregularities in the lunar theory, by E. W. Brown (pp. 244–263), gives a general solution in series of the problem: a system of three bodies is in motion in one plane, the first is revolving about the second, and is disturbed from its elliptic orbit by the third. The third body is supposed to be of infinite mass, and to be moving in a circle of infinite radius with a finite angular velocity. Given the relative positions of the three bodies at any one time, to find their relative positions at any other time. The differential equations used at the outset are given in Dr. Hill's paper (vol. i.) and M. Poincaré's researches (*Acta Math.* vol. xiii.) afford considerable help in the work.—On the transformation of linear differential equations of the second order with linear coefficients, by Oskar Bolza (pp.

264–273), is a fresh treatment of the problem by methods of the theory of invariants.—On certain properties of symmetric, skew-symmetric, and orthogonal matrices, by W. H. Metzler (pp. 274–282) proves in another way properties of these matrices which have been obtained by Dr. Taber (*L. Math. S. Proc.* vol. xxii.), and Mr. Buchheim (*Messr. of Math.* vol. xiv.). The number closes with a deduction and demonstration of Taylor's formula, by W. H. Echols (pp. 283–4).

Symons's Monthly Meteorological Magazine for September contains an interesting climatological table for seventeen selected stations in the British Empire, for the year 1892. This valuable summary has now been published for several years, and corresponding monthly tables with remarks have been also regularly printed since July, 1881. The highest temperature in the shade was 110°·8 at Adelaide on January 20. This station also recorded the highest temperature in the sun, and had the lowest mean humidity. The lowest shade temperature was -44°·4 at Winnipeg, on January 18; this station had also the greatest yearly and daily range, and the lowest mean temperature. The dampest and most cloudy station was Esquimalt. The greatest rainfall was 95·1 inches at Bombay, and the least, 21·3 inches at Jamaica. Attention is again drawn to the fact that the Australian stations record higher temperatures both in shade and in sun than occur at the East Indian stations. A table is given of the absolute maximum temperature in shade and sun for each of the ten years 1883–92, at Adelaide and Calcutta, and shows an average excess at Adelaide of 5°·2 in shade, and 6°·4 in sun; but the heat is more prolonged in India, and in the hottest months the average maxima in the shade are always higher at Calcutta.

Wiedemann's Annalen der Physik und Chemie, No. 9.—Luminous phenomena in vessels filled with rarefied gas under the influence of rapidly alternating electric fields, by H. Ebert and E. Wiedemann. Gas vessels without electrodes were placed between the condenser plates of a Lecher wire combination. The luminous phenomena were investigated and discussed from the point of view of tubes of electric force undergoing displacement. It was shown that the portion of energy dissipated by radiation is perfectly commensurable with that occurring in the field generally. The glowing of a gas is therefore a sufficient cause for diminution of pressure in tubes of force, and hence for the displacement of tubes in the field, leading to a dissipation of the energy contained in them. Experiments were also made with tubes fitted with electrodes, one or both of which were attached to an end of the Lecher system. It was shown that any metal plate in contact with a rarefied gas and exposed to slightly damped electric oscillations, shows all the phenomena of a kathode. Also, that at every wall suitably crossing a gaseous space filled with electric oscillations a kathode is produced.—Vapour pressures of aqueous solutions at 0° C. by C. Dieterici.—Thermo-electric studies, by E. Englisch.—Concerning the physical interpretation of thermo-electricity, by F. Braun.—Density of dilute aqueous solutions, by F. Kohlrausch and W. Hallwachs.—Solubility of some "insoluble" bodies in water, determined by the electric conductivity of the solutions, by F. Kohlrausch and F. Rose. The determination of small quantities of "insoluble" substances in a large amount of water is subject to many experimental errors due to the necessity of evaporating large quantities of water at the boiling point, whereby the solubility of the material of the dish becomes a disturbing factor. As the laws governing the relation between concentration and electric conductivity are fairly well known, it is possible to arrive at an estimate of minute quantities of dissolved matter by a determination of the electric conductivity of the solution. This method has proved to be very simple, expeditious, and accurate.—On heat generated by dielectric polarisation, by A. Kleiner.—Experiments on the generation of electricity by small drops, by A. L. Holz. A jet of mercury was projected upon an amalgamated copper plate, whence it rebounded in small globules on to a glass plate, and thence to the electrometer. The increase of potential was found to be proportional to the sectional area of the jet, the pressure and height of fall of the mercury, and the size of the saturated glass plate.—Dielectric constants of liquid bodies as dependent upon temperature and the Mossotti-Clausius formula, by A. Franke.—Experiments on the interference of electric waves in air, by I. Klemencic and P. Czermak.—Notice on secondary heatings of galvanic cells, by H. Jahn.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 4.—Henry John Elwes, President, in the chair.—Mr. F. Merrifield exhibited specimens showing the effects of temperature in the pupal stage on several species of Lepidoptera. *Vanessa polychloros* was much darkened, especially towards the hinder margin, by a low temperature. *Vanessa c-album* showed effects on both sides, especially in the female; they were striking on the under side. Some *Vanessa io* showed the gradual disintegration, by exposure to a low temperature, of the ocellus on the fore wing, which in the extreme specimens ceased to be an ocellus, and was a remarkable confirmation of Dr. Dixey's views of the origin of that ocellus, as exemplified in the plate attached to his paper in the Entomological Society's Transactions for 1890. Mr. Goss stated that in his experience of *V. c-album* in Northamptonshire, Gloucestershire, Herefordshire, and Monmouthshire, the form with the pale under side was the first brood, occurring in June and July; and that the specimens of the second brood, occurring from the end of July to October, were invariably dark on the under side.—Mr. A. H. Jones exhibited Lepidoptera collected in Corsica in June last, including dark forms of *Polyommatus phlæas*, *Lycæna astrarche*, in which the orange marginal band is very brilliant on upper and under sides of both wings, *Lycæna argus*, the females of which are much suffused with blue, probably var. *calliopis*: a series of *Vanessa urticæ* var. *ichnusa*, bred from larvæ, *Argynnis elisa*, *Satyrus semele* var. *aristæus*, *Satyrus neomiris*, *Cœnonympha corrina*, both spring and summer brood, and many others.—Mr. G. C. Champion exhibited for Mr. G. A. J. Rothney, a number of *Methoca ichneumonoides*, Latr. (female), taken at Bexhill, Sussex, showing great variation from the usual large black and red form.—Dr. D. Sharp, F.R.S., exhibited a pupa of *Galleria melonella*, on which the eggs of a parasitic Hymenopteron had been deposited while the insect was in the cocoon. He also exhibited the hitherto unique *Asprostoma planifrons*, Westw.—Mr. J. J. Walker exhibited specimens of the following species, viz. *Halobates sericeus*, from the Pacific; *H. sobrinus*, and *H. wüllerstorffi*, from Marquesas Islands; *H. princeps*, from the China Sea; and a female of *H. wüllerstorffi*, with ova attached.—Mr. W. H. B. Fletcher showed a variable series of 75 specimens of *Cymatophora or*, bred in 1893 from larvæ from Sutherland, a series of about 40 *C. ocularis* bred-in from stock from Oundle; also a series of 33 moths, all females, supposed to be hybrids between *C. ocularis* male and *C. or* female, from the above stock in each case, bred as a second brood in August and September, 1893. He stated that he placed the reputed parents in a muslin sleeve on a branch of *Populus nigra*, and did not open the sleeve until the resulting larvæ required fresh food. The supposed hybrids resembled the female parent, except that both orbicular and reniform stigmata were very conspicuous, being pure white filled up slightly with black.—Mr. F. J. Hanbury exhibited a specimen of *Leucania vitellina*, taken at Brockenhurst on August 24, 1893, and another taken at Freshwater, Isle of Wight, on September 7; also an extraordinary *Gonepteryx rhamni*, showing red blotches at the tips of the fore wings, taken at Walthamstow, Essex.—Mr. C. G. Barrett exhibited a gynandrous *Argynnis paphia* recently taken in the New Forest by Mr. Cardew.—Mr. J. M. Adye exhibited a specimen of *Deilephila livornica* recently caught at Christchurch, Hants.—Mr. Elwes exhibited and described two species of the genus *Œneis* (*Chionobas*, Bdv.) *Œ. beani* and *Œ. alberta*, from North America, which had not been previously described, and stated that he had prepared a revision of this very difficult genus, which would be read at the November meeting.—Mr. Osbert Salvin, F.R.S., exhibited a new genus and species of Papilionidæ (*Baronia brevicornis*). He also communicated a paper entitled "Description of a new genus and species of Papilionidæ from Mexico."—Dr. Sharp read a paper entitled "On the Cost and Value of Insect Collections." Mr. W. F. H. Blandford, Mr. McLachlan, F.R.S., Mr. Jacoby, Mr. Waterhouse, and the President took part in the discussion which ensued.—Prof. Auguste Forel communicated a paper entitled "Formicides de St. Vincent, récoltées par Mons. H. H. Smith."—Mr. Blandford read a paper entitled "Description of a New Subfamily of the Scolytidæ." The President, Mr. Jacoby, and Mr. Waterhouse took part in the discussion which ensued.

PARIS.

Academy of Sciences, October 9.—M. Lœwy in the chair.—On the theory of pyro-electricity and piezo-electricity, by Lord Kelvin.—On a class of new transcendentals, by M. Emile Picard.—Theorem on triple orthogonal systems, by M. Lucien Lévy.—Circles or spheres derived from a plane or solid envelope of any class, by M. Paul Serret.—On the aperture fringes, in the experiment with parallel gratings, by M. Georges Meslin. These fringes are independent of the form, the size, and the orientation of the slit; they do not require a particular position of the screen or the slit, and the use of a lens is not indispensable. Their essential characteristic is that of exhibiting alternate colorations, which are sensibly complementary. In other respects they present the same aspect as those produced by one slit illuminating one grating. But the black fringes, which are very fine in the first case, are less sharply defined; the second phenomenon does not reproduce the delicate portions of the first, but shows only those bands which have a certain breadth. If the periods of the gratings are identical, the bands are sharply defined. If the illuminating grating has a number of slits per mm. equal to half that of the second, the colorations are the same, but less brilliant. On reversing the positions, the fringes become achromatic, owing to the superposition of the red and green bands of the two systems.—On the relation between the precipitation of chlorides by hydrochloric acid and the lowering of the boiling point, by M. R. Engel. To precipitate one molecule of a chloride from its saturated solution at 0° requires in the case of monovalent chlorides, one molecule of HCl, and in the case of divalent chlorides, two molecules. This is now proved also to hold good for temperatures other than 0°, and for double chlorides, like that of copper and ammonium, containing four atoms of chlorine and requiring four molecules of HCl. The molecular depression of the freezing point of solutions of the various chlorides was also investigated in its relation to the concentration. It was found that for the monovalent chlorides the molecular depression remains sensibly the same, varying between 35 and 40, but tends to reach twice that value for divalent, and four times that value for tetravalent chlorides. Hence at the freezing point of the saturated solution of alkaline chlorides, bromides, and iodides, there must be a relation between the atomic weights of the constituents of the molecule and the solubility.—On the variations of glycogeny in anthrax infection, by M. H. Roger. The glycogenic function remains intact during the first stages of anthrax infection. The amount of sugar contained in the blood is normal or slightly diminished. At the end of the disease, the hepatic glycogen rapidly disappears and a considerable hyperglycemia is produced.—Researches on the extension of the blastoderm and the orientation of the embryo in the ova of the Teleostea, by MM. R. Kœhler and E. Bataillon.—On the localisation of the active principle in the Capparideæ, by M. Léon Guignard. The existence of special ferment cells is general in the Capparideæ. By their morphological characteristics in the root and the stem they resemble those found in the corresponding organs of the Cruciferæ. In the leaf and especially the flower of the caper-tree their grouping is peculiar. All the reactions of their contents are those of myrosine. In the capers they are most numerous, and the glucoside is most abundant. The grains of all Capparideæ, however, are relatively poor in ferment and in glucoside, and of their two constituents the embryo alone contains the ferment.—Sexual reproduction of the Ustilagineæ, by M. P. A. Dangeard. —On plane-tree honey, by M. Edm. Jandrier. During dry summers an exudation of varying consistence and aspect may be found on certain planes (*Platanus Orientalis*). It is sometimes dry and bright, sometimes pasty and yellowish, and contains, besides a small quantity of reducing sugar, probably glucose, about 80 or 90 per cent. of mannite, which may be extracted with the greatest ease by means of boiling alcohol and crystallisation.—Observation of an Aurora Borealis, by M. le duc Nicolas de Leuchtenberg. This was observed from the camp at Krasnoe Selo in the middle of July, about 10h. 30m. p.m. Its apex was situated very near the zenith, and seemed based upon a cluster of light vapours from which regular and regularly spaced bands proceeded, passing from white to a delicate pink and green, with a vibration resembling that exhibited by rarefied gases in Geissler tubes. It was seen to last about a quarter of an hour.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Solutions of the Examples in the Elements of Statics and Dynamics: S. Soney (Camb. Univ. Press).—An Elementary Treatise on Theoretical Mechanics, Part 1, Kinematics: A. Ziwet (Macmillan).—Text-book of Geology: Sir A. Geikie, 3rd edition (Macmillan).—Eskimo Life: F. Nansen, translated by W. Archer (Longmans).—Key to Carroll's Geometry (Burns and Oates).—The Shrubs of North-eastern America: C. S. Newhall (Putnam).—Handbook of Public Health and Demography: Dr. E. F. Willoughby (Macmillan).—An Elementary Treatise on the Geometry of Conics: A. Mukhopadhyay (Macmillan).—A Treatise on Hygiene and Public Health, Vol. 2, edited by Dr. T. Stevenson and S. F. Murphy (Churchill).—Vorlesungen über Maxwell's Theorie der Elektricität und des Lichtés ii. Theil: Dr. L. Boltzmann (Leipzig, Barth).—Healthy Hospitals: Sir D. Galton (Oxford, Clarendon Press).—Sporozoen als Krankheitserreger, Erstes Heft: Dr. A. Korotneff (Berlin, Friedländer).—Zoological Record 1892 (Gurney and Jackson).—Everybody's Letter Writer (Saxon).—The Out-door World: W. Furneaux (Longmans).

PAMPHLETS.—Reports of the Director of the Michigan Mining School for 1890-92 (Lansing).—Anleitung zur Krystallberechnung: Dr. B. Hecht (Leipzig, Barth).—Report on the Present State of our Knowledge respecting the General Circulation of the Atmosphere: L. T. de Bort (Stanford).—History of Slavery in Connecticut: Dr. B. C. Steiner (Baltimore).—Merchant Venturer's School, Prospectus 1893-94 (Bristol).—The Interdependence of Abstract Science and Engineering: Dr. W. Anderson (London).

SERIALS.—Mind, October (Williams and Norgate).—American Meteorological Journal, October (Ginn).—Boletin del Instituto Geografico Argentino, tomo xiv. Cuadermos 1 to 4 (Buenos Aires).—American Journal of Science, October (New Haven).—American Naturalist, September (Philadelphia).—John Hopkins University, Baltimore, Studies from the Biological Laboratory, Vol. v. No. 4 (Baltimore).—Records of the Geological Survey of India, Vol. xxvi. Part 3 (Calcutta).—Botanische Jahrbücher, Siebzehnter Band, 3 and 4 Heft (Williams and Norgate).—Kryptogamen-Flora von Schlesien, 3 Band, 2 Hälfte, 1 Lief (Williams and Norgate).—Annals of Scottish Natural History, No. 8 (Edinburgh, Douglas).—Agricultural Gazette of N.S.W., August (Sydney).—Palestine Exploration Fund. Quarterly Statement, October (Watt).—Nyt Magazin for Natur videnskaberne, 34 ke Binds, 2 det Hefte (Christiana).—Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, 2nd series, Vol. i. Part 2 (Halifax, Nova Scotia).

CONTENTS.